#1

PRODUCT LIABILITY of UNITED STATES' AIRCRAFT and COMPONENT MANUFACTURERS

VOLUME I

Robert M. Byrom
Institute of Air and Space Law
McGill University, Montreal, P.Q., Canada
April 1993

A thesis submitted to the Faculty of Graduate Research in partial fulfillment of the requirements for the degree of Masters of Laws

ABSTRACT

L'histoire du droit de la responsabilité du fait de produits, affectant l'industrie aéronautique, émane des décisions anciennes des tribunaux anglais. Aux Etats Unis, cette branche du droit est également jurisprudentielle. La diversité de plus de cinquante jurisdictions a eu - quant aux coûts - un effet néfaste pour toute l'industrie aéronautique américaine. Ce secteur de l'industrie américaine n'est plus compétitive, particulièrement à cause des coûts résultant des litiges concernant la responsabilité du fait de produits. Par conséquence, des entreprises importantes ont abandoné leurs efforts. Récemment, le Royaume-Uni, supporté par les autre états-membres de la communauté européenne, insiste à l'adoption de lois uniformes sur la responsabilité du fait de produits. Aux Etats-Unis, les constructeurs sont obligés de dessiner, construire et examiner leurs avions ainsi que de faire le choix des matériaux conformément aux normes uniformes fédérales. Cette dissertation examinera la loi actuelle pour ce secteur industriel, qui construit des avions pour l'éducation de jeunes pilotes, et proposera une réforme nécessaire par l'adoption de règles uniformes et fédérales sur la responsabilité délictuelle. Notre industrie aéronautique est très importante pour la sécurité nationale et pour la stabilité globale.

ABSTRACT

The history of products liability law affecting aircraft manufacturers today is rooted in the early decisions of English courts and, in America, still remains largely judge-made law. The cost of the legal diversity of more than fifty jurisdictions has been devastating to the American general aviation industry. This segment of American industry is no longer competitive, largely due to the cost of product liability litigation, and major corporations have abandoned the effort. At this time, the United Kingdom is forging ahead with its European Economic Community partners to achieve uniform products liability laws. In America, manufacturers must design, select materials for, manufacture, and test their aircraft according to uniform federal standards. This thesis examines the present law and proposes needed uniform federal tort reform for this industry, which must supply entry-level aircraft to train and develop young American pilots. Our aviation industry is vital to national security and to world stability.

CONTENTS

Page

INTRODUCTION

The purpose of this LL.M. thesis is to describe some of the legal and technical issues which appear in aviation accident cases and to serve as an advocacy paper for needed tort reform in aircraft and component manufacturer products liability in the United States.

Before a claimant alleges that a defective aviation product caused his injury, he should have sufficient evidence and technical evaluation of it to substantiate the claim. Aircraft are the product of advanced design and engineering and when crashed are effective at destroying much of the physical evidence and even witnesses that could best establish the causes of the crash.

The aviation industry (manufacturers and operators) and governmental agencies responsible for its regulation have developed thorough and effective procedures and techniques that are used in structured and disciplined ways by skilled professionals, to investigate and evaluate the causes of incidents and accidents. This very extensive and ever-continuing mission exists to improve the safety, efficiency, and therefore, the profitability of aircraft. It has grown to be a very honest and effective mission. No one involved truly benefits by concealing product or other defects that compromise safety, efficiency and profitability. When this mission errs it is usually because of limitations in the resources available to it.

Legal professionals who become involved in aviation tort cases best help themselves and their clients by gaining a working knowledge of aircraft accident investigation methods, reports, and experienced professionals in the business. Many lawyers working airplane cases are pilots themselves and those disciplines learned are a clear advantage.

This thesis contains an overview of aircraft accident investigation in Chapter IV, and appendices to this chapter are papers and documents already published. None of this material has been co-authored or contributed to by this author. Where McGill University requires technical information to be expressed in metric units, the metric conversion units have been provided by this author. The purpose and usefulness of Appendix documents has been addressed in the thesis text. They serve as examples of useful sources and the names and addresses of the sources are given, when available, and are in Volume II of this thesis.

For aircraft accidents and serious incidents occurring in the United States, and those involving international air carriers while operating over foreign lands or the high seas, the combination of the United States Federal Aviation Administration (FAA), and National Transportation Safety Board (NTSB) in Washington, D.C. and the International Civil Aviation Organization (ICAO), headquartered in Montreal PQ, Canada are the best first source for factual information. These sources should be able to advise of other governmental, commercial, and private organizations who have become involved. All sources have some legal protection for their investigative work and discovery may be regulated by administrative offices and courts. This thesis addresses the practical steps one may take to gain information efficiently. When foreign government, commercial, and private organizations are investigative sources, care must be taken to observe the law and procedure of the foreign jurisdiction. For example, protection for and access to foreign located physical evidence and its testing, witnesses and documents may be available to an American with valid interests if the required legal and protocol steps are taken with the foreign government. These actions, timely taken, may determine the outcome of litigation later brought in America or abroad, or facilitate settlement of disputes.

The United States must provide for its own national security. Airpower is essential to defense of the nation and its vital interests. Aviation is an American heritage that has been dynamic in exploration, development, and economic prosperity for ourselves and our international friends and partners. All single or combinations of factors that are harmful to aviation should be controlled such that our aviation activities prosper. The rapidly escalating costs to American aviation of products liability is a harmful factor. These costs have risen enormously while aviation safety has improved. These costs have little relationship to money damages actually paid to persons harmed by defective aviation products. American industry cannot now manufacture and sell its aviation products profitably,or for the market that most needs them, our young men and women who aspire to careers in aviation.

Until tort reform is achieved for this segment of American products, we must work our cases within the existing system of Federal and State Courts with the almost endless choices of forum and law combinations that confront party litigants, their counsel, and the courts. The author hopes that this thesis proves useful to some of you who work these very interesting and challenging cases.

Robert M. Byrom

Robert M. Byrom

This thesis is dedicated to my wife, Pat, and son, Chris, who have flown from the wilds of Western Guatemala to Pt. Barrow and Dead Horse working the disciplines of air and law.

PRODUCT LIABILITY OF UNITED STATES' AIRCRAFT AND COMPONENT MANUFACTURERS

CHAPTER I HISTORY OF LIABILITY OF MANUFACTURERS IN THE UNITED STATES

A. ENGLISH COMMON LAW

English common law liability for defective goods and products has been modified by case law and statutes. American Jurisprudence 2d states: "The term 'products liability,' a phrase almost unknown to the legal profession a generation ago, is now almost universally applied to the liability of a manufacturer, processor, or non-manufacturing seller for injury to the person or property of a buyer or third-party caused by a product which has been sold."[1]

B. TORT THEORIES FOR PRODUCT DEFECTS

A number of theories have been put forth upon which an action can be taken against a manufacturer or seller to recover for product caused harm. Almost all of the cases have been based upon assertions of negligence in the design, manufacture, inspection and sale of the product which may or may not be a breach of warranty. A smaller number of cases seem to rely on theories of fraud, deceit, misrepresentation or defendant's violation of a statute or ordinance designed to protect the injured party. Nuisance and the defendant's willful act proximately causing the alleged injury are

1 63 Am. Jur. 2d Products Liability S 1 (1984).

occasionally alleged. In the mid-1960's, the principle of strict liability in tort for products liability cases began to emerge".[2]

It was in February of 1903, as Wilbur and Orville Wright labored over a new machine in their Dayton, Ohio, bicycle shop, that a Federal Circuit Court of Appeals was studying the plight of Mr. O.S. Huset who had been injured by quite a different machine. Mr. Huset, who had worked in Minnesota for Mr. J.H. Pifer, attended the operation of a threshing machine that Mr. Pifer purchased from the J.I. Case Threshing Company. The design and manufacture of this particular threshing machine incorporated a rotating cylinder set with iron spikes, turning within a frame set with similar spikes. This mechanism was covered by a sheet iron plate. Mr. Huset claimed that it was necessary for him to walk on this plate to tend the machine when it was in operation. The plate gave way, Mr. Huset lost a portion of his leg, and American manufacturers subsequently lost a major part of their immunity from successful actions by third parties outside the privity of contract.[3]

C. CONCEPTS OF NEGLIGENCE

The concept of negligence in America seems to have grown out of the English action of trespass on the case,

---

[2] Greenman v. Yuba Power Products, Inc., 377 P.2d 897, 899 (Cal. 1967). and see 63 Am. Jur. 2d, note 1, supra.

[3] Huset v. J.I. Case Threshing Machine Co., 120 F.2d 865 (8th Cir. 1903).

utilized against innkeepers and common carriers, and where there was a contractual relationship between the parties.[4] Action of trespass on the case also could extend to damages sought for the spread of fire[5] and to abate a nuisance.[6] In these original English actions negligence was not described or, apparently regarded as a factor, and strict liability applied. The Comyn's digest of law (1762 - 1765) first utilized the term negligence and described it as a failure in the performance of a determinable and provable legal duty arising from a statute, or from the defendants' profession which created a duty of care.[7]

Four objectives of legal actions in tort have been stated as desirable and reasonable.

(1) The first of these is a "Moral Objective" which is to impose liability on one who has been guilty of some personal moral shortcoming, such as negligence, and shielding from liability the person who has been free from blame.[8]

(2) A second objective is the compensation of accident victims which seeks to repay them for injuries and damages caused by another, regardless of whether the defendant

---

[4] Perez H. Winfield, History of Negligence, 42 Law Q.Rev. 184, 186 (1926).

[5] John H. Wigmore, Responsibility for Tortious Acts, I, 7 Harv.L.Rev. 441, 448 (1894).

[6] Thomas A. Street, Foundations of Legal Liability, 182-215 (1906).

[7] Winfield, supra note 4, at 186.

[8] Fowler V. Harper et al., The Law of Torts, (2d ed. & Supp. 1986).

was morally wrong or negligent.[9]

(3) A third objective is to deter conduct that causes accidents. Courts have imposed sanctions such as punitive damages, and strict liability in certain cases.[10] Some studies favor strict liability as they argue it best addresses the principal causes of accidents.[11]

In aviation, studies by industry, the Federal Aviation Administration, and the National Transportation Safety Board attribute most aircraft accidents to pilot error. Estimates range from 80% to almost 100%, naming pilot error as the principal or contributing cause of aircraft accidents.[12] Probably, most aircraft accidents are due to a combination of factors and analysis of a single accident may not identify all of the causes. One particular model, single engine general aviation aircraft, has experienced more than 230 in-flight structural failure accidents. The manufacturer felt that the airplane met the regulatory requirements for structural integrity and, therefore, that the crashes were not its fault, but rather the result of pilot error coupled with bad weather

---

[9] James B. Ames, Law and Morals, 22 Harv.L.Rev. 97 (1908).

[10] L.Green, Judge & Jury, 76 (1930).

[11] David Klein and Julian A. Waller, Causation, Culpability, and Deterrence in Highway Crashes, in U.S. Department of Transportation, Automobile Insurance and Compensation Study, 213 (1970).

[12] Robert Martin, General Aviation Manufacturing, in The Liability Maze, 478 (1991).

conditions.[13] Many plaintiffs have faulted the design and manufacture, and failure to warn. Aircraft are often efficient instrumentalities in destroying evidence in crashes. Wreckage may be spread over a large area, underwater or on inaccessible terrain. When recovered it may be lost or subjected to destructive testing. Witnesses may all be dead or, so badly injured they cannot help reconstruct events leading to the accident. Therefore, the best and most balanced approach to deterring conduct that causes aircraft accidents may be an objective, non-adversarial analysis of each accident, with a concurrent analysis of trends from recurring accidents that is used to correct pilot and product defects; and a national, uniform aviation product liability law sufficient both to compensate plaintiffs for injuries and damage, and to permit profitable manufacture of new aircraft for all users and purposes. Administrative and criminal law sanctions now exist to discipline manufacturers and individuals producing dangerous products.

In the United States there are about 210,000 registered and active general aircraft. These aircraft flew 33.6 million hours in 1988. Their average age is twenty-four years. Production of new general aviation aircraft was 17,881 units in 1978, and 1,143 units in 1988. Historically, United States manufacturers have supplied most of the world's general aviation aircraft. In 1988 the balance of trade deficit of the

---

[13] Andrew Craig, Product Liability and Safety, in The Liability Maze, 456, 467 (1991).

U.S. in these aircraft had grown to $700 million. The General Aviation Manufacturers Association states that from 1976 to 1986 the costs to the industry for product liability claims escalated from $24 million a year to $210 million a year. Beech Aircraft Corporation has estimated that less than 17% of their product liability costs reaches plaintiffs.[14]

(4) A fourth objective of tort law is commonly understood to be the avoidance of undue collateral disadvantages, such as the over-burdening of desirable economic activity.

> Perhaps the heaviest artillery that the proponents of the fault principle can muster is the contention that any stricter rule of liability will discourage affirmative activity and unduly fetter desirable enterprise. If this were true it would constitute a pragmatic objection to a scheme of strict liability that would certainly deserve serious consideration. But like so many appeals to practical common sense this one probably rests on no solid foundation of fact but simply on a bald assertion of plausible error. If a system of strict liability involves fixed limitation on the amount recovered, as in the case of worker's compensation it may actually cost little or no more than a system where liability is for negligence as determined by a jury without limitation on the amount."[15]

As the law of product liability has evolved in America, it has created unpredictable and, for some manufacturers, unaffordable costs for production of general aviation aircraft. Most have gone out of the business, or in the situation of Piper Aircraft Co. are operating in bankruptcy.

---

[14] Martin, <u>supra</u> note 12, at 482.

[15] Harper, <u>supra</u> note 8, at 124.

D. PRIVITY OF CONTRACT, CONSTRUCTIVE NEGLIGENCE, ASSUMPTION OF RISK, CONTRIBUTORY NEGLIGENCE, AND STRICT LIABILITY

In Huset v. J.I. Case Co., the trial court had sustained defendant Case Co.'s demurrer and dismissed Huset's action on the grounds that he was a stranger to the contract between the J.I. Case & Co. and Pifer and, thus, without this privity of contract the defendant owed no duty to the plaintiff. Huset appealed and the Appellate Court focused on the English case of Winterbottom v. Wright, 10 Mee. and W. 109, 11 L.J. Ex. 415 (1842). Winterbottom had been thrown from the driver's seat and injured, near Hollyhead, England, when a wheel of the Royal Mail Coach failed because of the alleged negligence of Mr. Wright to maintain and inspect it properly. Mr. Winterbottom argued that, since the Postmaster General was an agent of the Crown and could not be sued, he must have a remedy against Mr. Wright. Lord Abinger disagreed, stating, "...but that is by no means a necessary consequence - he may be remediless altogether - there is no privity of contract between these parties." Justice Rolfe exhibited some sympathy for Winterbottom as he joined Lord Abinger's opinion, concluding that, "it is, no doubt a hardship upon the plaintiff to be without a remedy, but by that consideration we ought not to be influenced. Hard cases, it has been frequently observed, are apt to introduce bad law." Lord Abinger, in commenting further on protection of privity of contract had said, "I am clearly of the opinion that the defendant is entitled to our judgment. We ought not to permit a doubt to rest upon the subject, for our doing so might be the means of letting in upon us an infinity of actions - unless we confine the operation of such contracts - to the parties who entered them, the most absurd and outrageous consequences, to which I can see no limit, would ensue."

Judge Sanborn, giving the opinion of the Federal Appellate Court for Huset, went on to cite more than forty cases in England and the United States agreeing in principle with the Winterbottom decision of 1842, and could find only one distinctly in conflict. This, too, was a Minnesota case, wherein a painter employed by the purchaser of a ladder was injured by the failure of a defective step caused by the negligence of the manufacturer.[16] Judge Sanborn stated that there were three exceptions to the rule excluding liability outside of privity of contract which courts can apply and that were as well defined as the rule itself:

> The first is that an act of negligence of a manufacturer or vendor which is imminently dangerous to the life or health of mankind, and which is committed in the preparation or sale of an article into commerce to preserve, destroy, or affect human life, is actionable by third parties who suffer from the negligence;
>
> The second exception is that an owner's act of negligence which causes injury to one who is invited by him to use his defective appliance upon the owners's premises may form the basis of an action against the owner;
>
> The third exception to the rule is that one who sells or delivers an article which he knows to be imminently dangerous to life and limb to another without notice of its qualities is liable to any

[16] Schubert v. J.R. Clark Co., 51 N.W. 1103 (Minn. 1892).

> person who suffers injury therefrom which might have been reasonably anticipated, whether there were any contractual relations between the parties or not.

The appellate court stated that Huset's case fell fairly within the third exception, and reversed the trial court's dismissal.[17]

E. JUSTICE BENJAMIN CARDOZO'S ROLE IN EVOLVING MANUFACTURER LIABILITY

> A gentle, modest man sits on the extreme left of the Chief Justice of the United States. As he listens intently to the arguments of counsel, he radiates an atmosphere of benevolence and wisdom. Everyone in the austere court room, judges and lawyers alike, pay him homage of warm good-will and admiration bordering on awe. Confidence in the just decision dispels doubt. It is a feeling which could only be directed toward a man whose great talents in the law had been heralded far and wide before his accession to the high tribunal. Liberals and conservatives both see something to applaud in the record and attainments of Mr. Justice Cardozo; for humanity and honor and fair play, woven into the law through the loom of a prodigious learning, an understanding of modern human needs, and a vivid and striking power of expression, leave their mark...
>
> The American judiciary has seldom been graced with the presence of a man who combines the talents of a philosopher, poet and lawyer.[18]

This gentle jurist brought profound changes to the law of torts, and, in particular, to the liability of manufacturers for their products. The decision given by Judge Cardozo, then sitting on the Court of Appeals of New York, in the case of MacPherson v. Buick Motor Co.[19] is a landmark

---

[17] Id. at 870-1.

[18] Joseph P. Pollard, Mr. Justice Cardozo, 7 (1935).

[19] MacPherson v. Buick Motor Co., 111 N.E. 1050 (N.Y. 1916).

decision deserving closer attention.

Don MacPherson was motoring through suburban New York at a prudent eight miles per hour when the wooden spokes on one wheel of his Buick automobile collapsed and, like Mr. Winterbottom, he was pitched from the vehicle and injured. MacPherson sued the manufacturer of the auto, Buick Motor Co., who had purchased the defective wheel from the Imperial Wheel Co., which had furnished the defendant more than 80,000 wood spoke wheels, none of which had proved to be made of defective wood prior to the MacPherson accident. Buick Motor Co. had relied upon the wheel manufacturer to make all necessary tests as to the strength of the materials and had made no such tests itself. Justice Cardozo stated an opinion confirming the trial court judgment for MacPherson, which went considerably farther than was necessary to sustain the findings below. Judge Willard Bartlett dissented strongly, stating,

> [T]he rule upon which, in my judgment, the determination of this case depends, and the recognized exceptions thereto, were discussed by Circuit Judge Sanborn of the United States Circuit Court of Appeals in the Eighth Circuit. That the Federal Courts still adhere to the general rule and those exceptions (given by Judge Sanborn in Huset v. J.I.Case Co.) appears by the Circuit Court of Appeals in the Second Circuit, in March of 1915 in the case of Cadillac Motor Co. V. Johnson, 221 F. 801 [(2d Cir. 1915)]. That case, like this one, was an action by a subvendee against a manufacturer of automobiles for negligence in failing to discover that one of its wheels was defective, the Court holding that such an action could not be maintained....A perusal of the opinion in that case and in the Huset case will disclose how uniformly the courts throughout the country have adhered to the rule and how consistently they have refused to broaden the scope of the exceptions. I think we should adhere to it in the

> case at bar, and therefore I vote for a reversal of this judgment."[20]

How did Judge Cardozo justify a different decision on substantially the same facts as Cadillac Motor Co. v. Johnson? In dismissing privity of contract as an issue, he said, "[p]recedents drawn from the days of travel by stage coach do not fit the conditions of travel today. The principal that the danger must be imminent does not change, but the things subject to the principle do change. They are whatever the needs of life in a developing civilization require them to be."[21] He further observed that arguments that the dealer was the purchaser of the auto from Buick and that MacPherson was not in privity with Buick were illogical:

> The maker of this car supplied it for the use of the purchasers from the dealer - the dealer was indeed the one person of whom it might be said with some approach to certainty that by him the car would not be used. It knew also that the car would be used by persons other than the buyer. This was apparent from its size; there were seats for three persons - the English Courts agree with ours in holding that one who invites another to make use of any appliance is bound to the exercise of reasonable care, citing Caledonian Ry. Co. v. Mulholland A.C., 216, 277 (1898). - That at the bottom of it is the underlying principle of Devlin v. Smith 89 N.Y. 470; the contractor who builds the scaffold invites the owner's workmen to use it. The manufacturer who sells the automobile to the retail dealer invites the dealer's customers and others to use it. The invitation is addressed in the one case to determinate persons and in the other to an indeterminate class, but in each case it is equally plain, and in each its consequences must be the

[20] Id. at 1053.

[21] Id. at 1054.

same.[22]

Judge Cardozo also described several hypothetical landlord tenant situations illustrating foreseeable duty to invitees. His opinion focuses on the manufacturer's negligence rather than a breach of an express or implied warranty. He did not abandon the inherently or imminently dangerous test, but modified it by not observing the knowledge factor required by the Huset decision. He did use foreseeability as a test, stating "[i]f the nature of a thing is such that it is reasonably certain to place life and limb in peril when negligently made, it is a thing of danger."[23]

Several facets of the MacPherson case have made it one of the most significant tort cases decided in American courts. This case essentially removed privity of contract as a defense in a product liability controversy. The opinion went far beyond that necessary to sustain the trial court's verdict for MacPherson. The dicta essentially extended Buick Motor Co.'s liability for defects in this product to anyone who might have ever ridden in the several seats of the automobile. The court could simply have found that MacPherson was in fact in privity of contract with the manufacturer, because of the nature of the dealership system used by Buick where the dealer actually acts as agent for the manufacturer rather than as an independent wholesale buyer and retail seller of products. Judge Cardozo's judicial assertions as to dangerousness led the

---

[22] Id.

[23] Id. at 1053

law away from things historically regarded as inherently dangerous to the idea that "they are whatever the needs of life in a developing civilization require them to be."[24] He also found that the manufacturer could be held liable for failure of all the component parts used in his product not manufactured by him and that he had a duty to inspect and control the quality of such component parts.

The results and legal philosophy expressed by Judge Cardozo in MacPherson are accepted by American courts generally, and the Second Restatement of Torts adopts the MacPherson rule.[25] Justice Cardozo left his imprint in virtually every area of American jurisprudence and a list of his opinions could serve as a substantial checklist of textbook cases.[26] Other courts have since enlarged Justice Cardozo's new fields. However, he can properly be regarded as the father of product liability before that term was known as a legal principle.

Following MacPherson, the steps have been relatively easy for courts to find manufacturers liable for negligence in the design, manufacture, packaging, labeling, or failing to warn of virtually every implement, machine or product used for

---

[24] Id.

[25] Restatement (Second) of Torts § 395 (1964). [Hereinafter Second Restatement]

[26] Levy, Cardozo and the Legal Thinking, 121 (1939); and see Benjamin N. Cardozo, Law is Justice, Notable Opinions of Mr. Justice Cardozo, (1938).

humans, flora or fauna.[27]

F. GENERAL CONSIDERATIONS IN PRODUCT LIABILITY CASES

Aircraft Manufacturer liability cases closely follow the fundamentals of any product liability action, and usually have not been the first to state those fundamentals. The plaintiff must select a forum having jurisdiction over the parties and subject matter of his suit. The burden of proof remains on him in a products liability case for all the necessary elements of his complaint. These are as follows:

1. Identity of the defendant as the one who manufactured and or sold the product.

This is not always as straight forward as it might seem. Many large companies have products bearing their name sold through owned or independent retailers, where the actual product was manufactured by an unnamed source. The courts have tended to hold that party liable whose name appears on the product.[28] Courts have found manufacturers liable for their defective products when there was no sale, but only a bailment or loan of the product. The New York Court of Appeals in Delaney v. Towmotor Corporation found that the manufacturer of a defective fork-lift truck which proximately caused the injuries to Delaney to be strictly liable to him to tort. Mr.

---

[27] 63 Am. Jur. 2d Products Liability § 5 (1984).

[28] Armour and Co. v. Leisure, 177 A. 393 (Md. 1939)(meat); Tiedje v. Haney, 239 N.W. 611 (Minn. 1931)(medicine); Mobberly v. Sears Roebuck & Co., 211 N.E. 2d 839 (Ohio Ct. App.1965)(tires); Ford Motor Co. v. Mathis, 322 F.2d 267 (5th Cir. 1963) (component of auto); and see Second Restatement at §400 (1964).

Delaney was an employee of a stevedoring firm in New York to which the fork-lift truck had been loaned as a trial demonstrator, and where no sale or lease purchase contract had been entered into between Towmotor Corporation and the stevedoring company.[29]

2. Necessity of proving defectiveness or harmfulness.

The manufacturer or seller of the product cannot be held liable absent proof the product was defective, dangerous and harmful in some way:

> None of the vast number of cases on the subject of products liability has ever expressed or intimated in any way anything out of harmony with this principle, and it seems safe to say none ever will. This necessity of proving defectiveness of the product applies no matter what theory governs the particular action; negligence, breach of express or implied warranty, strict liability or any other theory.[30]

Recent aviation cases support this principle that the burden of proof is on the plaintiff to establish satisfactory evidence of the defects. In a case brought in the United Kingdom, the British Airways Board sued the Boeing Company stating the cause of disintegration of BOAC's Boeing 707 near Mount Fuji, Japan, on March 5, 1966, was without intervention of any act by BOAC's flight crew, but that the accident resulted from defective design and manufacture of the fin attachment fitting of the aircraft, which caused the tail of the plane to crack and then to separate in flight.[31]

---

[29] Delaney v. Towmotor Corp., 339 F.2d 4 (2d Cir. 1984).

[30] 63 Am. Jur. 2d Products Liability SS 224-7.

[31] British Airways Board v. Boeing Co., 585 F.2d 946,962 (9th Cir. 1978).

Boeing's evidence was that the in-flight airframe failure was probably due to the effect of severe air turbulence encountered when the plane's pilot flew close to Mount Fuji at too low an altitude. The federal district court granted summary judgment for the Boeing Company on completion of the evidentiary hearing. The Ninth Circuit Court of Appeals affirmed the judgment.[32]

3. Necessity of proving defendant had possession or control of the product when defective.

The plaintiff must prove that the defect, danger and/or harmful nature of the product existed when the defendant had the product in his actual or constructive control. For example, in a line of beverage cases, if there is a bug in the container or bottle the trier of fact must believe it was there when the product was bottled to find the bottling company liable. If the trier of fact believes the bug arrived in the bottle after it was opened then the defendant is not liable.[33]

Where the injured plaintiff has used the product satisfactorily for some time, and or failed to maintain properly or abused the product, then his burden of proving a preexisting defect becomes very hard. In Rogers v. W.T. Grant Co., 331 A 2d 54 the court found that where an electric blanket functioned normally before it allegedly overheated and

[32] Id., (citing Hager v. Mooney Aircraft Inc., 407 N.Y.2d 21 978 (1978)); Mercado v. Wollard Aircraft Equipment Co., 574 F.2d 654 (1st Cir. 1978).

[33] Tarwacki v. Royal Crown Bottling Co., 330 So.2d 253 (2d Cir. 1976).

caught fire, there was insufficient evidence to prove it was defective at the time it was in the possession or control of the seller.[34]

An excellent case illustrating that abuse and/or neglect of a product can make it impossible for the trier of fact to find a preexisting defect is Duncan v. Rockwell Manufacturing Co.[35] Roy Duncan purchased his fully assembled Rockwell Table Saw in Missoula, Montana, and hauled it eighty miles in his pick-up truck to Flathead Lake, Montana. There he used it satisfactorily for several months on a daily basis for home construction. He then hauled the saw back to his home in Missoula and stored it for a year. Next, Duncan set up the saw in his garage and, on first use, it tilted, the board he was sawing jammed, and his hand went into the blade severing a finger. This evidence, and the fact that Duncan was a master carpenter and aware of the dangers of power saws, but had not checked the saw for stability prior to using it when injured, caused the trial court to grant summary judgment for Rockwell Co. Duncan had claimed the accident was due to one leg of the saw being 1/4 inches shorter than the others, due to a defect in manufacture. In affirming the trial court decision the supreme court of Montana stated, "the theory of Restatement of Torts (Second) §402 A only imposes liability on the seller or manufacturer if the product is, at the time it leaves the

---

[34] Rogers v. W.T. Grant Co., 321 A.2d 54 (Vt. 1974).

[35] Duncan v. Rockwell Manufacturing Co., 567 P.2d 936 (Mont. 1977).

seller's hands, in a condition not contemplated by the ultimate consumer, which will be unreasonably dangerous to him."

Where the case involves a relatively new product, which was operated properly and not abused, the court may impute evidence that a failure was caused by a manufacturing defect. Bill Novick was flying a Bell Model 47G-5A helicopter for an agricultural spraying firm when the tail rotor drive gear failed. Although Novick attempted to control the resulting centrifugal force spin, the aircraft crashed and burned. A Louisiana trial court awarded Novick $147,500.00, and the Fourth Circuit Court of Appeals affirmed the judgment.[36] This was a hard fought case. The court of appeals observed,

> [t]he voluminous record is replete with contradictory statements by the parties involved, and this is especially true of the testimony of the expert witnesses presented by them. In addition, the testimony and briefs are replete with contradictions and accusations, plaintiff attempting to discredit appellant's experts because they were its employees and defendant attempting to discredit plaintiff because of alleged defects in his character and personality. We confine ourselves to a determination of the central issues on liability.[37]

One material issue was whether the tail rotor drive gear failed from manufacturing defect or improper lubrication and maintenance. Plaintiff's evidence was that he and his employer had performed proper routine maintenance, that he had noted a sound or pitch of tone not common to this model

[36] Novick. v. Textron, Inc., 375 So.2d 730 (4th Cir. 1979).

[37] Id. at 731.

helicopter, that the aircraft had been flown to a Bell Helicopter Co. authorized repair station where the problem was diagnosed as excessive lubrication in a grease boat along the tail rotor shaft. The excess grease was squeezed out and the aircraft cleared for flight. Following the accident which occurred on the aircraft's next flight, metal particles were found by the FAA Investigator on the inner surfaces of the tail rotor transmission case, but none were found in the oil filtering system which should have shown if present on the oil filter screen. The plaintiff's evidence was that he personally checked the oil filter screen after the Bell repair station had cleared the aircraft and had found no metal particles. He also testified that he had twenty years successful experience as a helicopter pilot in both military and commercial operations. Plaintiff's expert was an aeronautical engineer who testified that the crash was caused by tail rotor drive gear failure and emphasized that the FAA report indicated metal particles were not yet in the oil filter system. None of the Bell Company's expert witnesses were engineers or metallurgists, although called by the defendant for their expert testimony in those areas. An engineer for the manufacturer of the quill assembly in the tail rotor gear testified that the transmission had been shipped to Bell in March of 1969, was then overhauled by his firm in August of 1971 and returned to Bell Helicopter Company, where it was installed in the new helicopter which crashed. It had been certified originally by FAA in April of 1972.

The court of appeals concluded,

> Thus, the trial judge was faced with a question, whether the failure of the tail drive rotor gear was of such a nature as to be imputed to a manufacturing defect. He obviously concluded it was, and subsequently held the appellant manufacturer in damages. As the record contains sufficient substantial evidence supporting that conclusion, we cannot say that the trial judge abused his discretion in so holding. Relative to appellants contention regarding contributory negligence, as we have said in part, the record contains ample substantial evidence showing that, contrary to appellants contention, plaintiff did provide proper or adequate maintenance, was qualified to so provide, and was not negligent. Accordingly we affirm on the issue of liability.[38]

The court also affirmed plaintiff's damages. The court seemed surprised and critical that Bell Helicopter's experts were not qualified engineers. The principle legal point in Novick was the court's readiness to impute negligence to a manufacturer even when direct evidence may be lacking, where the product is relatively new and has been properly cared for by the user.

4. Plaintiff must prove proximate causation of injury or damage by the defect.

Regardless of the ground on which it is sought to recover for injury allegedly caused or traceable to the product sold, success requires proof that the injury was proximately caused by the defective product - evidence that the injury could have been caused by some other than defectiveness of the product will justify a verdict for the defendant in a products liability case.[39] If the product met contemporary standards

---

[38] Id. at 734.

[39] 63 Am.Jur.2d Products Liability § 22; see also id. § 224.

when manufactured it is not regarded necessarily as a manufacturing or design defect if the product does not meet new standards of quality.

In Bruce v. Martin-Marietta Corporation Inc., the plaintiffs brought an action predicated on theories of products liability and negligence against the manufacturer of an aircraft and its intermediate seller.[40] Mr. Bruce and other members of the Wichita State University football team and some of its fans were on a chartered Martin 404 which crashed into a mountain west of Silver Plume, Colorado. The aircraft was owned by Jack Richards Aircraft Co. and flown by Golden Eagle Aviation, therefore, the plaintiffs in this suit did not contend that any action of either defendant caused the plane to crash. They claimed that the defendant's failure to design, manufacture, modify or maintain the aircraft in crashworthy condition caused the deaths or enhanced the injuries of the passengers. The alleged defects were inadequacy of seat fastenings and lack of protection against fire. Seats in the cabin broke loose on impact, were thrown forward against a fuselage bulkhead and blocked the main exit. Fire developed immediately on impact. The trial court found both defendants to be not liable to the plaintiffs and the 10th Circuit affirmed. The plaintiffs' assertions were that, had not the seats torn loose and blocked the main escape exit, the injuries ordinarily sustained from such a crash would have permitted

[40] Bruce v. Martin-Marietta Corporation Inc., 544 F.2d 442 (10th Cir. 1976).

successful escape from the aircraft. Thirty-two of the forty persons aboard died. The aircraft had been manufactured by Martin in 1952, it had been sold new to Eastern Air Lines and then successively sold, used, until Jack Richards Co. bought it in 1970. At trial an expert witness testified that there were airline passenger seats in common use on October 2, 1970, the date of the crash which, if installed in the subject Martin 404, would have remained in place throughout this otherwise survivable accident and would not have trapped the occupants in the burning aircraft. Evidence introduced by defendants showed the aircraft, when manufactured, was within the state of the art and met existing applicable Federal design and manufacturing standards and specifications.

Among arguments raised was that evidence as to the state of the art is not relevant to a strict liability claim. The plaintiffs cited Gelsumino v. E.W. Bliss Co., where the Illinois Court of Appeals, First District, held that plaintiffs need not prove "unreasonable dangerousness,"[41] and Anderson v. Fairchild Hiller Corp., where the federal district court for the district of Alaska held the plaintiffs need not prove a "defective condition."[42] The Bruce court rejected the plaintiffs' state-of-the-art arguments as an inapplicable Illinois rule. The court then observed that a consumer would not expect a Model T. Ford to have the safety features in

---

[41] Gelsumino v. E.W. Bliss Co., 295 N.E.2d 110 (Ill. 1973).

[42] Anderson v. Fairchild Hiller Corp., 358 F.Supp. 976 (D.Alaska 1973); See also Ross v. Up Right Inc., 402 F.2d 943 (5th Cir. 1978).

automobiles made today and that the same expectation applies to airplanes. The questions as to the necessity of proving "defective condition" and "unreasonable dangerousness" were resolved by the court using the principles given in the Second Restatement § 351 comments g & i, which provide that a successful plaintiff in the case must prove both.

Where a plaintiff alleges that the defect was in instructions provided by the manufacturer for use of his product, the successful plaintiff must still prove that such defect proximately caused the damage or injury. In Leverson and Schlemmer v. Boeing Company,[43] the plaintiffs were surviving relatives of the captain and first officer of a United Airlines-owned Boeing 727 which crashed into the Pacific Ocean off Santa Monica, California. The plaintiffs alleged Boeing's flight manual was defective in its instructions on loss of electrical power, and that the crew could have been following the defective instructions proximately causing the crash. United Airlines, however, had issued and required aircrews to use a supervening electrical malfunction checklist. The trial court questioned whether the Boeing checklist had even been used, and if electrical failure was a cause of the crash and gave judgment to defendant Boeing Company. The Ninth Circuit Court of Appeals affirmed, observing in dicta that the deceased crew members no doubt had some workmen's compensation survivor plan and that every verdict need not go to injured

[43] Leverson and Schlemmer v. Boeing Company, 510 F.2d 937 (9th Cir. 1976).

plaintiffs for public policy reasons.

G. THE DOCTRINE OF *RES IPSA LOQUITUR*: CONSTRUCTIVE NEGLIGENCE

Res ipsa loquitur is a rebuttable presumption that the defendant was negligent. The presumption arises upon proof that the instrumentality causing injury was in the defendant's exclusive control and that the accident was one which ordinarily does not happen in absence of negligence.[44] In the early years of aviation, writers in aviation law and the courts favored the idea that the mere occurrence of an accident causing injury was not enough to bring this doctrine into a case. In Benedick v. Potts, the Maryland state court of appeals said:

> In no case where the thing which occasioned the injury is unknown has it ever been held that the maxim applies; because when the thing which produced the injury is unknown it can not be said to speak or to indicate the existence of constructive negligence. In all cases, whether the relation of carrier and passenger existed or not, the injury alone furnishes no evidence of negligence - something more was required to be shown.[45]

In State of Maryland, to the use of Beall v. Mc Leod, the trial judge instructed the jury in the following language:

> The mere happening of the accident complained of raises no presumption of negligence, on the part of the defendant in operating the airplane referred to in evidence, but the burden is upon the plaintiff to establish by a preponderance of affirmative evidence that the negligence on the part of the said defendant

[44] Black's Law Dictionary 1173 (5th Ed. 1979) (citing Sliwowski v. New York, N.H. & H.R. Co., 108 A. 807 (1920)).

[45] Benedick v. Potts, 88 Md. 52,56 (Md. 1898).

> caused the said accident and if the minds of the jury are left by the evidence in a state of even balance as to the existence of such negligence then the verdict of the jury must be for the defendant.[46]

The Supreme Court of Massachusetts, in Wilson v. Colonial Air Transport held that the doctrine of *res ipsa loquitur* will not be applied if there is any other reasonable or probable cause from which it might be inferred there was no negligence at all.[47]

In commenting on the applicability of the doctrine, J. Francis Mc Cormick wrote:

> To adopt the maxim (*res ipsa loquitur)* at the present state of development in air travel would subject those who operate aircraft to unduly severe liability because experience to date does not justify such a rule of liability since the rule assumes that this explanation of the accident is more reasonable and more likely to be accurate than some other explanation such as an airpocket, an act of God, condition of the atmosphere, or other dangerous natural conditions.
>
> However the rules of law are not founded alone upon logical reason but also upon social desirability, and many assert that public policy demands the application of this maxim, because it is most difficult and in many cases impossible to prove negligence, and therefore, it is in the interest of the traveling public to impose such a role of presumptive liability.[48]

In the intervening years, the courts have more readily accepted the doctrine and applied it in actions against aircraft

---

[46] State of Maryland, to the use of Beal v. McLeod, U.S.Av.R. 94, 98 (1932).

[47] Wilson v. Colonial Air Transport, 180 N.E. 212 (Mass. 1932).

[48] 5 Air L.Rev. 336 (1934).

manufacturers. In Moore v. Douglas Aircraft Co., the plaintiff was injured when a yoke and sling apparatus manufactured by Douglas Aircraft broke, allowing an engine to fall injuring him and others.[49] The plaintiff based his action on alternate theories of breach of warranty, negligence and strict liability. The trial and appellate courts sustained defendant's motion for summary judgment on breach of warranty as the plaintiff was not in privity of contract with defendant. The court also granted summary judgment against plaintiff on strict liability. The court then held on the issue of plaintiff's reliance as to negligence under the doctrine of *res ipsa loquitur*:

> In determining whether the facts here allow application of the rule of *res ipsa loquitur*, I must of course accept that version of the facts most favorable to the plaintiff.
>
> Accordingly, it is assumed that the yoke failed when a weld at one of is joints came apart, as alleged by plaintiff. As noted above, the yoke was presumably designed to hold heavy machinery, and as such one would not be unreasonable in expecting it to withstand great stress. It is certainly unusual for such an apparatus to fail. In the light of practical human knowledge and experience, a reasonable trier of fact could conclude that the unexplained separation of the yoke was probably due to defendant's negligence in assembling it.
>
> Douglas argues that in the intervening eight months between the time the apparatus was purchased by Capitol Airways, Inc. and the time of the accident, the yoke and sling could have been subjected to abuses which would have weakened the structure. It is defendant's position that since there are such alternate explanations for the accident, it is not more probable that the break occurred due to defendant's negligence than it is that the break did

[49] Moore v.Douglas Aircraft Co., 282 A.2d 625 (Del. 1971).

> not so occur. These matters however are matters of defense once the plaintiff produced sufficient evidence to require such a defense and as I have noted above there do appear at this stage of the proceedings sufficient facts available to the plaintiff to require the defendant to defend against an inference of negligence.
>
> At the trial, Douglas may offer proof of misuse of the yoke and sling, if that proof is available, and of the age of the apparatus, as part the circumstances tending to show that Douglas was not negligent in constructing the machine. Since only the accident itself may be considered as the circumstances from which an inference of negligence may be drawn, Skipper v. Royal Crown Bottling Co., supra at 912, it is my conclusion that since the apparatus was manufactured by the defendant, and since the facts before this Court it could be found that the failure of the apparatus was due to some negligence in its manufacture, the availability to the plaintiff of the theory of *res ipsa loquitur* is not precluded at this point as a matter of law....
>
> It is held, therefore, that the plaintiff has standing to maintain a cause of action for negligence, and that he is entitled to rely on the theory of *res ipsa loquitur* in doing so. Accordingly, defendant's motion for summary judgment is denied.[50]

A further case illustrates the evidentiary problems of cause when the physical evidence is destroyed and there are no surviving witnesses from the crashed aircraft. In North American Aviation, Inc. v. Hughes the defendant, North American Aviation, Inc. appealed a verdict for plaintiff, where plaintiff's decedent husband was killed in a crash following takeoff of a newly manufactured F-86 F fighter aircraft.[51]

---

[50] Id. at 629.

[51] North American Aviation, Inc. v. Hughes, 247 F.2d 517 (9th Cir. 1957), cert. denied, 355 U.S. 914 (1958).

The aircraft was completely demolished and the pilot instantly killed. At trial, all expert testimony of the crash investigation was provided by defendant and that evidence was that the aircraft contained about 1,000,000 parts - thousands of these airplanes had been delivered, and there was no evidence that any of them had ever had any trouble. Throughout the course of the manufacture of the plane it is minutely checked and inspected in all of its various systems. They agreed that it was not due to any failure of the aircraft or its component parts and suggested nine pilot error causative factors that could cause the jet airplane to crash.[52] North American Aviation also argued that plaintiff had "produced not one scintilla of evidence that there was any defect in this particular aircraft or, that there had ever been any defect or defects in any other machine of similar type manufactured by the appellant, which would indicate negligence in design or fabrication," and that "[i]t is only by resort to the doctrine of *res ipsa loquitur* that the verdict and judgment can be upheld."[53] The plaintiff's evidence at trial was that foamite was found on part of the electrical system as the plane neared final assembly indicating a fire and that the parts affected by the fire were not replaced or inspected for damage. The judgment for the plaintiff was affirmed.

H. NEGLIGENCE PER SE

---

[52] Id. at 518.

[53] Id. at 520.

The Second Restatement § 286 provides that a statute or administrative regulation, if adopted for the protection of a certain class of persons, may provide the standard of care to such persons in negligence actions. Much of aircraft design, fabrication and materials, ground and flight testing and flight stability, control and performance is governed by Federal Regulations in the United States. Foreign manufacturers are subject to similar national standards at home, and to many of the United States regulations when they market their products here. Similar regulations apply to parts and components manufacturers. In fact, much of every aspect of aviation is so governed including fight crew members, maintenance and flight operations, air traffic control, weather services, escape and survival equipment and crash and rescue services. Courts have expanded on the doctrine of negligence per se to include liability for acts "so opposed to the dictates of common prudence that it can be said without hesitation or doubt that no careful person would have committed it."[54]

I. STRICT LIABILITY IN TORT

The origin of the modern American concept of strict liability in tort for defective products can be traced to the decision in Greenman v. Yuba Power Products, Inc.[55] In this

---

[54] 57A Am. Jur. 2d § 27, (citing Bloundell v. Wailuku Sugar Co., 669 P.2d 163 (Haw. Ct. App. 1983)).

[55] Greenman v. Yuba Power Products, Inc., 377 P.2d at 900 (Cal.1962).

case Justice Traynor announced what is known as the "Greenman" rule: "A manufacturer is strictly liable in tort when an article he places on the market... proves to have a defect that causes injury to a human being."[56] The Second Restatement, § 402A elaborates on this, stating in part:

> (1) One who sells any product in defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer or to his property, if
> (a) the seller is engaged in the business of selling such a product, and
> (b) it is expected to and does reach to consumer without substantial change in the condition in which it is sold.
>
> (2) The rule stated in subsection (1) applies although
> (a) the seller has exercised all possible care in the preparation and sale of his product, and
> (b) the user or consumer has not bought the product from or entered into any contractual relation with the seller.[57]

Most states have adopted, by court decisions, the Second Restatement standard or its equivalent.

In California, the state's courts have attempted to lessen the burden of plaintiffs having to prove the manufacturer's strict liability. In Cronin v. J.B.E. Olsen Corp. the California supreme court held that a plaintiff did not have to prove that there was a defect in the product and the defect was unreasonably dangerous.[58] It reasoned that requiring such proof was a much greater burden than intended by

[56] Id. at 900.

[57] Second Restatement at §§ 345-6.

[58] Cronin v. J.B.E. Olsen Corp., 501 P.2d 1153 (Cal.1972).

that Court in Greenman v. Yuba Power Products, Inc. In Cronin the California court required the plaintiff only to prove that the product had a defect, and that the defect was a cause of plaintiff's injuries for the manufacturer to be liable.[59]

Litigation under the principles set forth in the Second Restatement § 402A and established by case law has significantly shaped the law as it applies to transportation, particularly by automobile and aircraft defect cases. In 1961, the Seventh Circuit Court of Appeals in Evans v. General Motors Corporation, denied recovery under a crashworthiness concept and by strict liability.[60] A 1961 Chevrolet station wagon was designed and manufactured with an "X" frame instead of a perimeter frame as used by other manufacturers. The vehicle was involved in an accident and Roy Evans died of his injuries sustained in the accident. The plaintiff, the decedent's wife, alleged strict liability, breach of implied warranty for fitness of purpose, and negligence in design of the vehicle. Specifically, she claimed that the perimeter frame provided much more protection for occupants of the vehicle in a collision, and that by omitting side frame rails defendant created an unreasonable risk of harm. The court, in ruling against plaintiff, noted that the plaintiff had not asserted defendant's design could have functioned to avoid the collision; neither did plaintiff assert that the "X" frame was

---

[59] Compare, Barker v. Lull Engineering Co., 573 P.2d 443 (Cal. 1978).

[60] Evans v. General Motors Corporation, 359 F.2d 822 (7th Cir. 1966), cert. denied, 87 S.Ct. 83 (1966).

a cause of the collision. The court, citing a New York case, Campo v. Scofield for the proposition that "a manufacturer is not under the duty to make his automobile accident- or fool proof," recognized the defendant had a duty to insure that the automobile was reasonably fit for its intended purpose, but "the intended purpose does not include its participation in collisions with other objects, despite the manufacturer's ability to foresee the possibility of such collisions."[61] Some commentaries criticizing the court's holding in Evans, focused on two weaknesses in the reasoning of the opinion. First, the majority of the Court did not recognize that the manufacturer had a duty to use such care in designing its automobiles that reasonable protection is given purchasers and users against death and injury from accidents which are expected and foreseeable, yet unavoidable despite careful use.[62]

A 1968 case, also against General Motors Corporation, involved an accident in a Chevrolet Corvair.[63] The head-on collision of this vehicle caused the rearward thrust of the steering wheel into the plaintiff's head causing severe injuries. Plaintiff alleged defective design and manufacture of the vehicle as a cause. Defendant General Motors, relying on the Evans Court rationale, argued that a

[61] Campo v. Scofield, 95 N.E. 802 (N.Y. 1950).

[62] Evans v. General Motors, 359 F.2d at 825 (7th Cir. 1966); see also Note, Boulineaux v. City of Knoxville, 13 U.S.Av.Rev. 145 (1937).

[63] Larson v. General Motors Corp., 391 F.2d 495 (8th Cir. 1968).

head on collision was not the intended use and purpose of the vehicle and thus there was no manufacturer liability regardless of the ability to foresee the occurrence of such collisions. The Larson court found a broader definition of a manufacturer's duty owed to a user, stating,

> The duty of reasonable care in design rests on common law negligence, that a manufacturer of an article should use reasonable care in design and manufacture of his product to eliminate any foreseeable injury... that while all risks cannot be eliminated nor can a crash-proof vehicle be designed under present state of the art, there are many common sense factors in design, which are or should be well known to the manufacturer that will minimize or lessen the injurious effects of a collision.[64]

Courts have followed the general premises of both Evans and Larson. In General Motors v. Howard the Supreme Court of Missisippi adopted the more conservative Evans approach to manufacturer liability. It held that the manufacturer was not liable to the truck owner for injuries sustained when, as a result of the collision with another truck, his head and chest struck the telescopic steering column, which did not telesscope. The manufacturer had never asserted that the steering column would telescope under all circumstances.[65] An earlier Mississippi case, Walton v. Chrysler Motor Corp., resulted in the state's supreme court affirming the judgement for the defendant Chrysler, where the plaintiff alleged a seat defect to be a cause of his injuries.

---

[64] Id.

[65] General Motors Corporation v. Howard, 244 So.2d 726,729 (Miss. 1971).

The court stated, "[w]e are of the opinion that the automobile manufacturer is not an insurer against the possiblity of accidental injury arising out of the use of its product."[66] In Ford Motor Co. v. Simpson, in reversing a trial court judgment for the plaintiff, the court held that "an automobile manufacturer is not liable for injury arising from defects in the automobile which did not cause or contribute to the cause of the accident, such as a rear-end collision."[67] Finally, In Henderson v. Ford Motor Co., the Supreme Court of Texas held that the plaintiff, Henderson, could take nothing from defendant for an alleged, but not proven design defect, where a portion of an air filter gasket lodged in the carburetor and held open the gas feed on a 1968 Lincoln Continental.[68]

A more modern rationale of manufacturer product liability, following the Larson decision, was adopted by by the Seventh Circuit in Huff v. White Motor Company, where the court recognized the principle of strict liability for the defective design of a fuel system that caused a truck to ignite upon impact.[69] There, the court recognized that an intended purpose of the vehicle was to be reasonably safe in foreseeable collisions, and to be free of hidden defects which would render

[66] Walton v. Chrysler Motor Corp., 229 So.2d 568, 572 (Miss. 1970), reh. den. (1970).

[67] Ford Motor Co. v. Simpson, 233 So.2d 797, 798 (Miss. 1970).

[68] Henderson v. Ford Motor Co., 519 S.W.2d 87, 92 (Texas 1974)

[69] Huff v. White Motor Company, 565 F.2d 104 (7th Cir. 1977).

it unsafe in the course of such use.[70] Courts have usually followed consistent holdings in automobile and in aircraft cases, except where Federal law has mandated particular design standards for aircraft. Where the vehicle mishap is not reasonably foreseeable it has been held that the manufacturer is not the plaintiff's insurer, and that misuse of the product can bar recovery.[71]

In aircraft accident cases, courts have also followed different and independent policies with regard to strict liability of manufacturers. In Eichstedt v. Cessna Aircraft Co., No. 28209, District Court of Washoe County, Nevada, Aug. (1977) the Court upheld the jury's finding that the manufacturer was negligent in design and installation of seatbelts and inadequately anchored seats, and failing to install a shoulder harness for the passenger. Plaintiff's decedent died following the crash of a Cessna aircraft into a canyon wall. He survived the initial impact, but died of the dynamic crash injuries.

J. BREACH OF WARRANTIES, EXPRESS AND IMPLIED

Because of the contractual nature of express warranties there are few cases reported, outside of privity of contract, where courts have permitted plaintiff's recovery for

[70] See also Passwaters v. General Motors Corp., 454 F.2d 1270 (8th Cir. 1972), Dreinsonstok v. Volkswagenwerk A.G., 489 F.2d 1066 (4th Cir. 1974), and Polk v. Ford Motor Co., 529 F.2d 259 (8th Cir. 1976).

[71] General Motors Corp. v. Hopkins, 548 S.W. 2d 344 (Texas 1977).

injuries resulting from a manufacturer's breach of an express warranty. In Murray v. Bensen Aircraft Corp. a personal injury action was brought by plaintiff in Wake County, North Carolina Superior Court against Bensen Aircraft Corp., a domestic corporation.[72] He alleged that when flying a Bensen Model B-7 Gyro Glider in California the rotor blade section would bind or freeze and that this caused him to lose all control over the aircraft, the subsequent crash, and his personal injuries. Plaintiff had not stated in his complaint that he had purchased the said Gyro Glider from the defendant, but alleged that defendant in national publications had advertised that members of the public could purchase and use the Bensen Model B-7 Gyro Glider for the intended purpose of rotary flight and in complete safety.

Plaintiff cited California law, the site of the accident, as controlling whether the alleged wrongs were a tort or breaches of a contract. The trial court sustained defendant's demurrer as to the breach of an express warranty and dismissed that cause of action. The Supreme Court of North Carolina sustained the demurrer, but held that the dismissal was error and plaintiff should be permitted to amend his pleadings to show any contractual agreement with defendant. In its opinion the Supreme Court of North Carolina stated, "the word warranty, by definition, implies a contractual relation between a party making a warranty and the beneficiary of the

---

[72] Murray v. Bensen Aircraft Corp., 131 S.E. 2d. 367 (N.C. 1963).

warranty."[73] The court further stated, "[t]he rule announced and applied in the cases cited above is supported by the great weight of authority."[74]

A later case, Fullerton Aircraft Sales and Rentals, Inc. v. Beech Aircraft Corp. involved an aircraft manufactured by Beech and sold to plaintiff by Page Avjet Corp., an authorized Beechcraft dealer.[75] Plaintiff alleged a product defect causing abnormal vibrations in the aircraft, and breach of express and implied warranties by Beech. The trial court granted summary judgment for Beech Aircraft on the grounds of collateral estoppel and want of privity of contract between Beech and Fullerton. In an earlier action for revocation of contract by Fullerton against the seller Page Avjet and Beech Corp., the claim against Beech was voluntarily dismissed since the remedy sought lay only against the seller.

The appellate court reversed and remanded the case on both grounds. In considering the breach of warranty claims, the court reviewed provisions of the Uniform Commercial Code §11-5, Kansas statutes, and a number of earlier cases and concluded plaintiff was not barred by lack of privity in bringing both express and implied breach of warranty claims against the aircraft manufacturer.

In Held v. Mitsubishi Aircraft International, Inc.

---

[73] Id. (citing with approval Wyatt v. North Carolina Equipment Co., 117 S.E.2d 21 (N.C. 1960)).

[74] Id. at 369.

[75] Fullerton Aircraft Sales and Rentals, Inc. v. Beech Aircraft Corp., 842 F.2d 717 (4th Cir. 1988).

the plaintiff brought an action in wrongful death against defendants in the fatal crash of a Mitsubishi MU-2b aircraft, alleging breach of express and implied warranties and negligence in design, manufacture, overhaul, service and repairs.[76] The action was brought in the United States District Court in Minnesota, however both parties agreed Texas law applied to sales contract issues because the sales contract stated Texas Law would apply. The defendants moved for summary judgment as to plaintiff's claims of breach of warranties because of disclaimers in the sales contract. This used aircraft had been sold by an independent dealer, defendants Mitsubishi were not a party to the sale. The court ruled that Mitsubishi could not rely on another's disclaimers and could be liable for breach of express and implied warranties outside of privity of contract for injury and economic loss.

The Uniform Commercial Code has provisions that address both express and implied warranties. Article 2 of the Code describes warranties of merchantability and fitness for purpose, and also deals with exclusion or modification of express warranties. The code permits limitations of warranties by agreement between buyers and sellers. The District of Columbia and all states except Louisiana have adopted Article Two dealing with sales.

K. DEFENSES TO A PRODUCT LIABILITY ACTION IN AVIATION CASES

---

[76] Held v. Mitsubishi Aircraft International, Inc., 672 F.Supp. 369 (D.Minn. 1987).

Although NTSB may find pilot error as a cause in about 85% of General Aviation accidents it investigates, the courts may be more tolerant of pilots. Court holdings such as: "[i]t is a common and not an unusual occurrence for airplanes to stall and fall while in operation, and without intervention of any act upon the operator"[77] and that "[i]t is a matter of common knowledge that an aircraft may fall or crash in the absence of negligence or fault on the part of its pilot"[78] show a continuing sympathy for pilots caught up in events perhaps beyond their control. At times, pilots receive an oversolicitous understanding in publications that should be more pragmatic. In an article in the March 1992 issue of Flying Magazine, the author described the events of a fatal accident involving a doctor and his Piper Apache light twin engined aircraft.[79] This aircraft had factory-new engines installed in an after-market modification of the aircraft. The article described this apparent stall and fall accident as follows:

> The left engine would run fine for a while, then begin to backfire and run lean. Once the engine lost fuel pressure on climb-out; on another occasion it quit on the run-up pad and the doctor had a struggle to taxi the airplane back to the hanger on the right engine alone....he had mentioned several occasions of faulty operation to friends....One winter day in 1989 the doctor went to the airport for a local flight.

---

[77] Note, Boulineaux v. City of Knoxville, 3 U.S.Av.R 145 (1937).

[78] 7b Michie's Jurisprudence of Virginia and West Virginia § 10 (citing Surface v. Johnson, 214 S.E.2d 152 (1975)).

[79] Peter Garrison, Aftermath, Loose Needle, Flying Magazine, March 1992.

> The weather was clear - a good day for the doctor, who had not flown in the past 13 weeks, to brush up on his takeoffs and landings. A pilot who was in a nearby hanger described the take-off; 'As he passed the hanger his engine began after firing' Another witness stated 'My attention was drawn to the heavy and continuous amount of backfiring, which sounded as though both engines were contributing to the back-firing. Also, I was somewhat astounded that the pilot continued the take-off, as he had ample time to put the aircraft down on the remaining runway.....' The pilot had obtained his multi-engine rating in 1979. He had flown 83 hours in the twin - an average of about 10 hours a year.... The real cause of the engine trouble was discovered too late. A complete tear down revealed a metering needle rolling around loose in the carburetor float bowl. It had been there long enough to leave polished spots on the grainy surface of the casting - presumably since the engine was built....Why did the pilot continue to takeoff after the engine started to backfire? We don't know a great deal of detail about the history of the pilot's problems with his left engine, but he had mentioned several occasions of faulty operation to friends; possibly there had been others as well. Perhaps there had been occasions on which the problem had spontaneously cured itself; in fact, from the pilot's point of view it must have seemed as though it always did so, until the "final" repair of the damaged seal. But if the problem had been persistent and seemed to defy diagnosis, the pilot-owner of the airplane had probably made a mental accommodation to it. After all, if the engine works fine most of the time, and the airplane does after all have two of them, and you don't want to just give up flying altogether, then there's nothing to do but accept that the problem may occur and be ready to deal with it. That attitude was the mainstay of the early days of aviation, and it still has wide currency today.

Was this an accident caused by a product defect, a metering needle loose in the carburetor float bowl - presumably since the engine was built? The author seems to suggest that the pilot by soldiering on with an intermittent engine problem, possessed the attitude that was the mainstay of the early days of aviation, still widely current today. Almost heroic, or was the doctor even a responsible and proficient pilot? The engine with the recurring problem had been on the doctor's airplane for ten years. In this decade he had flown fewer hours than the bare minimum required of an Air Force pilot in one year. He had not flown in more than three months. The field elevation was 4700 feet. Light twin-engine planes such as the Apache, with one failed engine have faint or no climb performance at this altitude, require superior pilot skill and proficiency to maintain control, and have a minimum control airspeed that if not maintained under full asymmetric engine power causes loss of control. Was the doctor's alternative to give up flying altogether? He should have been able to get the problem diagnosed and repaired and not flown the airplane until it was safe. More sensibly, he could have rented a much newer more capable airplane and flown with a competent and current pilot at a small fraction of his per hour cost of ownership. Nevertheless, the manufacturer may still have to pay all the damages, and more, in a defective products case. In another engine failure accident involving the same manufacturer, but a different model aircraft, the jury award was $31 million and the company is now operating in bankruptcy.

In the foregoing sections we have seen that a successful plaintiff must generally prove: 1) that a defendant manufacturer sold or put into commerce a defective product, which defect was harmful or dangerous, 2) that such defect existed when the defendant had possession or control of the product, 3)that such defect was not caused by subsequent abuse or misuse, and 4) that the alleged defect proximately caused plaintiff's injury or damage. A plaintiff, having proved the above should have established defendant's liability for the defective product and can move on to proving the amount of his damages.

A number of defenses are available to the defendant. In the foregoing cases one could see operation of some successful defenses where the plaintiff did not prevail. In this section we will take a closer look at manufacturer's defenses and consider how they may be affected by strict liability, warranties express or implied, and compliance or non-compliance with statutes or other regulatory provisions that are directive in nature. We will also examine the efficacy of manufacturer's warnings and contract disclaimers. Finally, we will look at cases where assumption of risk and or contributory negligence have been an important factor.

L. NEGLIGENCE

"The duty of care owed by a manufacturer and seller of a product is that of reasonable care. The manufacturer of the product is presumed to be an expert in the field, and the standard by which he is measured is that of a reasonable man of ordinary prudence who is an expert in manufacturing that particular product."[80]

---

[80] Guffie v. Erie Strayer Co., 350 F.2d 378 (3rd Cir. 1965), and see Valgahn v. Menlove, 132 Eng. Rep 490 (1738).

This same standard of care has been used in the Uniform Commercial Code in the United States where it is applied to a retailer dealing with the average consumer who relies on the expertise of the dealer as to the product sold. The least ambiguous definition of manufacturers liability for negligence is in Second Restatement § 395 which reads,

> **Negligent manufacturer of chattel, dangerous unless carefully made.**
> A manufacturer who fails to exercise reasonable care in the manufacture of a chattel which, unless carefully made, he should recognize as involving an unreasonable risk of causing physical harm to those who use it for a purpose for which the manufacturer should expect it to be used and to those whom he should expect to be endangered by its probable use, is subject to liability for physical harm caused by its lawful use in a manner and for a purpose for which it is supplied.

Therefore, the manufacturer may successfully defend if he can show his reasonable care by the industry standard in design and manufacture of the alleged defective product, or can show that the product was used outside the manner and/or purpose for which it was designed and manufactured and that such improper use was a direct or intervening cause of the injury. In fact, the defendant may well have the burden of affirmatively asserting his defenses to overcome presumptions of his negligence simply because an accident occurred.[81]

A similar presumption of fault where a defendant or his servants had management or control over the design or manufacture of a product, exists in many civil law jurisdictions signatory to the Hague Convention on the Law Applicable to Products Liability. Article 4 of the Convention states in part, "[t]he applicable law shall be the law of the State of the place of injury, if that State is also, (a) the place of habitual residence of the person directly suffering damage, or (b) the principal place of business of the person claimed to be liable, or (c) the place where the product was acquired by the person directly suffering damage."[82] In an action between international parties this Convention should be consulted along with the law of the forum and place of accident if different. An excellent treatise on the subject is that of C.F.J. Morse of Kings College, London. Mr. Morse has given

---

[81] The doctrine of *'res ipsa loquitor'* in tort law originated from Baron Pollock's argument in a case wherein a barrel of flour rolled unwitnessed out of Mr. Boadle's warehouse window and fell upon Mr. Byrne causing him serious injury. A formal description of the doctrine that has been since accepted in jurisprudence was given by Chief Justice Erle in a case two years later. Justice Erle said in his opinion, "There must be reasonable evidence of negligence. But where the thing is shown to be under the management of the defendant or his servants, and the accident is such as in the ordinary course of things does not happen if those who have the management use proper care, it affords reasonable evidence, in absence of explanation by the defendants, that the accident arose from want of care." (Scott, 159 Eng.Rep. at 667) The doctrine of 'res ipsa loquitor' is accepted and applied by all United States courts. The doctrine has also been adopted by statute or in case law by most Commonwealth countries.

[82] Hague Convention on Product Liability, 1972, 1056 U.N.T.S. 187.

some treatment to the problems of choice of law and conflicts of law in this book.

M. FORESEEABILITY

A valid defense for a defendant manufacturer is that the accident complained of was so remote in possibility as to be not in the contemplation of a reasonable man. Justice Cardozo had some opinions on this subject that are still valid in the United States and probably most Commonwealth Nations where strict liability has not preempted foreseeability. In Palsgraf v. Long Island R.R.[83] the court in an opinion given by Judge Cardozo found that although Mrs. Palsgraf had been injured by a heavy scale owned and under the possession and control of defendant or his servants, and that the injury occurred on defendant's property, a railroad boarding platform, and although defendant owed a very high duty of care to the plaintiff because he was engaged in the business of transportation services for the public and plaintiff was an invitee for such services, that, nevertheless, the defendant was not liable as the cause of injury was not foreseeable. The evidence at trial was that the scale fell over onto Mrs. Palsgraf as a result of an explosion of a package of fireworks dropped by another passenger as he was being assisted and 'jostled' by defendant's servant in boarding the train.

The Second Restatement § 395 has formally stated the

[83] Palsgraf v. Long Island R.R., 162 N.E. 99, 104 (N.Y. 1928); see also Law of Torts, supra note 8, at 259.

legal principle of foreseeability to be "that the risk of harm must be foreseeable and unreasonable; that the use to which the product was put to use most be foreseeable, and the plaintiff or injured party must fall within a class of persons foreseeable as victims." This principle has been described as "the conceptual can of worms opened for modern lawyers".[84]

N. EXPRESS WARRANTY

In the United States common law has been largely preempted by Federal or State Legislation regulating actions based on express warranties. Thus, a manufacturer may be protected under this theory by privity of contract because the element of inducement to purchase is an indispensable ingredient of an express warranty. In Murray v. Benson Aircraft Corp. a third party purchaser of a Bensen Gyro Glider kit claimed his personal injuries were proximately caused by a rotor blade failure, and that the manufacturer had expressly warranted the part to be airworthy. The court, finding for the defendant said, "the word warranty by definition implies a contractual relation between a party making a warranty and the beneficiary of the warranty. A warranty, express or implied, is contractual in nature. Whether considered collateral thereto or an integral part thereof, a warranty is an element of a contract of

[84] William Kimble and Robert O. Lesher, Products Liability, Foreseeability, § 73 (citing Schneider v. Chrysler Corp., 401 F.2d 549 (8th Cir. 1968), and Stelly v. Quick Manufacturing Co., 246 So.2d 302 (La.Ct.App. 1972), cert. denied, 95 S.Ct. 323 (1979).

sale."[85] Even where a manufacturer has extensively advertised certain qualities of its product, courts have held that such claims cannot be construed as an express warranty even where there is privity of contract between the parties. The Continental Motors Corporation had advertised their fuel injected aircraft engine in the following way:

> The engine icing hazard, inseparable from carburetor-type aircraft engines, vanishes when you fly with Continental fuel injection, for the refrigerating effect of vaporizing fuel at the carburetor is ended by eliminating the carburetor itself. With Continental Fuel Injection, no carburetor heat is ever required. You always use the coldest available air, for maximum power.[86]

The company had also published a circular stating that freedom from icing is one of several advantages of their fuel injected engine. The circular stated: "You get better acceleration, with no tendency to stall after idling, because fuel is always present at every cylinder. Even without heated induction air, there is no danger of icing, because the refrigerating effect of vaporization at the carburetor is removed. Power is improved at every engine speed". In Banko v. Continental Motors Corp. the plaintiff claimed he crashed because fuel was no longer present at each cylinder due to icing in the induction system of his Continental engined airplane.[87] The express warranty given Banko by Continental warranted the engine or part to be

---

[85] Murray v. Benson Aircraft Corp., 131 S.E.2d. 367 (N.C. 1963).

[86] Id. at 641.

[87] Banko v. Continental Motors Corp., 251 F.Supp 229 (D.VA. 1966), aff'd., 373 F.2d. 314 (4th Cir. 1966).

free from defects in material and workmanship, when properly installed and used under normal conditions, for one hundred fifty days, in no case to exceed one hundred hours of operation after the shipment of the engine from the plant. A disclaimer was included in the warranty that it is expressly in lieu of all other warranties or representations, express or implied, and all other liabilities on the part of the Aircraft Engine Division of Continental Motors Corporation. Evidence at trial indicated that the type of icing found in Banko's engine air induction system was icing of the throttle controls. The court, in finding for defendant, stated:

> When read as a whole, Continental's advertising publications cannot be construed as constituting an express warranty on the part of Continental that its fuel injection engine would not ice under any and all flying conditions. There are several types of icing hazards known to the aviation industry, the type Continental sought and claimed to eliminate was icing resulting from the refrigeration effect of evaporating fuel....To construe the language used as a warranty that airplanes powered by Continental fuel injection engines would not ice under any condition would make Continental an insurer against any and all kinds of weather. Such was never intended and neither Banko nor any of his witnesses so read and construe the publications.[88]

Thus, the federal court in Banko construed Continental Motors' advertising to be a part of its express warranty, although a disclaimer was present in the contract, but found that the particular icing defect complained of fell outside of the manufacturer's representations.

It should be noted that, although most cases seem to

---

[88] Id. at 235.

regard warranties as a part of contract, not all experts in the field agree with this. Dean Prosser has written that an action for breach of warranty originally sounded in tort and later cases considering warranty as sounding in contract have led the courts into the error of requiring privity of contract in products liability cases. In noting this trend he stated:

> [T]he adoption of this particular device was facilitated by the peculiar and uncertain nature and character of warranty, a freak hybrid born of the illicit intercourse of tort and contract. A more notable example of legal miscegenation could hardly be cited than that which produced the modern action for breach of warranty. Originally sounded in tort, yet arising out of the warrantor's consent to be bound, it later ceased necessarily to be consensual, and at the same time came to lie mainly in contract.[89]

The ambiguity between theories of tort and contract in product liability cases appeared in a recent action for damages following the crash of a Cessna light airplane.[90] The Salmon Rivers court stated in part:

> [T]he role of privity in products liability actions remains an unsettled legal issue, demonstrating an ambiguity which derives partly from a failure to delineate precisely the contest in which courts make statements regarding privity....Courts resorted to the legal ground of breach of warranty in attempts both to increase the protection of consumers beyond that afforded them through recovery grounded on negligence, and yet to refrain from specifically enunciating the concept of strict liability in tort. Courts and commentators making the distinction between tort and contract recognize that privity of contract is necessary in a contract action for breach

[89] William L. Prosser, Strict Liability to the Consumer, 69 Yale L.J. 1099.

[90] Salmon Rivers Sportsman Camps, Inc. v. Cessna Aircraft Co., 544 P.2d 306 (Idaho 1975).

of implied warranty."[91]

Where the action is sounded in tort, an alleged breach of warranty for fitness of purpose required no privity of contract. In the same year a New Jersey Court was deciding the landmark tort case of Henningsen v. Bloomfield Motors, Inc.,[92] a federal district court in New York was faced with the same question as to privity of contract being a defense to an allegation of breach of an implied warranty for fitness of purpose in the aviation case of Middleton v. United Aircraft Corp.[93] In the Henningsen case Mr. Henningsen had purchased in his name the alleged defective automobile from Bloomfield Motors in which his wife was driving and was injured. Mr. and Mrs. Henningsen sued both the automobile dealer and the manufacturer, Chrysler Corporation. Both defendants contended that, since there was no privity of contract between them and Mrs. Henningsen, she could not recover for breach of any warranty made by either of them. The trial court disagreed, citing, among other authorities, the Uniform Commercial Code § 2-318 which stated the warranty should be extended "to any natural person who is in the family or household of the buyer or who is a guest in his home if it is reasonable to expect that such person may use, consume or be affected by the goods and who is injured in person by breach of the

[91] Id., at 311.

[92] Henningsen v. Bloomfield Motors, Inc., 161 A.2d 69 (N.J.1960).

[93] Middleton v. United Aircraft Corp., 204 F.Supp 856 (D.N.Y. 1960).

warranty."[94] The trial court discredited the effect of the sales contract and manufacturer's disclaimers of further express or implied warranties, citing International Harvester Co. of America v. Bean[95] and stating "it must be borne in mind that the warranty of fitness for a particular use, which is implied by law where a manufacturer sells machinery for a purpose made known to him by the buyer thereof, relying on the skill and judgment of the manufacturer in selecting machinery adopted thereto, is a warranty which attaches itself to the contract of sale, independent of any express representation by the manufacturer of the suitability of the machinery for such use. It attaches by implication of law as a direct result of the communication to the buyer by the manufacturer of the intended use." The trial court found, although the contract for the new automobile was made by the buyer, Mr. Henningsen, the buyer's wife was a person who, in the reasonable contemplation of the parties to the implied warranty of merchantability and fitness for purpose, might be expected to become a user of the automobile and hence, the wife's lack of privity of contract did not prevent her recovery of damages for personal injuries proximately caused by the defective auto. The Supreme Court of New Jersey affirmed.[96]

The premise that a manufacturer cannot be shielded

---

[94] Id. at 100-1.

[95] International Harvester Co. of America v. Bean, 169 S.W. 549 (Ky. 1914).

[96] Henningson, 161 A.2d at 104.

from liability for defects in breach of express or implied warranties by lack of privity where an intermediate dealer is the seller to the consumer exists also in civil law countries. In General Motors Products of Canada Ltd. et. Leo Kravitz[97] the Appellate Court observed that although Article 1023 of the Quebec Civil Code states, "Contracts have effect only between the contracting parties, they cannot affect third persons, except in the cases provided in the article of the fifth section of this chapter," Kravitz still benefited from all express and implied warranties even though he had purchased his vehicle from an intermediate dealer. In explaining the opinion the court said:

> While it is generally true that a contract binds only the contracting parties, and their successors either universal or by general title, this does not necessarily mean that a contract can never benefit a successor by particular title. Indeed, it seems to have been recognized that some rights are so closely related to a thing that they can benefit only its owner. Pothier, who was the source of these provisions in our Civil Code and those in the Code Napoleon, states clearly that successors by particular title benefit from the stipulations pertaining to the thing they acquire.[98]

The General Motors et Kravitz court was not faced with, and did not address, the extension of implied warranties to a subsequent buyer's family. However, the Pothier reasoning logically would extend "stipulations pertaining to the thing" to persons reasonably contemplated to use it.

---

[97] General Motors Products of Canada et Kravitz, 15 S.C.R. 790 (Quebec 1979).

[98] General Motors Products, 15 S.C.R. at 807-8.

The 1960 case of Middleton v. United Aircraft Corp., a contemporary of Henningsen, also found that privity of contract for a breach of an implied warranty for fitness of purpose as a defense against actions by third parties was an "anachronism."[99] This was a wrongful death admiralty action against United Aircraft as manufacturer of a helicopter which crashed into the Gulf of Mexico, killing the pilot and passengers. The Middleton court said, in part,

> [t]he doctrine of liability of the manufacturers to remote users without the so-called privity of contract has been sustained in respect to other items than food. There is no reason why recovery should be allowed in food and related cases and denied in others so far as the privity requirement is concerned. There is, in my opinion, no reason why the rule in the Federal Courts with respect to privity should be based upon an ancient error. There has been no logical or realistic reason advanced why privity should be retained in a breach of implied warranty case. The trend is toward the abrogation of this anachronism.

The Federal District Court of Illinois applying Washington law in Manos v. Trans World Airlines, Inc.[100] in a case involving a crash of a Boeing 707 aircraft declared, "[t]here is a warranty implied in law (and not dependent on the warranty provisions of the Uniform Sales Act) - The warranty is not dependent on contract, does not require privity, and is available to all who may suffer damage by reason of the

[99] Middleton v. United Aircraft Corp., 204 F.Supp. 856 (D.N.Y. 1960).

[100] Manos v. Trans-World Airlines, Inc., 324 F.Supp. 470 (D.Ill. 1971).

products use in the legitimate channels of trade."[101]

O. STRICT LIABILITY IN TORT: DEFENSES TO STRICT LIABILITY IN TORT

The foregoing section considered defenses that a manufacturer could use in product liability cases, and also pointed out the steady erosion of those defenses by courts intent on greater protection and improved likelihood of recovery of damages for consumers and third parties injured by defective products. A non aviation case, Greenman v. Yuba Power Products, Inc.,[102] decided in California in 1962 is a turning point in the law of strict liability which should be carefully examined before moving on to that principle's application in aircraft cases. William Greenman's wife purchased and gave to him a Shopsmith home workshop tool for Christmas. This was a multi-purpose power tool which could serve, among other things, as a lathe with appropriate attachments. The Shopsmith had been purchased in 1955 and the lathe attachment in 1957. There was no evidence that the basic machine or its attachment had not been properly cared for or used, when a piece of wood secured in the lathe attachment flew out of the machine striking Greenman and seriously injuring him. Greenman sued under the theories of negligence and breach of warranty, both the dealer and the manufacturer. The trial

---

[101] Id. at 484.

[102] Greenman v. Yuba Power Products, Inc., 377 P.2d. at 897 (Cal. 1962).

court then found for the retailer against Greenman, and for him against the manufacturer. The manufacturer and the plaintiff appealed. The Supreme Court of California affirmed. The issues raised by the plaintiff against the retailer did not reach the jury since the trial court ruled as a matter of law that the retailer was not liable under the facts in the case, and submitted to the jury only the matters of alleged negligence and breach of express warranties against the manufacturer. The Supreme Court of California, in an opinion ranging farther than necessary to affirm the verdict held,

> to impose strict liability on the manufacturer in the facts of this case, it was not necessary for plaintiff to establish an express warranty as defined in §1732 of the Civil Code. A manufacturer is strictly liable in tort when an article he places on the market, knowing that it is to be used without inspection for defects, proves to have a defect that causes injury to a human being. Recognized first in the case of unwholesome food products, such liability has now been extended to a variety of other products that create as great or greater a hazard if defective.
>
> In the present case, for example, plaintiff was able to plead and prove an express warranty only because he read and relied on representations of the Shopsmith's ruggedness contained in the manufacturer's brochure. Implicit in the machine's presence on the market, however, was a representation that it would safely do the jobs for which it was built. Under these circumstances it should not be controlling whether plaintiff selected the machine because of the statements in the brochure or because of the machine's own appearance of excellence that belied the defect lurking beneath the surface, or because he merely assumed that it would safely do the jobs it was built to do. It should not be controlling whether the details of the sales from manufacturer to retailer and from retailer to plaintiff's wife were such that one of the implied warranties in the sales act arose. The remedies of injured consumers ought not to be made to depend upon

the intricacies of the law of sales.[103]

The court further stated, "[t]o establish the manufacturer's liability it was sufficient that plaintiff proved that he was injured while using the Shopsmith in a way it was intended to be used as a result of a defect in design and manufacture of which plaintiff was not aware that made the Shopsmith unsafe for its intended use."[104]

The doctrine of strict liability in tort has been accepted by over half of the jurisdictions in the United States.[105] Thus, where strict liability is the applicable law the manufacturer's defenses are essentially reduced to his proving contributory negligence, assumption of risk, or modification or abuse of the product causing the defect complained of which caused injury.

The Restatement (Second) of Torts §402-A states the rule as follows:

> 1. One who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if
>   (a) the seller is engaged in the business of selling such a product, and
>   (b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.
> 2. The rule stated in sub-section (1) applies although
>   (a) the seller has exercised all possible care in the preparation and sale of his product, and

[103] Id. at 900-1, citing Ketterer v. Armour & Co., 200 F.322 (1957).

[104] Id.

[105] Stuart M. Speiser and Charles F. Krause, 2 Aviation Tort Law § 19-12 (1979).

(b) the user or consumer has not bought the product from or entered into any contractual relation with the seller.

The Restatement was applied in Lindsay v. McDonnell Douglas Aircraft Corp.[106] by the Federal District Court of Missouri in an Admiralty Action under Death on the High Seas Act. The court, stated that the rule of the Second Restatement applies to an airplane. The federal courts would be expected to apply the State Law where they are sitting in domestic cases. The Pennsylvania Supreme Court presented a public policy statement in the Cardozo manner for the rationale of manufacturer's strict liability in tort in the aviation case of Berkebile v. Brantly Helicopter Corp.[107]

> the law of product liability developed in response to changing societal concerns over the relationship between the consumer and the seller of a product. The increasing complexity of the manufacturing process placed upon the injured plaintiff nearly impossible burdens of proving negligence where, for policy reasons, it was felt that a seller should be responsible for injuries caused by defects in his products. - We emphasized the principle of liability without fault most recently by stating that the seller is "effectively the guarantor of his products safety." - Our Courts have determined that a manufacturer by marketing and advertising his product impliedly represents that it is safe for its intended use. We have decided that no current social interest is served by permitting the manufacturer to place a defective article in the stream of commerce and then to avoid responsibility for damages caused by the defect. - The crucial difference between strict liability and negligence is that the existence of due care, whether on the part of the seller or consumer is irrelevant. The seller is responsible for injury

[106] Lindsay v. McDonnel Douglas Aircraft Corp., 352 F.Supp. 633 (D.Mo. 1972), affd. 485 F.2d 1388 (8th Cir. 1973).

[107] Berkebile v. Brantly Helicopter, 337 A.2d 893 (Penn. 1975).

> caused by his defective product even if he has exercised all possible care in the preparation and sale of his product.[108]

P. EVALUATING THE AVIATION CASE

The very technical nature of product defects as a cause of injury and property damage in aircraft accidents and incidents, usually requires the services of experts to evaluate alleged defects and totestify as to the injuries caused. Since many other causes or intervening factors may be present, a very thorough investigation is usually needed. In addition, such investigation requires the consideration of multiple technical areas, including, but not limited to: engineering, metallurgy, medicine, weather, air traffic control, pilot, aircrew and ground crew qualifications, management support, and legal questions which apply, including forum and venue, as discussed above. Chapter IV, Investigating an Aircraft Accident, discusses the methods and resources available which assist in the affordable production of evidence essential to evaluating injuries, property damage and their causes in aviation accident cases. In the next chapter, recent developments in aviation products liability law are discussed.

[108] Berkebile, 337 A.2d at 898.

Chapter II RECENT DEVELOPMENTS IN AVIATION PRODUCTS LIABILITY LAW

A. FORUM SELECTION, OTHER LAW AND FACT ISSUES

After the probable causes of an accident have been determined by investigation and decisions are made that legal wrongs were committed which fit the causes, counsel for an injured party must decide where to proceed and against whom. These initial decisions are extremely important, because they are determinative of success or failure, and the degree thereof.

> The attorney representing survivors of those killed in an air crash disaster should not underestimate the importance of his selection of the appropriate forum, for upon that choice rests myriad decisions concerning the applicable law on the many questions of the elements of proof, evidence, measures of damages, right to recover, and others, which, even singly, can determine the outcome of litigation.[1]

Notice must be given to those regarded as expected defendants, and that notice must conform to the law and rules of the forum. If federal, state, or local governments are thought to be proper party defendants, the notice requirements will ordinarily be much in advance of the jurisdiction's statutes of limitations for property damage, personal injury and wrongful death.

---

[1] Stuart M. Speiser & Charles F. Krause, 1 Aviation Tort Law, 129 (1978).

1. Threshold Forum Decisions

In selecting the forum that best favors a claimants's cause, the forum must have jurisdiction over the subject matter and the parties. If a federal court is preferred or mandated, then that federal court in the state with law most favorable to the plaintiff may be best, if reasonably convenient. Many general aviation aircraft are old, their average age exceeds the statutes of repose in many states so, if a product defect was an identified cause, this will be an early factor in a plaintiff's choice of forum.

2. Statutes of Repose

Statutes of repose are a very dynamic area of law and must be carefully evaluated for their effect and timing for each potential jurisdiction.

> Several years ago, in a wave of products liability reform, a number of states enacted statutes of repose. These statutes typically barred claims based on products liability theories if the product was manufactured more than a fixed number of years before the action was filed, regardless of when the injury occurred. A typical state statute of repose bars claims for products manufactured 10 to 12 years prior to the lawsuit. These statutes received varied reception in the courts, and a number of them have been held unconstitutional under state constitutions. See, e.g., Kennedy; v. Lumberland Eng'g Co., 471 A.2d 195 (R.I. 1984); Lankford v. Sullivan, Long & Hagerty, 416 So. 2d 996 (Ala. 1982).
>
> Berry v. Beech Aircraft Corp.,717 P.2d.670, (Utah, 1985),involved the application of Utah Code Ann. § 78-15-3 (1953), the Utah products liability statute of repose, to bar a claim arising out of the crash of a twenty-three year old aircraft. Unlike some statutes of repose, the Utah law barred products

liability claims on all theories against the manufacturer. The plaintiffs challenged this statute of repose as a violation of various provisions of the Utah Constitution. In evaluating the validity of the statute, the Utah Supreme Court first turned to the "open courts" provision of the Utah Constitution which provides, that "every person, property or reputation, shall have remedy by due course of law." Utah Const. art. I, § 11.

After extensive review of the decisions of other courts throughout the country which have analyzed statutes of repose in light of similar provisions, the court found that open Courts provision of the Utah Constitution is satisfied if the challenged law "provides an injured person an effective and reasonable alternative remedy 'by due course of law' for vindication of his constitutional interest." If the law provides no such remedy, then a statute can be valid only if "there is a clear social or economic evil to be eliminated and the elimination of an existing legal remedy is not an arbitrary or unreasonable means for achieving the objective." The court then found that the Utah statute completely barred any remedy to an injured person if it applied to that person's claim. Further, the court found that the statute did not "reasonably and substantially advance its stated purpose." The court also found that statute to be unconstitutional as violating the section of the Utah Constitution guaranteeing a right of action for a wrongful death. It should be noted that the court took pains to distinguish the decision in which it upheld a statute of repose contained in the Medical Malpractice Act and its decision upholding a statute of repose intended to protect architects and builders.

The Oregon statute of repose received considerably more favorable treatment at the hands of the Oregon Court of Appeals in Erickson Air Crane Co. v. United Technologies Corp. In that case the plaintiff purchased a helicopter from United Technologies in 1971 which crashed in June, 1981, presumably because of a defective compressor disc. The plaintiff claimed to have received documents in 1977 indicating that the useful life of the disc was 6000 hours, rather than the correct 4000 hours. The court denied the defendant's motion for summary judgment based on the Oregon statute of repose and entered a judgment for the plaintiff in the amount of $7,404,775.

The court of appeals reversed the trial court's decision, holding that the court should have granted defendant's motion for summary judgment based on the statute. The court concluded that the plaintiff's claim was governed by the Oregon statute of repose and that, under the statute, a products liability action must be commenced within eight years from the date of the first purchase of the product for use or consumption. Since the statute did not contemplate a manufacturer's negligent actions or omissions before or after the date of purchase as having any bearing on the limitation period, any allegations concerning such actions were not relevant to the determination of whether the statute barred the plaintiff's claims. The court relied on Daque v. Piper Aircraft Corp., 418 N.E. 2d. 206 (1981), in holding that, even if an aircraft manufacturer has a continuing duty to warn of defects in a product after sale of the product, the statute of repose bars products liability claims against the manufacturer based on breach of that duty after the time limit contained therein has lapsed.[2]

3. Contributory Negligence and Assumption of Risk

If the claimant is the pilot or a crew member and aircrew error was identified as a cause by the plaintiff's, then states with a contributory negligence bar to recovery should be avoided. In any event, at the trial of his case the pilot or pilot-decedent will be charged with negligence by the defendants so, states with a comparative negligence standard favor pilot-decedent cases. Windle Turley identifies Alabama, Delaware, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, and Virginia as states with contributory negligence law. All other states have some form of comparative

[2] Michael J. Sehr, Recent Developments in Aviation Case Law, 53 J. Air L. & Commerce, 85 at 143 (1987).

negligence.[3]

In ruling on a motion for a new trial, a district court in Pennsylvania recently allowed evidence of a pilot's alcohol consumption over twenty-four hours prior to the crash at issue in the lawsuit. In Stevens v. Cessna Aircraft Co., 634 F. Supp. 137 (E.D. Pa.), affirmed 806 F. 2d. 254 (3rd. Cir. 1986), the decedent pilot's former wife brought suit against Cessna for alleged defects in the rudder controls of a Cessna 411 aircraft, and for an implied failure to warn of the defects. The crash occurred soon after takeoff when the plane was at an altitude of one hundred feet. The pilot notified the tower that he had lost power in his left engine and turned to land. An examination of the wreckage revealed that the pilot had not retracted the landing gear or feathered the propeller of the dead engine. Cessna contended that the pilot's failure to perform these acts constituted misuse of the plane, because he could simply have landed without turning at the time he lost the engine. Cessna's evidence of decedent's misuse came from a physician trained in aeronautical psychology who testified that decedent had been under a great deal of stress in his personal life, and that he had been drinking about twenty-four hours prior to takeoff. The expert testified that residual effects from alcohol can hamper perception even after twenty-four hours. Plaintiff objected to this testimony because decedent's autopsy revealed no alcohol in his bloodstream. The court denied plaintiff's motion for a new trial and ruled that evidence of decedent's alcohol consumption was proper because it showed the stress on decedent and it supported the suggestion that decedent's perceptions may have been dulled at the time of the accident. The evidence was held to be admissible because it is of the type normally relied on by such experts, pursuant to Rule 703 of the Federal Rules of Evidence. Further, the court noted that the limiting instructions which were given at trial effectively negated any prejudicial effects of the evidence.[4]

In Bearden v. United States, 21 Av.Cas. (CCH) 17,533

[3] Windle Turley, Aviation Litigation, 570, 578 (1986).

[4] Sehr, supra note 2 at 148.

(N.D. Ala. 1988), the court held that, where a pilot rated only for visual flight rules deliberately flew into instrument meteorological conditions and crashed, the accident and resulting injuries were not foreseeable by United States weather service and air traffic control employees. Both prior to and during this flight the decedent pilot violated several Federal Aviation Administration Regulations, USAF Regulations and aero club rules.[5]

4. Survival and Wrongful Death Statutes

The variations in survival and wrongful death statutes are almost infinite, and how they will be applied is often a choice of law question.[6] An example of how a plaintiff, who brought her action where she resided and where the accident occurred, was able to get that court to use the more favorable damages law of another state, is found in a recent Colorado case.[7] Mrs. Lewis-DeBoer was a passenger in an aircraft manufactured by defendant, Mooney Aircraft Corp., which crashed shortly after take-off from the Jefferson County, Colorado airport. Her husband and one of their children were killed and she was injured because of an alleged fault in a cargo door latch which permitted the door to open in flight.

---

[5] Patricia K. Gilmore and Julia A. Day, Litigation in Aviation; Litigating the Aviation Case, 34 (1988).

[6] Turley, supra note 3, at 582 (Tables briefly summarizing the statutes for each state).

[7] Lewis-DeBoer v. Mooney Aircraft Corporation, 728 F.Supp. 642 (D. Col. 1990).

The Federal District Court of Colorado ruled the Texas law of damages applied, as the aircraft and its cargo door latch were designed and manufactured, promoted and sold by the defendant in Texas. Texas damages law had no cap on non-economic personal injury and permitted exemplary damages in wrongful death actions. In its consideration of defendant's appeal whether Colorado damages law should apply, the appellate court held that the Restatement of Conflict of Laws § 145 "most significant relationship" analysis supported the application of Texas damages law under the facts presented and that the defendant, in locating its business in Texas, could expect application of its law for wrongs occurring there. The Court also held that the situs of the injuries, Colorado, was fortuitous, citing In re Air Crash Disaster at Stapleton International Airport, 720 F.Supp. 1445 (D.Colo. 1988).

Another recent case, involving the crash of a helicopter owned by one of the Donald Trump enterprises, illustrates how a state's survival and wrongful death statutes can limit or totally preclude recovery by a plaintiff regardless of the fault.[8] Trump Taj Mahal was an employer of passengers killed in the crash of a helicopter manufactured by Agusta in Italy. The plaintiff brought its actions in New Jersey state court, alleging defects in the design and manufacture of the helicopter and its rotor blades which failed

[8] Trump Taj Mahal Associates v. Costruzioni Aeronautiche Giovanni Augusta, S.P.A., 761 F.Supp. 1143 (D.N.J. 1991).

in flight causing the subject crash and deaths. Agusta had the case removed to federal court on the basis that Agusta was owned by the Italian Government and qualified as a "foreign state" under 28 U.S.C. Section 1603 (a). The federal district court granted summary judgment for defendants on the basis that this plaintiff could not recover damages claimed under New Jersey survival and wrongful death statutes. The appellate court affirmed without dissent. Plaintiff had alleged recurring mechanical faults and abnormal vibrations were reported to the manufacturer and the aircraft had been taken for repairs and service to the manufacturer's United States agent prior to the accident. Furthermore, similar defects in this model Agusta A109 helicopter had occurred preceding the Trump crash as a result of failed rotors, and that all this was known to Agusta. Plaintiff's motion for remand of the case to the state court was overruled.

Other United States forum concerns for plaintiffs arise when the accident occurs over the high seas or in a foreign country, and when the claimant is foreign. Admiralty law, the United States' Death on the High Seas Act, various treaties and bilateral agreements may apply to these accidents.

B. LAW AND FACT ISSUES INVOLVED IN ACCIDENTS WITH AN INTERNATIONAL COMPONENT

1. Accidents on the High Seas

In a controversial five to four decision the United

States Supreme Court ruled in Offshore Logistics, Inc. v. Tallentire that the exclusive remedy for wrongful death damages occurring over the high seas were those remedies found in admiralty law, contained in Death on the High Seas Act (DOHSA), 46 U.S.C. § 762 et. seq.[9] This case arose from the crash of a helicopter servicing oil platforms on the Continental Shelf. The plaintiff claimed damages in wrongful death under the Louisiana wrongful death statute, which permits recovery of non-pecuniary losses. DOHSA limits damages in wrongful death to pecuniary loss.

2. The Warsaw Convention

Manufacturers have argued that they become, at times, defendants in cases of accidents where no certain evidence of product defect exists, but where international agreements such as the Warsaw Convention and its subsequent agreements and protocols limit the damages recoverable from an air carrier for injury and death. These liability limitations can be quite low and must be proved by the claimants, $75,000.00 is the present cap under the Montreal Agreements of 1966 Relating to Liability Limitation of the Warsaw Convention and the Hague Protocol.[10] In a recent decision concerning litigation in the destruction of Korean Air Lines flight 007 by a Soviet air defense fighter, a United States court of

---

[9] Off Shore Logistics, Inc. v. Tallentire, 106 S.Ct. 2485 (1986).

[10] See 49 U.S.C.S. § 1502, (1970).

appeals set aside punitive damages against an air carrier on the basis of Article 17 of the Warsaw Convention, the whole of which was originally written in French.[11] The English translation was entered into the United States law in 1934 at 49 Stat. 3000. Interpretation of the original French and subsequent translations have challenged the courts ever since, resulting in uncertainty when the Convention applies to given litigation. Article 25 of the Convention states in part, "[t]he carrier shall not be entitled to avail himself of the provisions of this Convention which exclude or limit his liability, if the damages were caused by his willful misconduct." At the trial of the Korean Air Lines case in the Federal District Court for the District of Columbia the jury found Korean Air Lines (KAL) guilty of willful misconduct and awarded the plaintiffs compensatory and punitive damages. The appellate court in a split decision set aside punitive damages stating that the Article 17 language, that the carrier was "liable for damages sustained," limits the recovery to compensatory damages because federal courts recognize punitive damages as being retribution and deterrent in nature. Chief Justice Mikva dissented.

Article 25 - interpreted literally - places willfully wrong conduct outside of treaty provisions for compensatory damages. There was ample evidence of gross negligence by the airline in investigations of this and other

---

[11] In re Korean Air Lines Disaster of Sept. 1st, 1983, 932 F.2d. 1475 (D.C. Cir. 1991).

KAL incidents by the International Civil Aviation Organization (ICAO) and the United States National Transportation Safety Board (NTSB). Warsaw treaty provisions limiting recovery against scheduled air carriers may be a factor in causing more products liability claims against aircraft and component manufacturers in international airline accidents.

3. Admiralty Law and Economic Harm

Where only economic harm has been suffered, a U.S. court of appeals ruled that a plaintiff in an admiralty case cannot recover under alleged product defect outside of contract. In July of 1983 a helicopter operator providing oil well air services in the Gulf of Mexico experienced a forced landing in the Gulf. The helicopter was equipped with emergency flotation. After landing, the float failed and the aircraft capsized. It was later recovered, but had sustained major water damage. The plaintiff alleged negligent and defective design and manufacture of the float system, claiming strict product liability. Because of multiple defendants and actions the United States Court of Appeals, 5th Circuit, did not rule on the products question until 1991, when it held "whether stated in negligence or strict liability, no products liability claim lies in admiralty when the only injury claimed is economic." Thus, it confirmed the trial court's grant of summary judgment for the defendant.[12] The trial court had cited the United States Supreme Court decision in East River Steamship Corp. v. Transamerica DeLaval, Inc.,[13] where the Court stated "a manufacturer in a commercial relationship has no duty under either a negligence or strict liability theory to prevent a product from injuring itself."

In a similar, non-admiralty case, a helicopter lost power and crashed because of alleged engine defects, resulting in only economic losses to plaintiff. The Federal District Court in Northern California granted the defendant manufacturer's motion to dismiss. The Court based its decision on a four part test and held that, where all conditions are met, products liability of California law does not apply. The four conditions are:

1. The parties deal in a commercial setting;
2. They are in a position of relatively equal economic strength;
3. They bargain specifications of the product; and
4. They negotiate concerning risk of loss from defects in the product.

The court of appeals reversed and remanded because it found the parties' pleadings, in themselves, could not establish answers to these four questions.[14]

---

[12] Petroleum Helicopters, Inc. v. AVCO Corporation, 930 F.2d. 389, 391 (5th Cir. 1991).

[13] East River Steamship Corp. v. Transamerica DeLaval, Inc., 106 S.Ct. 2295, 2302 (1986).

[14] ARIS Helicopters, Ltd. v. Allison Gas Turbine, Inc., 932 F.2d. 825 (9th Cir. 1991).

4. Foreign Plaintiffs and Defendants

In Piper Aircraft Co. v. Reyno[15] the United States Supreme Court held that a *forum non conveniens* motion by the defendant aircraft manufacturer was appropriate where the foreign plaintiff had an adequate alternate forum. In this case Mrs. Reyno was appointed administratrix of the estates of five passengers, all Scottish citizens, who were killed in the crash of a Piper aircraft in Scotland. She filed suit in California Superior Court against Piper, alleging product defects and strict liability. Piper had the case removed to the Federal District Court, Central District Court of California and then had the case transferred to the District Court of the Middle District of Pennsylvania, where the aircraft had been manufactured. There, Piper moved that plaintiff's action be dismissed for *forum non conveniens*. The trial court granted defendant's motion and, ultimately, the superior court confirmed this decision. In a subsequent case, the Court of Appeals for the 5th Circuit, citing Piper v. Reyno, stated "if American law, either federal or state, applies to the action, the Federal Court should retain jurisdiction; if foreign law applies, dismissal may be appropriate if there exists a convenient forum"[16] This is an

[15] Piper Aircraft Co. v. Reyno, 102 S.Ct. 252 (1981), reh. denied 102 S.Ct. 1296 (1982).

[16] In Air Crash Disaster Near New Orleans, Louisiana, on July 9, 1982, 789 F.2d. 1092 (5th Cir. 1986).

interesting case because it is more protective of the interests of foreign plaintiffs seeking recovery against an American company where the law of their nation of citizenship might not be as beneficial to them. The trial court followed an interest choice of law test and found Louisiana state law to be the applicable law for the issue of damages. The court denied defendant's motion to dismiss for *forum non conveniens*. The appellate court affirmed.

In a more recent case interpreting Piper v. Reyno, the trial court twice granted defendant's motion to dismiss for *forum non conveniens* and the Appellate Court twice remanded the case. The case involved allegations of serious personal injury of an Austrian citizen in the crash of a Cessna 421 aircraft in British Columbia.[17] Plaintiff Lacey was working in British Columbia and there boarded the Canadian Forest Service-operated Cessna which crashed shortly after takeoff. He suffered severe burns. The Canadian Aviation Safety Board investigation attributed the crash to a failure of an engine exhaust system component which then caused turbocharger and engine failure. The exhaust system was manufactured by Hanlon and Wilson Company in Pennsylvania and the plaintiff sued Cessna and the component manufacturer.

The defendants moved for dismissal for *forum non conveniens* citing Piper v. Reyno and arguing that British Columbia was a better forum. The trial court granted the

[17] Lacy v. Cessna Aircraft Co., 932 F.2d. 170 (3rd. Cir. 1991).

motion, and on appeal the appellate court remanded based upon a strong presumption in favor of the plaintiff's choice of forum, and the fact the witnesses to the design and manufacture of the exhaust system were in Pennsylvania. The trial court again granted defendants' motion to dismiss for *forum non conveniens*. On appeal the appellate court again remanded, stating in part "[w]e do not think that the Piper court intended its decision to allow such ping pong between trial and appellate courts to continue unabated, producing delays that inevitably harm injured plaintiffs."[18] For foreign plaintiffs, these delays and dismissal of their actions may not toll the statutes of limitations for actions in their own country, so their American counsel should be coordinating efforts if their clients have legal representation at their residence of citizenship.

5. Actions Against Foreign Defendants

Many foreign airlines and aircraft manufacturers are wholly or partly owned by the nation of their principal place of business. An example of this was the Trump Taj Mahal v. Agusta case where the aircraft manufacturer was deemed to be the Government of Italy.[19] In 1976, The Foreign Sovereign Immunities Act, was enacted to grant authority to the Federal Courts over decisions of sovereign immunity and to codify the restrictive theory of sovereign

[18] Id. at 190.

[19] 761 F.Supp. at 1144.

immunity.[20] In a products liability case brought in the United States District Court for the Eastern District of New York arising out of a Soviet airliner crash in Warsaw, Poland on March 14, 1980, the defendant, manufacturers of the aircraft, moved for dismissal for lack of subject matter and in personam jurisdiction over the USSR.[21]

> Defendants argued that they were entitled to immunity under the FSIA, and that plaintiffs could prove no set of facts within the commercial activities exception contained in FSIA which would entitle them to relief. The court stated that the burden of proof in establishing the inapplicability of an exception to immunity rests upon the party claiming immunity. Plaintiffs alleged that the various defendants designed, manufactured, assembled, tested, inspected, marketed, sold, leased, and serviced the aircraft, and the court held that these allegations qualify as commercial activities within the meaning of FSIA. Defendants' affidavits in support of their motion failed to show that they did not have a connection to any of these activities. Accordingly, the court held that subject matter jurisdiction was proper.
>
> The court similarly disposed of defendants' arguments that it lacked *in personam* jurisdiction over them. It held that *in personam* jurisdiction exists as long as the defendants in such an action are properly served under FSIA's service provision.[22]

Where a plaintiff's contract for air carriage was made outside of the United States, the FSIA may not apply, and a different court has held the Act is the exclusive source of jurisdiction in these cases. In <u>In re Korean Air Lines</u>

---

[20] Foreign Sovereign Immunities Act (FSIA) 24 U.S.C. § 1330 et. seq.; Sehr, <u>supra</u> at note 2.

[21] <u>Gayda v. USSR</u>, 3 Av.L.Rep (CCH) (20 Av. Cas.) 17,634 (E.D.N.Y. Feb. 3, 1987).

[22] Sehr, <u>supra</u> note 2 at 87.

Disaster of September 1, 1983:

> The United States District Court for the District of Columbia held that the United States had no subject matter jurisdiction in a case where the plaintiff's decedent, a passenger killed aboard the Korean Airlines flight shot down by the Soviets, purchased his ticket from a travel agent in Montreal, Canada. In arriving at this conclusion, the court rejected the argument that the decedent was to leave from New York, make intermediate stops in foreign nations, and then return to New York, and refused to look beyond the face of the ticket in determining the passenger's destination.

Stanley Dorman, a resident of New York, was employed by a Canadian company, Banff Ltd. Banff purchased a round trip ticket on Korean Air Lines (KAL) for Dorman in Montreal, for travel from Montreal to the Orient, with an intermediate stop in New York. Banff then mailed the ticket to its employee Dorman, who boarded the KAL flight in New York, which was subsequently shot down by the Soviet Union over the Sea of Japan. Banff purchased the ticket in Canada because it was cheaper than if it had been purchased in New York. KAL moved to dismiss Dorman's action for lack of jurisdiction, based on the argument the United State was not the proper venue under the terms of the Warsaw Convention, since the ticket had been purchased in Canada and not the United States. The motion was granted and Dorman's action was dismissed.[23]

Exclusivity of the FSIA as a Source of Jurisdiction

> A district court has addressed the issue of whether the FSIA is the exclusive source of jurisdiction over a foreign sovereign, even in instances where another federal statute may confer

[23] In Re Korean Air Lines Disaster of September 1, 1983, 664 F.Supp. 1478 (1986).

jurisdiction.[24]

Where a defendant is a foreign business organization doing business in the United States plaintiffs may proceed in state or federal court. They may obtain service on the organization's registered agent or corporate representative in the United States, or through long arm statutes for the plaintiff's selected forum. The general considerations of subject matter and *in personam* jurisdiction and convenient forum apply.

C. GOVERNMENT CONTRACTOR DEFENSES

Where an aircraft manufacturer has designed, selected materials, manufactured, tested, and provided instructions for operation and maintenance including appropriate cautions and warnings for aircraft and aircraft components according to government specifications, courts have been reluctant to find product liability on allegations of negligent design and product defect. Different courts have formulated varying tests and standards to be used in evaluating alleged contractor wrongs. The United States Supreme Court granted certiorari in a recent case, Boyle v. United Technologies Corp., to help reconcile different tests used by the Circuits and settle the question of applicability of negligence and strict liability standards.[25] This case has an importance beyond that of government contractor aircraft

[24] Sehr, supra note 2 at 88.

[25] Boyle v. United Technologies Corp., 108 S.Ct. 2510 (1988).

manufacturers because it recognized the need for predictable tort law in areas of manufacturing where United States standards and controls are pervasive. Manufacturers of civil aircraft must also conform to uniform federal standards and specifications, from design through manufacture and lifetime service of its aircraft, so long as they are in business and retain the Federal Aviation Administration type certificate for the aircraft. The major difference, of course, between civil and military aircraft is that with military and other government aircraft, the end customer is directly involved, or should be, in every important aspect of an aircraft's design, development, production, use and retirement. The civil aircraft customer usually purchases the aircraft "off-the-shelf," whether new or used and has no input or expertise in design, or selection of materials and manufacture. He has to rely on the prudence of Federal minimum standards and the manufacturer's faithfulness in meeting the federal and industry standards for the product. Washington, D.C. lawyers Patricia Gilmore and Julie Day characterized the status of government contractor defense following the Supreme Court's decision in Boyle as follows:

> In Boyle v. United Technologies Corp., 108 S. Ct. 2510 (1988) the United States Supreme Court established a new and sweeping "government contractor defense." This new federal defense applies in both federal and state courts, and immunizes a contractor from liability for design defects in equipment built to government-approved specifications. In establishing this defense, the Court's majority found that United Technologies could not be held liable for the allegedly dangerous design of a CH-53D

military helicopter because the government had specifically approved that design. The defense applies when: (1) the United States approves reasonably precise specifications, (2) the equipment conforms to those specifications, and (3) the contractor warns the United States about the dangers of the use of the equipment which are actually known to the contractor but not known to the United States.

The Boyle formulation of the defense is similar to the one adopted in the seminal case of McKay v. Rockwell International Corp., 704 F. 2d. 444, 451 (9th Cir. 19483), cert. denied, 464 U.S. 1043 (1984). In fashioning the test, the Court in Boyle analogized to the "discretionary function" defense available under the Federal Tort Claims Act.

The Supreme Court explicitly rejected a more stringent test adopted by the United States Court of Appeals for the Eleventh Circuit in Shaw v. Grumman Aerospace Corp., 778 F. 2d. 736, 746 (1985), cert. denied, 108 S. Ct. 2896 (1988). Under the Shaw test, the contractor would be immune from liability only if: (1) it participated minimally or not all in the product's design, or (2) if it warned the government of alternative designs reasonably known to it, and the government, despite the contractor forewarning, clearly authorized the contractor to proceed with the dangerous design.

At the time Boyle was decided, four cases raising the government contractor defense were pending before the Supreme Court. The Court denied certiorari in three of these cases, in which the courts of appeals had adopted versions of the government contractor defense similar to that adopted in Boyle. Dowd v. Textron, Inc., 792 F. 2d. 409 (4th Cir. 1986), cert. denied, 108 S. Ct. 2897 (1988); Tozer v. L.T.V. Corp., 792 F. 2d. 403 (4th Cir. 1986) cert. denied, 108 S. Ct. 2897 (1988); In re "Agent Orange" Product Liability Litigation, 818 F. 2d. 187 (2d. Cir. 19487), cert. denied, 108 S. Ct.2898 (1988).

Curiously, however, the Court also denied *certiorari* in the Shaw case - which, as noted, had adopted a different test - and did not vacate and remand for further consideration in light of its decision on Boyle.

> Boyle was an action brought under Virginia tort law, whereas Shaw was an action brought under the Death on the High Seas Act (DOHSA). The Court's rationale in Boyle rested largely on notions of federal preemption of state law. That reasoning would not necessarily apply to liability imposed by a federal statute such as DOHSA. Instead, the constitutional basis for recognizing the government contract defense in the DOHSA (or other federal law) context would probably be separation-of-powers concern - an area that the Supreme Court avoided in Boyle. It is likely, therefore, that the Supreme Court sees a possible distinction between federal and state-imposed liability for purposes of the government contractor defense.
>
> The denial of *certiorari* in Shaw, however, should not be seen as approval of the Shaw test for federal law claims. On the same day it denied *certiorari* in Shaw, the Court also denied *certiorari* in Tozer, another DOHSA case, in which the United States Court of Appeals for the Fourth Circuit had applied the test ultimately adopted in Boyle. It can only be assumed that the Supreme Court is not ready to address the issue of a government contractor defense in the federal statutory context. Indeed, the Boyle majority noted in a footnote that "the dissent's assumption that the outcome of this case would be different if it were brought under the Death on the High Seas Act.... is not necessarily correct. That issue is not before us, and we think it inappropriate to decide it in order to refute (or, for that matter, to construct) an alleged inconsistency. Boyle, 108 S. Ct. at 2518.[26]

In 1990 the Boyle test was applied in a case arising out of the crash landing of an Army National Guard helicopter following engine failure from alleged product defect.[27] In MacGuire v. Hughes the trial court granted summary judgment, because, as in Boyle, the helicopter engine had been designed

---

[26] Gilmore and Day, supra note 5, at 49.

[27] Maguire v. Hughes Aircraft Corp., 912 F.2d. 67 (3rd. Cir. 1990).

and built to military specifications. The judgment was affirmed on appeal.

Another post-Boyle federal case brought in the Southern District of Ohio involved the crash of a USAF Boeing EC-135N, a model belonging to a family of aircraft which includes the civil model Boeing 707 airliner. This aircraft was cruising at 29,000 feet when it disappeared from FAA air traffic control radar and crashed in Maryland. There were no survivors. The aircrew had made no distress radio calls. The USAF accident investigation, which included the examination of the wreckage, found the stabilizer pitch trim was in the full "nose down" position, and that the resulting negative G forces caused loss of alternating current (A.C.) electrical power necessary for the pilot to re-trim the stabilizer. The aircraft had no manual stabilizer trim capability in event of complete A.C. power failure. When the electric stabilizer trim system malfunctioned, it caused loss of control of the aircraft, which disintegrated in the high speed loss of control descent. The plaintiffs alleged design and manufacturing defects in the aircraft's trim system and autopilot. The trial court granted summary judgment for defendants under the government contractor defense. The appellate court affirmed in a careful and detailed forty-three page analysis of the facts as applied to the government contractor immunity defense test.[28]

---

[28] In re Aircraft Crash Litigation, Frederick, Maryland, May 6, 1981, 752 F.Supp. 1326 (S.D. Ohio 1990).

D. USE OF NATIONAL TRANSPORTATION SAFETY BOARD REPORTS

In Curry v. Chevron, USA and Kept v. Sikorsky Aircraft[29] the surviving passengers and estates of deceased passengers brought actions to recover damages arising out of the crash of a Sikorsky helicopter transporting workers to and from oil rigs in the Gulf of Mexico. The survivors stated that five to ten minutes after takeoff from an oil drilling platform they heard a loud snap coming from above and towards the center of the helicopter, followed by violent vibration and crash into the sea. The plaintiffs' claims were consolidated for trial against the remaining defendant Sikorsky. Plaintiffs' expert testified that, in his opinion, the failure of a main rotor blade caused the accident. The expert based his opinion partly on findings in the NTSB Probable Cause Report which the trial court admitted into evidence. Rule 703 provides: "The facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to him at or before the hearing. If a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence." The court of appeals held that such evidence was not admissible under language of the Act establishing NTSB which states "[n]o part of any report or reports of the National Transportation Safety Board relating to

[29] Curry v. Chevron, USA, 779 F.2d. 272 (5th Cir. 1985).

any accident or the investigation thereof, shall be admitted as evidence or used in any suit or action for damages growing out of any matter mentioned in such report or reports."[30] The court of appeals reversed and remanded the cases on this and other findings.[31]

In another case where the plaintiff's expert witness relied on factual data from an NTSB investigation report but apparently avoided use of the probable cause findings in his testimony. The trial court admitted and the appellate court affirmed use of such evidence.[32]

In another case brought against Cessna Aircraft Co. in Missouri for damages arising out of a crash occurring in Canada, the trial court admitted into evidence "factual findings" of the Canadian Aviation Safety Board report. The Court held that the report fell within the hearsay exception of Federal Rule of Evidence 803 (8)(c). The Court also allowed to stand certain statements in the report which were technically double hearsay.[33]

E. STRICT LIABILITY

Strict liability may arise when an injury occurs from proper use of a defective product, even if the product was

---

[30] 49 U.S.C. §1441(e).

[31] Id. at 274.

[32] Sehr, supra note 5, at 169.

[33] Id. at 171 (citing First National Bank v. Cessna Aircraft Co., Av. Lit. Rep. (Andrews) 6653 (W.D. Mo. Feb. 24, 1987)).

not negligently manufactured or marketed. Both the manufacturer and seller may be liable and privity of contract is not a defense. Most jurisdictions have adopted the doctrine of strict liability under §402 of the Second Restatement of Torts, which provides, in part:

> (1) one who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if
> (a) the seller is engaged in the business of selling such a product, and
> (b) it is expected to and does reach the user or consumer without substantial change in the condition in which it is sold.
>
> (2) The rule stated in Subsection (1) applies although
> (a) the seller has exercised all possible care in the preparation and sale of his product, and
> (b) the user or consumer has not bought the product from or entered into any contractual relation with the seller.[34]

Courts have held that product defect includes manufacturing and design defects and failure to warn.[35]

Because warning a user of a product's characteristics may serve to insulate a manufacturer from liability or at least invoke comparative negligence, contributory negligence or assumption of risk as a defense, manufacturers have provided warning and caution placards to general aviation aircraft owners and operators that have been

---

[34] See 63 Am.Jur.2d Products Liability §§ 537-38 (1984) for a summary of jurisdictions adopting or rejecting § 402A.

[35] Scott Gordon Knight, Products Liability: Component Part Manufacturer's Liability for Design and Warning Defects, 54 J.Air L. & Commerce 215 (1989).

described as impractical. The following placard which a manufacturer provided and which was to be installed in the aircraft within view of the pilot reads:

> Prior to flight following exposure to rain, sleet, snow or after fueling from an unfiltered fuel source:
>
> 1. Drain and catch the contents of the gascolator, wing, and (if equipped) reservoir tank sumps and check for water contamination.
>
> 2. Place the airplane on a level surface and lower the tail to within five inches of the ground (on nose-gear airplanes).
>
> 3. Rock the wings 10 inches up and 10 inches down at least 12 times.
>
> 4. Drain and catch the contents of the fuel gascolator wing, and (if equipped) reservoir tank sumps and check for contamination.
>
> 5. If water is found in step four, repeat steps three and four until no additional water is detected, or drain the entire fuel system.
>
> The placard takes up a great deal of space, pertains to procedures which are performed *outside* the cockpit and which cannot be performed alone, and seems to place responsibility for a serious design defect on the pilot of the aircraft.[36]

Where warning placards appear to be issued out of liability concerns of the manufacturer above safety of flight concerns, some commentators have complained in publications serving aircraft owners and pilots.[37]

In Kay v. Cessna Aircraft Co., 548 F. 2d., 1370 (9th

---

[36] James E. Link, II, Placards, Warning Labels and Operation Manuals: An Aircraft Manufacturer's Duty to Warn, 5 J.Air L. & Commerce 265, 266 (1990).

[37] Id. (citing Miller, Placards, Placards Everywhere, AOPA Pilot Magazine, Jan. 1987, at 103).

Cir. 1977) the trial court found that the manufacturer was not liable in the crash of a Cessna 337 Skymaster where the pilot decedent attempted takeoff in this twin engine aircraft where one engine, the rear engine in this in-line twin, had stopped prior to the takeoff. The manufacturer's operating instructions required engine functional checks and inspection of engine instruments by the pilot prior to takeoff and warned against takeoff with engine malfunctions. The appellate court affirmed the trial court's judgment for the defendant not withstanding the jury verdict.[38] In a later case, Rehler v. Beech Aircraft Corp., the jury found for the defendant and the court of appeals affirmed, where plaintiff alleged a failure to warn of aircraft spin characteristics.[39] The same manufacturer was found negligent for product defect and failure to warn where elevator trim tab actuators were installed in reverse by a mechanic causing the crash of a Beech Baron. The actuators could not be distinguished visually and plaintiff alleged that the aircraft manufacturer's failure to warn mechanics was negligence. The industry standard for control mechanisms is that they be "Murphy proof" such that the parts cannot be reversed inadvertently.[40]

Where a state has adopted the provisions of strict liability as set out in Second Restatement §402(a) by its own

---

[38] Kay v. Cessna at 1371.

[39] Rehler v. Beech Aircraft Corp., 777 F.2d 1072 (5th Cir. 1985).

[40] Id. (citing Nesselrode v. Executive Beechcraft, Inc., 707 S.W.2d. 371 (Mo. 1988).

statutes, and permits recovery for injuries caused by a defect, it may exclude punitive damages where the plaintiff has alleged only strict liability. In Barnwell v. Barber-Colman Co., 393 S.E.2d. 162 (1989) the South Carolina Supreme Court held that the plaintiff could not recover $2,800,000 in punitive damages awarded in the jury's verdict. In a dissenting opinion Justice Finney listed a number of case citations where states award punitive damages in strict liability actions.[41]

F. MULTIDISTRICT LITIGATION: CHOICE AND CONFLICT OF LAWS

In 1968, the United States adopted the Multidistrict Litigation Act (MLA) to facilitate more efficient consolidation of federal cases.[42] The Judicial Panel on Multidistrict Litigation (JPML) has the authority and responsibility to transfer civil actions for coordinated or consolidated proceedings.[43] Where common issues of law and fact exist, they can most efficiently, and perhaps most fairly, come before one court. Use of the JPML has not necessarily simplified choice of law questions in aviation cases, or insured efficiency.

> The present choice of law methodology for multidistrict litigation virtually assures forum shopping as well as wide disparity in the compensation awards of airplane crash victims....In the case In Re Disaster at Detroit Metropolitan Airport, the court examined the product liability laws of Michigan (the place of the injury), California (where the alleged defective parts were produced), Missouri (McDonnell Douglas Corporation's

[41] Barnwell, 393 S.E.2d at 164.

[42] Mulitdistrict Litigation Act § 28 U.S.C. § 1407 (1988).

[43] Id. at § 1407(d).

> principal place of business), and Arizona (the plaintiff's domicile)....The court selected California law to govern the product liability claims....The court then conducted the choice of law process eight more times on the issue of the availability of punitive damages, and required that the parties brief the law issue with regard to compensatory damages....[which required] another four trips through the choice of law process....As the Detroit case illustrates, the multidistrict transferee court applies the law of no existing jurisdiction to the cases; a collage of law governs because of depecage.[44]

[44] Kyle Brackin, Salvaging the Wreckage, Multidistrict Litigation and Aviation, 57 J.Air L.& Commerce 665, 675 (1992).

Chapter III - PRODUCT LIABILITY: AVIATION SAFETY AND UTILITY

A. PRESENT TRENDS

Unless one is prepared to argue, and support their arguments with facts, that old airplanes are safer and more utilitarian than new airplanes, then it seems clear that product liability actions against general aviation aircraft manufacturers adversely affect safety. The industry delivered almost 18,000 new aircraft in 1978 when their cost of product liability insurance was about $24 million per year. By 1985 that cost had risen to $210 million per year.[1] Production fell, and at this time in 1993, the three major American companies that historically produced general aviation aircraft in quantity have:

1. gone bankrupt, and may be purchased by a foreign investor and relocated outside of the United States (Piper Aircraft Company);

2. ceased manufacturing all piston engine aircraft and has been sold by its parent company (Cessna Aircraft Company); and

3. ceased manufacturing trainer and entry-level piston engine aircraft (Beech Aircraft Company).[2]

At the same time, general aviation is becoming more important as business transportation in the United States and Canada. In the U.S., deregulation of the airline industry has

---

[1] James D. Gormley, Speech before the Canadian Aircraft Owners and Pilots Association, Edmonton, Canada, June 22, 1991.

[2] National Transportation Safety Board, Annual Report (1992).

forced a consolidation of airline companies, and economic pressures have caused the surviving major airlines to curtail or stop service altogether at smaller cities and towns. Concentration of airline traffic into the airports of big cities and dense population areas is making those airports off limits or costly in terms of time and expense for general aviation use. This problem exists in Canada, also. Dennis Green, Chairman of the Board of the Canadian Business Aircraft Association has said the question of access to larger airports is becoming a serious concern. As satellite and reliever airports near major metropolitan areas become more important for flight access, the general aviation fleet becomes ever more important to business and personal travel.

B. LIMITATIONS ON AIRCRAFT PRODUCTION

How will that fleet be replenished with new airplanes? The Chairman of Cessna Aircraft Company, Russell W. Myer, Jr., has repeatedly said that when tort reform is enacted, his Company will begin making plans within 24 hours to get back into the light, piston engine airplane business. Cessna is an experienced supplier of splendid, safe airplanes. Most of the American fleet of about 194,000 piston engine airplanes were built by Cessna. The company ceased production of these airplanes in 1986 solely due to product liability costs.[3] Cessna continues to build turbine and turbo-prop

[3] *Ibid.*

business aircraft where product liability costs can be absorbed in their multi-million dollar sales price, and where risks are less since these aircraft are normally piloted, maintained and managed by aviation professionals. Are new Cessna aircraft safe and utilitarian? The least expensive of these aircraft, the single engine Cessna Caravan, has a 99.8 % dispatch reliability rate in around-the-clock and all-weather operations with Federal Express Corporation. The United States Air Force has used Cessna entry-level trainers for more than thirty years, and now must shop foreign markets for trainers that will not be as safe or effective.

America's youth have learned to fly in light aircraft that were available and affordable to the small fixed-base operator. There are no such new American made aircraft available; product liability costs have killed that business. America's national security and future competitiveness in air and space have already been compromised.[4]

In his speech to the Canadian AOPA, Mr. Gormley also noted:

1. Cessna Aircraft Company was required to pay a multi- million dollar judgment in a case involving their Skyhawk model 172 aircraft where the alleged aircraft defect as a cause of the accident was speculative. This particular model aircraft has consistently proved to be the safest

[4] *See* Appendix One.

of of its type, and was sold new for decades for less than $25 thousand. It is possible that this single judgment cost exceeded Cessna's net profit on this model over the preceeding decade.

2. A pilot in New Mexico removed the front seat of his Piper aircraft and mounted a large cinema camera on a wood frame to film a glider tow and, with his view impaired, attempted take off from the rear seat. The airport operator who objected to the proposed photography, parked a van on the runway to block the takeoff. The pilot attempted to take off, crashed into the van, and sued Piper for alleged limited visibility from the rear seat. He obtained a judgment of more than one million dollars against the manufacturer.[5]

3. One general aviation manufacturer in a four year period was sued 203 times for accidents where federal accident investigators had not found manufacturer fault. The manufacturer won more than 90% of these cases, but the average cost to the manufacturer of the 203 cases was $530,000.00 each.

---

[5] See Appendix Two.

4. Teledyne Continental Motors, manufacturer of the engines which powered Voyager on its round the world non-stop flight, reported to the U.S. Senate Judiciary Committee that the cost of product liability on new engines had increased from $300.00 per engine in the 1970's to an average of $15,700.00 per engine for the four year period of 1986-1990.

5. Piper's chief counsel testified before Congress in 1990 "The exponential increase in number and size of verdicts and settlements has driven hundreds of aviation component manufacturers out of business....On the average, 3/8 work hours, or $12,000.00 is spent every time a vendor tells us he can no longer risk supplying a product for aviation application." New vendors must be found each time this occurs.

6. In 1978, the domestic industry delivered close to 14,400 single-engine, piston-powered airplanes....We were down to 8,650 in 1980, 1370 in 1985 and 608 in 1990 - a 93% drop in unit shipments over the past eleven years.

C. AIRCRAFT AND PILOT FACTORS

As aircraft age, parts wear out and deteriorate. When corrosion and metal fatigue occur in structural parts of the airframe there can be dangerous weakening, and in time structural failure in flight. Engines, propellers and all other moving and non-moving mechanical and electrical parts suffer and fail with age. Manufacturers have repeatedly proposed more careful and stringent federal inspection and repair standards for aging aircraft. Some aircraft owners who must bear the additional expense and their interest groups have vigorously opposed tougher, and more expensive, inspection and repair standards. Recurring accidents in some of the higher performance and aerodynamically clean general aviation aircraft indicate that better and more closely supervised training and evaluation of pilots would make flight in these airplanes safer. Manufacturers have supported Federally mandated minimum standards of training and aircraft type ratings in these aircraft, and often offer this training to pilots. This specialized training is costly and, again, those who must bear the costs, aircraft owners and pilots, have at times opposed it and have had their membership organizations lobby against it. Aircraft owners and pilots outnumber manufacturers so their positions often prevail over those of the airplane manufacturer.

D. RESPONSIBILITIES OF THE BAR

Lawyers have great power in numbers and resources in the courts, and in state and federal legislatures and administrations. Most lawyers are advocates for consumers and plaintiffs. If numbers alone are to prevail, those relatively few manufacturers and their counsel are going to lose every time in the matter of legal tort reform that will lower the costs of product liability such that general aviation piston engined aircraft can be economically produced and sold in the United States. It is going to require statesmanlike, cooperative efforts by all interests and their lawyers to achieve tort reform for this industry. As one distinguished and eminently successful aviation plaintiff's attorney has observed, "We are killing the geese that have laid our golden eggs." When tort reform has been achieved and manufacturers have resumed volume production of profitable light aircraft, manufacturers will be able to improve designs and quality afforded by modern technology. In the present legal climate, manufacturers cannot feasibly admit fault and correct defects, and are reluctant to introduce new technology in their smaller, least profitable aircraft. Punitive sanctions against a manufacturer who will not correct defects should come from administrative and criminal actions. Punitive damages awarded to plaintiffs in general aviation accident litigation have probably reflected plaintiff lawyer's skills and the availability of expert witnesses willing to support hypothetical theories of cause, much more than actual wanton, willful, malicious or criminal misconduct by manufacturers. This is evident in that manufacturers routinely fly their own products, and common sense precludes willful or malicious acts towards one's self. Punitive civil action money damages have had no evident useful purpose in improving general aviation product safety. If they cannot be eliminated in tort reform it seems that they could best be applied to improved general aviation pilot training, supervision and evaluation on an on-going and recurring basis.

E. RESPONSIBLILITIES OF AVIATION INTERESTS

Professional pilots flew about one-half of the 33.6 million general aviation hours flown in 1988. Pilots not flying as their occupation flew the remaining one-half, 16.8 million hours. Those pilots not flying professionally experienced more than eighty percent of the serious personal injury and death accidents. NTSB investigations have consistently found pilot error to be a cause in more than eighty-five percent of general aviation accidents.[6] The need for better training, supervision and evaluation of general aviation pilots has been recognized by the AOPA Air Safety Foundation. Federal Agency actions have proved effective in causing manufacturers to correct defects in light aircraft and

[6] Robert Martin, General Aviation Manufacturing, an Industry under Siege, The Liability Maze; The Impact of Liability Law on Safety and Innovation, The Brooking Institution, 478 (1991).

examples of this are the adoption of counter rotating propellers by one manufacturer to alleviate stall-spin accidents, restrictions of center of gravity limits, operating limitations imposed until deficiencies were corrected, recalls for modification, grounding a manufacturer's aircraft model until defects are corrected, required advisories and warnings to operators, and withdrawing airworthiness certification.[7] Federal Agencies have the power to put a non-complying manufacturer out of business.

The costs of litigating product liability lawsuits are so expensive for plaintiffs and defendants that other compensation procedures should be considered. Piper Aircraft Company, before it entered bankruptcy, reported that its legal defense costs exclusive of settlements and judgments averaged a quarter of a million dollars every month. Russel W. Myer, Jr., CEO of Cessna Aircraft Company, has emphasized that as they continue to build excellent aircraft and emphasize professional pilot training and good pilot judgment, their product liability costs increase even as their safety record has improved. The General Aviation Manufacturers Association, GAMA, has pointed out consequences of a 65 % drop in employment in the industry, increasing age of aircraft in service, and foreign manufacturers moving rapidly in to fill the void. One English publication, Air Pictorial, stated, "There is an international

---

[7] Andrew Craig, Product Liability and Safety in General Aviation, The Liability Maze,The Impact of Liab.lity Law on Safety and Innovation, The Brooking Institution, 456 (1991).

market advantage at hand for European companies if the issue is handled with vision." The United States recently transferred some of its most advanced aviation research and technology to Japan with virtually no conditions on its use in economic competition. Within a few years it can be expected that member nations of the European Economic Community, former Communist Bloc States, and Japan will be moving aggressively to fill the general aviation void in America. None of these Nations has a liability burden of a fleet of aircraft in use in America creating high liability costs. Their products will reflect the price advantage, although, in flying safety, their products do not approach the safety and reliability of United States manufactured aircraft. However, as FAA has succinctly stated, "Foreign manufacturers do not have that liability anchor around their neck."[8]

F. NATIONAL SECURITY AS AFFECTED BY THE AVAILABILITY AND USE OF GENERAL AVIATION AIRCRAFT

GAMA gathers and publishes a great deal of statistical information useful for analyzing aviation trends other than manufacturing. Following are some examples and they do not show positive trends for a nation that has rapidly grown in population while competing against advanced nations that in some instances outperform America in educational achievement for their youth and productivity for their adults.

- America had 824,677 registered pilots in 1979 and

[8] General Aviation Manufacturers Association, Washington, D.C., (1991).

700,010 in 1989;

- there are more pilots in the age group 50 - 54 than 20 - 24;
- in 1979 there were 140,000 new student pilots and in 1989 there were 88,926;
- general aviation aircraft flew 43 million hours in 1979 and 35 million hours in 1989;
- the United States exported 3,995 general aviation aircraft in 1979 and 566 in 1989.[9]

In the recent war against Iraq, air power was decisive and one U.S. Infantry general observed that no American infantryman has lost his life to enemy air action in almost forty years. Although the collapse of Communism as a major political system in Europe has made that area much safer for America at this time, the political future of former East Bloc Nations is not clear. They retain large armies, backed in some instances with nuclear weapons. The former Soviet Union may have served as a stabilizing force on other Communist nations such as North Korea. If we accept that the predatory nature of men and nations prevails, we must do all that we can to protect America and the values it cherishes. Advanced technology and youth attracted to learn and become proficient in its use are essential to America's safety. Flying is much more than slipping the surly bonds of earth and dancing on laughter-silvered wings, however much they remain compelling.

Frederick B. Sontag, CEO of Unison Industries,

[9] GAMA, General Aviation Statistical Databook (1990).

pointed out that American general aviation presently flies more than four times the hours of all the airlines combined, and that while the airlines serve a few hundred of our largest cities, general aviation aircraft utilize over 12,000 airports, 3,000 heliports and 400 seaplane bases - it is not a luxury, it is a national resource.[10]

In testimony before the House Sub-committee on Transportation, Aviation and Materials, October 22, 1985, Edward W. Stimpson, then president of GAMA, made the following points:

- the cost per airplane for product liability insurance increased from $51 in 1962 to $70,000 in 1985.
- some companies have experienced increases of 2,000 percent and 3,000 percent in the last four years.
- these phenomenal cost burdens are baffling to an industry whose safety record has shown improvement.
- 1985 was the best safety year for general aviation aircraft in two decades.
- The average insurance tab for airframe makers alone in 1985, was $70,000 per airplane - exceeding the selling price of many basic two and four seat aircraft.
- Ironically, only a token portion of all these costs ever reach the injured, about 17 %. The rest goes for legal fees and other expenses.
- Aviation is Federally regulated and manufacturers are supervised from initial concept and design through development flight and ground testing of the airframe and all components, manufacture, subsequent modification, and remain accountable

[10] Frederick B. Sontag, GAMA, Annual Industry Review, (1991).

for defects and their correction to the FAA. For liability purposes the laws are not uniform and differ throughout the fifty states.

- Individual manufacturers and the industry trade group, GAMA, have worked in conjunction with FAA to improve aircraft and pilot safety.

The Tort Policy Working Group of the U.S. Attorney General reported that between 1974 and 1985, there had been a 758% increase in the number of product liability lawsuits filed in federal District Courts, and that a survey of punitive damage awards in Cook County, Illinois, indicated that the average personal injury punitive damage award (measured in constant 1984 dollars) increased from $40,000 in 1970-74 to $1,152,174 in 1980-84.[11] The above figures are not constrained to aircraft manufacturer liability but show the upward spiral in these costs for several major industries which must be passed on in the price of products and services.

Some uniformity exists in liability limits for air carriers, as achieved in International Treaties and accords such as The Warsaw Convention and Montreal Agreement. These liability limitations have helped to protect air carriers but also have shifted some of the burden of passenger insurance to aircraft manufacturers. Judge Bertelsman in the litigation arising out of the Air Canada accident at Cincinnati made the remark: "it is obvious that if these Plaintiffs are going to have meaningful recovery they're going to have to go after the products

[11] Richard K. Willard, Report, Tort Policy Working Group, (1986).

defendants."[12] In general aviation accidents the owner and pilot often have limited insurance or may be uninsured, and are effectively "judgment proof" for injuries and death caused in the crash of their aircraft. Injured plaintiffs and their counsel turn to possible defendants who have adequate insurance, including manufacturers. In jurisdictions with joint and severable liability laws, a defendant found negligent in the smallest amount as a cause of the accident may have to bear the entire costs of a judgment for the plaintiff.

G. NECESSARY TORT REFORM

Senator Nancy Landon Kassebaum is one of a number of legislators who have proposed tort reform legislation, specifically addressed to the liability problems of the general aviation industry. In a Floor Statement to the U.S. Senate on March 7, 1991. Senator Kassebaum said, in part:

> There is no uniform standard which applies to liability cases for this industry....Close examination of the problems plaguing the general aviation industry is critical if we are going to help this industry survive....We have witnessed a dramatic decline in the sales of general aviation planes - over 90 %. In the process, we have lost thousands of high-technology manufacturing jobs... when the European Community consolidates its markets in 1992, our domestic industries will face new challenges in the trade arena....our foreign trading partners are readying their planes for export to our country... the need for a uniform federal product liability standard is clear....The federal Government regulates the industry from design to production; the air traffic control system is federally operated and regulated (and its liability is uniformly fixed by

[12] Ian Awford, Developments in Aviation Products Liability, 1 (1985).

> federal standards) The federal interest and presence in aviation is all pervasive except in one area....litigation is conducted under individual and widely varying State laws....General aviation is a major part of our national air transportation system and is today facing a crisis of unprecedented proportions which is related to the tort system.

Senator Kassebaum and other members of the House and Senate, with support of the U.S. Administration and industry - pilots and aircraft owners and their member organizations, have proposed modest tort reform to help the general aviation industry since 1985 - without success. The organized efforts of the plaintiff's bar have thwarted every legislative proposal.

It is far past the time when plaintiff's attorneys should very carefully and candidly weigh the damage that is being caused America by loss of the manufacture of the affordable and safe airlines that have attracted and trained the Nation's youth for generations, and that have served as the world standard in quality.

It is far past the time when members of the United States House and Senate should responsibly act to preserve the future safety of aviation, flight training of the Nation's youth, an industry that has provided good jobs at home and high income from sales abroad, and an industry that is essential to national security.

The aviation industry must design and manufacture its products to uniform, federally mandated standards, and should be held accountable to uniform standards of liability.

United States industry must be competitive with that of other nations and regions. The European Community is implementing products liability statutes of repose of ten years. Most American jurisdictions have no statutes of repose for defective products. At Chapter V is a proposed House and Senate bill that would secure better uniformity in litigation for plaintiffs and aircraft manufacturers, and which should economically serve the interests of all parties to aircraft product liability cases.

Chapter IV INVESTIGATING AN AIRCRAFT ACCIDENT

A. INTERNATIONAL OPERATIONS

The Convention on International Civil Aviation, adopted in Chicago, Illinois, on December 7, 1944, (The Chicago Convention) placed a requirement on signatory nations to investigate civil aviation accidents and placed responsibility on The International Civil Aviation Organization (ICAO) to oversee this. Article 37 states in part:

> The International Civil Aviation Organization shall adopt and amend from time to time, as may be necessary, international standards and recommended practices and procedures dealing with (k) aircraft in distress and investigation of accidents; and such other matters concerned with safety, regularity, and efficiency of air navigation as may from time to time appear appropriate.

Individual nations conduct investigations to their own standards. Larger nations, and those with intense air traffic, often must investigate accidents involving foreign aircraft. Thorough investigations require intensive work in the field, offices, shops and laboratories. Factors considered include: weather, air traffic control, navigation, as well as mechanical or structural failures of the aircraft or its components, its maintenance history, as well as all of the possible factors affecting the aircrews' medical conditions and qualifications, negligence, error or misconduct.

Because every aspect of investigation is complex, experts are needed. Cost and availability is often a problem. ICAO is able to assist member states in their investigations, however, for practical reasons, thoroughness is not always assured or required by law. ICAO assistance is available only for major accidents, usually those involving international airline flights. Most aircraft accidents must be investigated according to a nation's own resources and to its own standards.

Volume IX of Air Law contains articles by a diverse and highly qualified panel of experts with aircraft accident investigation interests. These articles focus on the international standards for aircraft accident investigation as expressed in ICAO documents, and on the procedures and standards that have been adopted by individual nations. Portions of these articles which are pertinent to this thesis are quoted throughout the body of the text. Other interests beyond those of the international community and those of individual nations affect the scope and quality of investigations. These include the interests of private organizations representing: manufacturers of aircraft and aviation products, airline companies, airline and commercial pilots, air traffic controllers, private aircraft owners and pilots, and the insurers of all these persons.

Dr. Michael Milde, Principle Legal Officer of the ICAO Legal Bureau, comments as follows:

> International legal regulation of aircraft accident investigation is - as aviation itself - a phenomenon of rather recent history. There are no deeply-rooted principles of general customary international law and no international law making treaties on this subject. In the early development of international air law, analogies with the traditional international maritime law played their role, but in the field of maritime law, international rules on investigation of

accidents are next to nonexistent.

It would not be realistic to expect that the existing framework of international law would provide any unequivocal guidance on the conduct of aircraft accident investigation or on the harmonization of the different competing and conflicting interests in such an investigation.

The first comprehensive 'charter' of international air law - the Paris Convention on Air Navigation of 1919 - did not contain any provision on the investigation of aircraft accidents. The body established by that Convention - the International Commission for Air Navigation (ICAN) - adopted during its prewar existence a certain number of resolutions of a purely recommendatory character on the desirability to hold a *technical investigation* into the causes of an accident; the predominance of the domestic law of the State on whose territory the accident occurred was emphasized in those resolutions; it was also emphasized that such a technical investigation was to be entirely independent of the police, judicial or other investigation provided for by the applicable laws.

The Chicago Convention on International Civil Aviation of 1944 - the present-day 'charter of international air law' - in its Article 26 provides: "*Investigation of accidents* In the event of an accident to an aircraft of a contracting State occurring in the territory of another contracting State, and involving death or serious injury, or indicating serious technical defect in the aircraft or air navigation facilities, the State in which the accident occurs will institute an inquiry into the circumstances of the accident, in accordance, so far as its laws permit, with the procedure which may be recommended by the International Civil Aviation Organization. The State in which the aircraft is registered shall be given the opportunity to appoint observers to be present at the inquiry and the State holding the inquiry shall communicate the report and findings to that State."

This provision is the basic and only conventional rule of international air law on investigation of accidents and its scope is rather limited. Its main elements are:

- the State of occurence has the *duty* to institute an investigation ('inquiry') into the accident in its territory;
- such duty exists only with respect to *foreign* aircraft;
- the investigation is to be conducted in accordance with the procedures recommended by ICAO (but only as far as the domestic law permits);
- the State of registry of the aircraft may appoint observers to be present at the 'inquiry'; and
- the report and findings are to be communicated to the State of registry. From the legal point of view, it is important to emphasize the phrase of Article 26 according to which the inquiry is to be instituted: 'in accordance, *so far as its laws permit,* with the procedure which may be recommended by the International Civil Aviation Organization:' this provision underlines the supremacy of domestic law over any procedures which may be recommended by the Organization.

Article 26 of the Chicago Convention raises more questions than it answers; it does not clarify:

- what is an accident;
- what is the purpose of an investigation;
- how does the investigation under Article 26 relate to other investigations, such as a police or coroner's inquiry, or judicial investigations;
- who are the participants in the investigation and how are their possibly conflicting interests harmonized;
- what are the rights of the observer appointed by the State of registry;
- what is the evidentiary value of the report and findings and what publicity are they to be given, etc.

On 11 April 1951, after years of deliberations in different bodies, the Council of ICAO adopted the Standards and Recommended Practices for Aircraft Accident Inquiries pursuant to Article 37 of the Chicago Convention and designated them as Annex 13 to the Convention; that Annex became applicable on 1 December 1951 and in its amended version represents the body of international law governing aircraft accident investigation.[1]

All governments, private and corporate persons, and organizations having an interest in the investigation of a particular aircraft accident may seek to participate in or have concurrent knowledge of the investigation. ICAO, in Annex 13 to the Chicago Convention, has addressed these interests and provided for participation in investigations and/or access to evidence and reports. Dr. Milde explains the ICAO policies and procedures as follows:

> Participation in the investigation should confer entitlement to visit the scene of the accident, examine the wreckage, question witnesses, have full access to all relevant evidence and documents and to make submissions in respect of the various elements of the investigation. The Annex emphasizes the need to co-ordinate the investigation with the judicial authorities in the receiving and custody of evidence (eg. custody of the flight recorders prior to their read-out).
>
> In general, the Annex prescribes that the accident investigation authority shall have independence in the conduct of the investigation and have unrestricted authority over its conduct. The investigation is to include the gathering, recording, and analysis of all relevant information, if possible the determination of the cause or causes, and the completion of the Final Report in the prescribed format followed, if appropriate, by Safety Recommendations for the purpose of accident prevention and any resultant corrective action. The Annex clarifies the distribution of responsibility, necessary notifications to different authorities, the form of the preliminary report, accident data report (for ICAO computer system ADREP, which allows States fast exchange of information for preventive action) and the final report. Detailed guidance on the conduct of an investigation is contained in the ICAO

[1] Michael Milde, Aircraft Accident Investigations in International Law, in IX Air Law 61, (1984).

> Manual of Aircraft Accident Investigation (Document 6920 - AN/855), which is widely used in practice, although its legal status is only one of *guidance material* without any legally binding force.

It has been the expressed purpose by ICAO and other national and private organizations who investigate aviation accidents, that the improvement of aviation safety is the central and principle objective. The evidence gathered and its analysis as to cause is also important to person whose central and principle interests are economic or, who may even face or intend to impose criminal sanctions. Dr. Milde explains ICAO's attempts to focus its investigations on air safety and to give member States first priority for their interests.

> In its present form - Sixth Edition which has been applicable since 26 November 1981 - Annex 13 contains three specifications which are of considerable legal interest.
>
> Specification (standard) 3.1 states that 'the fundamental objective of the investigation of an accident or incident shall be prevention of accidents and incidents. *It is not the purpose of this activity to apportion blame or liability.'*
>
> Specification 5.12 relates to the disclosure of records; if a State conducting an investigation considers that the disclosure of any records might have an adverse effect on the availability of information in that or any future investigation, then such records *shall not be made available for purposes other than accident or incident investigation;* such information includes statements from persons responsible for safe operation of aircraft, communications between such persons, medical or other private information regarding persons involved in the accident, cockpit voice recordings and their transcripts and opinions expressed in the analysis of information, including Flight Recorder information.
>
> Under specification 6.15, States shall not circulate,

publish, or give access to a Final Report or any documents relating to an investigation without the express consent of the state which conducted the investigation.

The fundamental reason for the provision on non-disclosure of records is closely connected with the specification on the objective of the investigation which has been formulated as 'looking ahead' to prevent a repetition of similar accidents, rather than 'looking back' at the accident and its causes with a view to apportion blame or liability. The rationale of the specifications 5.12 and 6.15 is to be found in the interest to protect the sources of information from any interests not directly related to the strictly preventive objective of the investigation. In the AIG/79 Divisional Meeting, it was believed that in the absence of such protection, persons responsible for the safety of an aircraft might be reluctant to provide information for fear that such information might be used against them in other proceedings - whether administrative, disciplinary, criminal or in civil suits for compensation of damage. It was believed that important information vital for the prevention of similar accidents could be lost to the investigation if the persons concerned could not express themselves in full freedom and without fear of possible consequences.

The provisions of Annex 13 on the objectives of investigation and on the non-disclosure of records are not impartial and take a clear side in the spectrum possibly competing or conflicting interests; they state what was considered desirable from the point of view of a preventive safety investigation without taking into account other legitimate interests. It is of interest to note that several participants in the AIG/79 Divisional Meeting strongly supported the recommendations dealing with restricted disclosure of records while 'at the same time, indicating that their States would subsequently have to notify a difference with respect to the related Annex provisions under Article 38 of the Convention in view of the imperative provisions of their domestic legislation on 'freedom of information' and other provisions on the availability of evidence.

> The AIG/79 Divisional Meeting was not unaware of the legal realities and adopted Recommendation 73 urging that ICAO should examine the legal implications of 'freedom of information' legislation with regard to accident investigation.

The laws of ICAO member States are as diverse as those nations and peoples who are members. Confidentiality of an investigation may be totally secure in one State and wholly discoverable in another. The analysis and findings of accident investigators may be inadmissible in the courts of some states and are routinely used in both civil and criminal actions in others. In his capacity as Principal Legal Officer of ICAO, Dr. Milde has worked with the representatives of member states to hold to the Convention purposes of accident investigation, while accepting that the sovereign laws and policies of their states may prevail when conflicts occur.

> In response to a questionnaire prepared by the ICAO Secretariat, only a few States indicated that they have, at present, specific legislation permitting unrestricted access to information; however, the interpretation of the replies leads to the conclusion that even in the absence of specific 'freedom of information' legislation, in most States a person, authority or court of law may obtain access to information relating to an accident investigation under the general legal provisions, in particular, the general procedural rules of evidence, if a satisfactory legal interest in such information is proved. Again, in most States such information has to be made available in the judicial process and the court may order (subpoena) the release of any particular information for a specific purpose under conditions determined by the court.
>
> The 25th Session of the ICAO Legal Committee in April 1983 endorsed the conclusions of the Secretariat study that the Convention on International Civil Aviation (Chicago, 1944) in Article 26, stresses the supremacy of the domestic law over any procedures

> which may be set out by ICAO Investigation of aircraft accidents. It recognized that national legislation relating to freedom of information and other legal provisions relating to availability of evidence are closely connected with fundamental constitutional provisions, are imperative in nature and form part of the legal public order of the State concerned; any attempt to legislate internationally - by a standard or by an international multilateral convention - any restrictions on the freedom of information, availability of evidence and full exchange of information relating to aircraft accidents was considered *a priori*, futile and unrealistic.

The diversity in the quality of aircraft accident investigations, their availability to parties in interest, and the admissibility of physical and analytical evidence (used for many different purposes) is a case by case problem for lawyers. Dr. Milde concludes that this situation is workable and need not compromise the safety purposes of investigations.

> The existing international air law does not provide detailed guidance on the investigation of aircraft accidents with a view to harmonizing the different conflicting interests in the conduct and results of such an investigation. The existing regulation is geared predominantly to the *technical safety investigation,* the purpose of which is to prevent the repetition of similar accidents in the future but its aim is not to apportion blame or liability. Thus the international regulation of aircraft accident investigation covers only a part of the wide spectrum of different conflicting interests. However, this international regulation and the domestic legislation implementing it do not in any way prejudge or prevent the conduct of separate, distinct and independent parallel investigations carried out by police authorities, coroner's inquests or a judicial investigation, the purpose of which might be not only to prevent repetition of similar accidents, but also to seek specific determination of the cause of the accident and of the person guilty and liable to punishment or liable to compensate the damage. Ideal and desirable legislation provides for a balance of

different interests. Such a balance has not yet been achieved in international air law relating to investigation of aircraft accidents.

B. ICAO ANNEX 13 STANDARDS AND RECOMMENDED PRACTICES

Annex 13 implements the purposes and spirit of the Chicago Convention of 1944; Article 26, which calls for civil aircraft accident investigations by member States, and Article 37, which calls for establishment of standards and recommended practices for the investigations. Annex 13 has 7 Chapters which cover the following topics:[2]

Chapter 1 - Definitions
Chapter 2 - Applicability
Chapter 3 - General Provisions
Chapter 4 - Notification of Accident
Chapter 5 - Investigation
Chapter 6 - Reporting
Chapter 7 - Accident Prevention

One hundred and forty Contracting States have made no comment to ICAO on Annex 13. Eighteen States notified ICAO that they accepted Annex 13 with no reservations. Eighteen Member States have notified ICAO of differences between their National Law and Annex 13, including the United States, Canada, many Western European Nations, the USSR (Russian Federation) and Japan.

Chapter 5, Sec. 12 addresses disclosure of accident investigation records and evidence and states in part "such records shall not be made available for purposes other than accident or incident investigation," and includes such evidence as witness statements, communications, cockpit voice recordings and transcripts and medical or private information. This may

[2] See also Appendix One

be one of the most contentious areas of difference as disclosure is thought by most Member States of ICAO to impair the safety purposes of investigations. Fourteen of the eighteen States that have notified ICAO of differences in their National Law or Policy with provisions of Annex 13, focus on Chapter 5, Section 12, including the United States and Canada. In February and March of 1992, ICAO hosted a conference of Contracting States to consider proposed changes to Annex 13. Changes to Chapter 5, Section 12 were not on the agenda. Probably the most important proposal before this conference is to extend Annex 13 to include domestic civil airline accidents. This idea has firm support among North American and European Nations and makes sense because a domestic accident often involves a foreign made airliner. Other nations are concerned about intrusion on their sovereignty while acknowledging the safety benefits of more fully shared investigations and their findings. The Senior Legal Advisor to ICAO has stated that investigations of such domestic accidents fall within the law of the Chicago Convention. The International Air Transport Association (IATA) is the coordinating proponent of this change and has done an effective job in achieving international consensus in the past. Adoption of changes by member States can be slow, however.

C. THE NATIONAL TRANSPORTATION SAFETY BOARD (NTSB), UNITED STATES

NTSB investigations share the same purpose as those of ICAO. They are technical in nature. They seek to be objective and have a singular purpose - improved safety. NTSB must investigate all major transportation accidents involving public transportation, surface and air. It is required to investigate all civil aircraft accidents whether in private or commercial operations. NTSB shares many of the same problems in aircraft accident investigations with ICAO and its member nations, a lack of resources. NTSB is headquartered in Washington, D.C..

Accidents involving airliners or large commercial and private aircraft get a high priority with a corresponding allocation of resources. The small general aviation accident will have the personal attention of a NTSB Field Office investigator if it involved major injury or death, however, this investigator may well be working a number of accidents simultaneously. General aviation accidents involving minor injuries and property damage are usually investigated by a Federal Aviation Administration (FAA) District Office for NTSB. FAA participates with NTSB in all aircraft accident investigations and may assume a dominant role.

The United States Federal Aviation Administration (FAA) is a regulatory agency charged with setting standards and overseeing them for every part of aviation; from the first glimmers in an engineer's eye as he seeks to get his ideas physically airborne, until long after his machine has been retired if it is being cannibalized for parts and perhaps most American airplanes that make it to the salvage yard, even with fifty years of loyal service, serve on for parts.

Every person who designs, builds, flies, services and repairs air vehicles and all who support air operations, is accountable to the FAA. FAA participates in all NTSB aircraft accident investigations and will enquire into any potential violations of qualifications or procedures whether they were a cause or not of the accident. Therefore, FAA has the same interests of NTSB in finding the causes of accidents and correcting them, but it has a further duty of discovering and sanctioning persons who violate Federal Aviation Regulations.

Because crashing aircraft are so effective in destroying necessary physical evidence and witnesses, accident investigation is closer to art than science. Routinely, experts will differ as to cause, which complicates findings of causes and promotes litigation.

James S. Dillman, Assistant Chief Counsel, Federal Aviation Administration, Washington, D.C., has commented on a number of aspects of United States aircraft accident investigations.

> The length of time involved in the NTSB investigation and the degree to which the investigation is thorough or comprehensive depends upon a number of factors, but certainly includes the inclination of the assigned investigator and the limits of his/her budget.
>
> According to its annual reports to the Congress, the NTSB determines the probable cause of as many as 5,000 aviation accidents per year. Of those somewhere close to 1,500 were investigated by its field offices. Given the workload at any given time, the limitation of time and money, and the fact that the field investigator may or may not be particularly qualified for the specific task - to say nothing of

> his/her possible bias -, one can only speculate as to the quality of the end product. That end product, the report and analysis of the field investigator, is important not only for what it says in itself, but more so because it is upon that report that the Board will base its findings of probable cause.
>
> Yes, I am often troubled by the quality of our general aviation accident investigations and reports of those investigations. I am troubled because I find the investigations and reports to be of inconsistent quality - often erroneous both in what they do say as well as misleading in what they fail to say.
>
> As a civil servant with a keen interest in aviation safety, I am troubled because it is based upon these reports that the Board makes its findings of probable cause. Obviously, if the investigation was incomplete, unprofessional or biased, the determination of probable cause can only be equally tainted.
>
> As a lawyer who oversees a team of lawyers with nearly $ 5 billion worth of claims and litigation pending, I am troubled because of the fact that incomplete and/or misleading accident reports by themselves, and also in combination with the findings of probable cause which are based upon those reports, generate unnecessary, costly and wasteful litigation - which at best keeps the plaintiffs bar busy, and at worst creates false hopes in the hearts and minds of innocent clients.[3]

Mr. Dillman expressed his concern about the legislative tasking of NTSB to find the probable cause of aircraft accidents and, as the board's reports do find and report probable cause, or causes, these are used in civil law actions for money damages. When the reported causes are erroneous because of inherent limitations and errors in the accident investigation process, innocent defendants are put

[3] James S. Dillman, Aircraft Accident Investigation Procedures in the U.S.A., in IX Air Law 39, 41 (1984).

through enormous costs to disprove the Safety Board's findings, if they can so prove it. This shifting of the burden of proof is an unintended product of the safety investigation.

Determining Probable Cause

This brings me then to two final points which I would like to make. Both concern the finding of probable cause. The first point is that both the Federal Aviation Act (§ 701) and the Independent Safety Board Act (§ 304) speak in terms of finding *the* probable cause. True to its mandate the Board issues reports which provide a finding of *the* probable cause, although it is true that the Board does not hesitate to find multiple causes in many cases. But the point is - the point I wish to make is, why is it that it is necessary to call it *the* probable cause. In fact it is at best *a* probable cause, and we all know it. The accidents are few and far between, especially the air carrier accidents, where a single failure caused the crash.

I believe that it is more than merely a question of semantics.

While both the Federal Aviation Act (§ 701 (e)) and the Independent Safety Board Act (§ 304 (c) purpose to insulate Board reports and particularly probable cause findings from use in litigation for damages - don't you believe for a minute that it works that way. As a trial lawyer, I can tell you from personal experience that thousands and thousands of dollars are spent by defendants who are compelled to disprove *the* probable cause in the various courts of the United States.

My second point goes beyond my first. It concerns the need to find probable cause at all. Would we be better off if we didn't determine probable cause? What do we really gain from having found *a* probable cause? Why can't the Board, - and believe me I am not proposing the abolition of the Board, - why can't the Board merely report the facts and circumstances of the accident and allow the aviation community to draw its own conclusions? Clearly, most of us are competent to do that.

At the major air carrier accident investigations,

> and at the public hearings that usually follow, it has been repeatedly said that the parties to the investigations spend more time and effort furthering their self interests than they do in contributing to the objective fact-finding process. Hardly an investigation goes by without at least one party being accused of holding back information.
>
> If the end result of an investigation was merely a recitation of the facts and circumstances of the accident, possibly we could eliminate - or at least significantly diminish - the protective posture that parties frequently take.
>
> I suggest that if we were to eliminate the need to make a finding of probable cause, the interests of aviation safety may well be advanced. We as lawyers, would suffer no loss, and perhaps the only loser would be the media as they would be forced to read the reports rather than simply read the findings of probable cause.

NTSB aircraft accident investigations figure importantly in litigation because they are done in a timely way, are often the best source of information about the accident, and they are available at minimum cost to all persons. In fact, they can be viewed free at NTSB Headquarters in Washington, D.C. The reports are usually released in parts, the first being a factual report and the final containing the finding of probable cause or causes.

The NTSB Investigator-In-Charge, the IIC, designates who may participate in the investigation. The Board regulations limit participants to those persons, government agencies, companies, and associations whose employees, functions, activities, or products were involved in the accident or incident and who can provide suitable qualified technical personnel to actively assist in the investigation.

None of these parties may be represented by any person who also represents claimants or insurers. The Independent Safety Board Act of 1974 and The Federal Aviation Act of 1958, 49 U.S. Code 1441 both state that NTSB accident reports cannot be admitted as evidence in any suit for damages growing out of accidents. Law suits do impact on NTSB investigations, such as when litigants contest the release of physical evidence by the Board like aircraft wreckage, maintenance records and pilot records etc., to the owners who may be parties to litigation. Testing of physical evidence which may alter or destroy the evidence has been challenged. The Board tries to resolve these challenges by agreement.[4] Patricia Goldman, Vice Chairman, NTSB, has expressed concern about investigation participants who are or may become litigants.

> I believe the most significant impact of litigation (or potential litigation) on the Board's investigation is the inhibition on the availability of information from the parties. Although we expect parties to participate with the interests of the Board's investigation uppermost in their minds, we are not so naive as to overlook the awareness of the parties and their representatives of the litigation.

NTSB participates as an accredited representative to ICAO when required. If the accident is a foreign one, NTSB will assist the nation making the investigation. Problems can arise out of domestic litigation concerning the foreign accident. NTSB refers requests for documents to the investigating nation, however litigants have obtained court

---

[4] Patricia A. Goldman, NTSB Procedures, in IX Air Law 42, 43 (1984).

orders compelling NTSB to release documents pertinent to the foreign accident. Although litigants cannot use as evidence published findings of NTSB, they can and routinely do conduct discovery of NTSB investigation participants, including board investigators, and may discover their physical evidence.

Not all persons and the organizations they represent favor open investigations such as the NTSB conducts. The criticism is that public openness inhibits the very candor that goes toward improving aviation safety, such candor being at times the admission of fault and correction of error. The electronic media focuses on newsworthy accidents and uses television sometimes to present, and even to capture the tragedy. How many times have each of us witnessed on television, without seeking to, the explosion of Challenger after launch at Cape Canaveral and the crash-landing of a United Air Line Aircraft at the Des Moines, Iowa, airport. Too much openness in asserting fault, particularly where fault may be founded on incomplete or erroneous data, ill serves aviation safety, injured parties and potential defendants.

Stanley J. Green, Counsel, General Aviation Manufacturers Association, states the adverse affects of present aircraft accident investigations on safety, fairness to accident victims and defendants in accident litigation, and the inefficiency of the compensation system in the United States Courts are:

> *Aircraft Accident Inquiry*, Whose Interest Prevails - an intriguing title so, perhaps, we should once again review, for purposes of remembering the objective of an accident inquiry, whose interest *should* prevail.

> Without question, it is the interest of the general public in the broad sense and the flying public in the narrow. The public, flying on airlines or in general aviation, is however, being short changed. The tax dollars that pay for the inquiries are not well spent and aviation safety suffers.[5]

Mr. Green expresses the concern of those companies he represents that the free and almost uncontrolled release of evidence that characterizes aircraft accident investigations in the United States has a chilling effect on the aviation community, and actually impairs flying safety, stating:

> As a representative of the manufacturers of the airplanes, the aircraft engines, the avionics and many components used in air taxi and commuter, executive, business, and personal operations, we are concerned about the release of tapes from the CVRs and towers because release inhibits the acceptance of such devices in many of our airplanes in which they could be economically installed. And lack of acceptance means a reasonable tool in accident investigation is not now available....
>
> Quick action of an airworthiness authority that could stem from a hastily called gut-spilling discussion of accident causing possibilities may save a few lives but such inquiries are not possible today. An end of the day discussion of field investigators - including representatives of the manufacturers and operators - that could provide an early clue ends up now with few if any talkers and mostly listeners of the truly interested parties - those who will be the plaintiffs. No one in his right mind is today going to volunteer speculative information, informally, that might lead to early detection of a problem when he does not know for sure that it will prevent another accident of the same kind but does know that it may cost him or his company one or two or ten million dollars in a law suit.

---

[5] Stanley J. Green, The Public Hearing: Should it Prevail?, in IX Air Law 47 (1984).

Mr. Green argues that the original purposes of NTSB investigations are now compromised, that the identification of causes, prompt corrective action to alleviate or eliminate them, all to improve the safety and efficiency of aviation, has degenerated into a mechanism for developing legal liability in civil law suits.

> Twenty five years ago, hearings were truly for the purpose of finding probable cause and participants searched the depths of their minds for every scrap or crumb that might contribute to this determination - without fear that they or their employer or agency would be subpoenaed in a civil action or made the butt of public ridicule through media exposure.
>
> The hearings have become places for individuals and organizations to defend themselves - to defend themselves from liability - not to defend the public against the potential of another accident from the same or similar causes.
>
> In the light of our present knowledge, it seems less than honest to assume that even with the best motives, the outcome of the hearing will not be affected by the chilling effect on those who testify. The lawyers, the accident investigators, the pilots, (airline and and general aviation) the airlines and the general aviation operators should work together to ensure that legislation, if needed, is passed or regulations written to *restore* the agreed upon purpose of accident inquiries - to prevent another accident from the same or similar causes.[6]

D. ARMED SERVICES AND OTHER UNITED STATES GOVERNMENT AGENCY REPORTS

The FAA participates in NTSB investigations and prepares its own reports. These are not published and are regarded by FAA as its working papers, not discoverable by

[6] Id. at 49-50.

others. The FAA actions taken as a result of its investigations are published and available. In challenging any FAA actions that involve sanctions, parties may be able to discover the underlying investigative records.

Where an accident involves a military aircraft or one chartered by the military for its purposes, the Armed Service involved will make its own investigation. It will be a participant in any FAA and NTSB investigations of the accident. Armed Services investigations are regarded by them as work product. Discovery may be possible by parties in interest through Freedom of Information Act requests, or litigation. The Armed Services cooperate with and assist other agencies such as NTSB, FAA and ICAO. In addition, they secure the cooperation of corporations whose products are involved and which may be a factor in an accident. Internally, the Services have laboratories and engineering services capable of excellent research and evaluation of accident causes, and very sophisticated aircraft simulators for evaluating aerodynamic and performance as well as air crew actions and possible error.

E. AIR CARRIERS, OTHER AIRCRAFT USERS AND MANUFACTURERS

Air carriers, other aircraft users and manufacturers routinely investigate accidents involving their operations and products. They also frequently serve as participants with ICAO, NTSB and other agencies in governmental investigations. American companies regard their investigations as confidential work product and do not often make them public. Litigants, through discovery, may be able to obtain documents pertaining to such investigations. The work product itself may be characterized as that of counsel and be less discoverable. Individual employees and experts can be questioned through interrogatories and depositions.

F. STATE AND LOCAL GOVERNMENTS

State and local governments investigate aircraft accidents and usually their personnel are among the first at the scene, helping in search, rescue, fire suppression, security, and medical care, as well as autopsy and pathology of deceased accident victims. Often their reports contain the freshest, least analyzed or contrived accounts and data. Their reports and investigators are an invaluable source of witnesses with which other investigating teams often do not or, cannot follow up. The costs of copies of state and local government investigations are minimal, are readily available, and seem to be seldom used.

G. PRIVATE ORGANIZATIONS, EDUCATIONAL INSTITUTIONS, LABORATORIES, EXPERTS, AND THE NEWS MEDIA

Private organizations, educational institutions, laboratories, experts, and the news media investigate many aircraft accidents. They do this usually out of their own interests. Industry trade groups, unions representing pilots,mechanics, or air traffic controllers, academic institutions and individuals retained as experts, and the news media will have made broad enquiries or very specialized studies into major aircraft accidents. These investigations are closely held, are rarely disclosed except to advance a position, and are difficult to discover even by litigants. Nevertheless the work may be excellent and should be sought by interested parties.

Many foreign state accidents are probably outside of the jurisdiction of ICAO and are investigated according to local procedures and standards. As examples, the procedures of France, Japan, The United Kingdom and Canada are described in the following paragraphs.

H. FRANCE

Mr. M. Vigier, Chief Engineer, French Accident Inquiry Bureau made the following comment: "France, as a member State of ICAO, follows Annex 13 standards and recommended practices (SARPS). As a matter of fact, our national regulations or procedures, in their own ways, not only respond to Annex 13 SARPS but may, sometimes, cover a larger field."[7]

Mr. Vigier then describes aircraft accident investigations in France generally as follows: The French conduct a technical and judicial investigation of aircraft accidents, therefore Ministries of Civil Aviation and of Justice participate. Both ministries seek to establish causes in their investigation. Thereafter the Ministry of Aviation

[7] M. Vigier, Aircraft Accident Investigation Procedures: The French System, in IX Air Law 5 (1984).

seeks to correct hazards and improve aviation safety. The Ministry of Justice looks to where liability shall lie. Judicial personnel are expected to rely on the technical investigations for the facts, and to work and cooperate with the technical investigators. To a large extent their duties and authorities may overlap. When a technical investigator wants to take hold of a piece of the wreckage, he must get Judicial permission. When a judge wants to study a piece of the wreckage he must ask the advice of the technical investigator. Technical investigators are required to make available to judicial investigators all evidence such as documents, reports, cockpit voice recordings, and flight data recorder read-outs.

On-going investigation materials are not released to the public, only the final reports. All evidence is at the disposal of judicial authorities.

I. JAPAN: Teruo Sakamoto, Japan Airlines.

In Japan an aircraft accident investigation has as its purpose improved safety, but, as in the United States and France, liability and law enforcement become an inseparable part. Facts creating legal liability for injuries and property loss or culpability for law violations may well be a product of all thorough technical investigations. Therefore, when Annex 13; 3.1 of the Chicago Convention states, "it is not the purpose of this activity to apportion blame or liability," this is an ideal not reached in participating States.

Teruo Sakamoto, of Japan Airlines, reported his nation's procedures to the International Bar Association to be generally as follows.[8] Japan has established its Aircraft Accident Investigation Board under the Ministry of Transportation. The Board is provided with a secretarial staff and expert investigators, it has the power to close the accident site, exclude unauthorized persons, inspect and retain physical evidence, and to summons and interrogate witnesses. This Board investigates all civil aircraft accidents. An Aircraft Accident Investigation Commission with similar powers investigates accidents involving the self-defense forces. These investigative agencies cooperate when required. The owner and user of the accident aircraft may also investigate, but it must be in cooperation with and under the direction of the Aircraft Accident Investigation Board. Police authorities and prosecutors are empowered to search, seize, arrest and detain if a crime of negligence or willful crime is suspected.

Major Japanese airlines have their own systems for investigating accidents that include three functions: the Accident Handling Headquarters under the Company President, the Accident Investigation Committee comprised mostly of technical experts, and the Damage Compensation Committee formulates the plans and policies for settlement of claims and works with legal counsel to do this. Civil litigation is rare in Japan

---

[8] Teruo Sakamoto, Aircraft Accident Investigation Procedures, in IX Air Law 9 (1984).

and most domestic claims are settled by negotiation. Mr. Sakamoto described the accident investigation of a domestic DC-8 flight as being typical of Japan's procedures:

> An accident occurred on the domestic flight of a DC-8-61 aircraft from Fukuoka to Tokyo on 9 February, 1982. The accident site was 360 to 510 meters off the end of the landing runway. Concerning this accident, the Aircraft Accident Investigation Board issued its Final Report on 16 May 1983 and determined that the probable cause of the accident was the maloperation of the aircraft captain.
>
> In the accident, 24 passengers died, and 142 passengers and 8 crew members, including the captain, were injured. The aircraft was totally destroyed.
>
> The Tokyo Metropolitan Police commenced a criminal investigation of the accident, as a part of which the captain was placed in confinement for psychiatric tests. Based on its investigation, the Metropolitan Police transferred the captain's case to the Tokyo District Prosecutors Office. However, the Tokyo District Prosecutors Office decided not to institute a criminal prosecution, based upon the result of the tests. The Tokyo District Prosecutors Office is, instead, investigating, at present, the possibility of criminal conduct on the part of senior captains who were in a position to supervise the sick captain and also medical doctors who examined the captain before the accident.
>
> The criminal investigation by the Metropolitan Police and the investigation by the Aircraft Accident Investigation Board were both commenced on the day of the accident. The Metropolitan Police, soon thereafter, requested the Board to give its expert opinion concerning the accident. The Board complied with this request in May 1983 by sending the Metropolitan Police a certified copy of its Final Report.
>
> This final report is made up of 246 pages and contains materials obtained through interrogations of persons concerned, including the senior captains and doctors who are under criminal investigation.
>
> There is no legal guarantee to prevent the use of

> reports of the Aircraft Accident Investigation Board in criminal or civil disputes. Moreover certain courts have recognized, in the past, the probative value of reports of the Aircraft Accident Investigation Board.

Mr. Sakamoto, speaking from his perspective that is on an opposite side of the world from Mr. Green, expresses the same concerns. Aircraft accident investigations have, in some locations, become a means for establishing civil and criminal liability and aviation safety suffers when that occurs. He summarizes this problem and proposes solutions as follows:

> The aircraft accident investigation should be conducted for the prevention of accidents and should not be pursued for the apportionment of blame or liability. This is clearly stated in Annex 13.
>
> In Japan, the Aircraft Accident Investigation Board is empowered by law to institute vigorous actions. However, a jurisdictional problem occurs when the Board's action conflicts with that of other government branches....
>
> If a report of the Aircraft Accident Investigation Board may later be used in a criminal court, the Board may thus be barred by the Constitution from compelling certain testimony, even though such testimony is critical to the determination of the cause of the accident.
>
> This is a problem not only in Japan, but also in other countries, except for a few which have proper measures. It is primarily a domestic problem, but it may be an international problem as well, because the report of the Accident Investigation Authority of one country may be used in other countries.

J. UNITED KINGDOM ACCIDENT INVESTIGATIONS

The United Kingdom maintains an Accident Investigation Branch (AIB) which is independent of their Civil

Aviation Authority, but which is under the Secretary for State Transport. In this regard, it is similar to relationships between NTSB and FAA in the United States.

The Accident Investigations Branch submits its report of an accident to the Secretary of State for Transport and it is his decision as to whether the report should be published or not. MR. G.C. Wilkinson, Chief Inspector of Accidents for the United Kingdom, has reported on UK investigation procedures as follows:

> U.K. AIRCRAFT ACCIDENT INVESTIGATION PROCEDURES
>
> Although the investigation of aircraft accidents is a severely practical business with a strong international flavour, it must be remembered that the legal environment varies markedly from State to State. Today I shall limit myself to the UK view of aircraft accident investigation. The views I express are my own and are not necessarily those of the Department of Transport.
>
> The Accidents Investigation Branch of the UK, of which I have the honour to be Chief, is a small autonomous unit which for administrative purposes is within the Department of Transport. It has no connection with the Civil Aviation Authority which is mandated to administer Civil Aviation within the UK. This separation of function, in my view is essential. As Chief Inspector of Accidents I report directly to the Secretary of State for Transport. I am extremely fortunate to enjoy a high degree of independence regarding decisions related to the investigation of civil aircraft accidents. I submit reports to the Secretary of Transport whose decision it is as to whether the report should be published or not. He can also order that a particular accident should be the subject of a Public Inquiry, a relatively rare occurrence. As Chief Inspector of Accidents I cannot be directed as to which accidents should be investigated or not investigated. It is left solely to my judgment as to what level of investigation is appropriate in any one case, a rare state of affairs when responsibility and accountability are

combined....

In the UK we have 250 - 300 reportable accidents a year (about one per working day). That is those involving serious injury or death or severe damage. It is neither practicable nor desirable for a full-blown formal investigation leading to a published report in each case. Each accident is evaluated and is the subject of a short factual report....

An internal report is written in each case and any information relevant to flight safety is immediately directed to the appropriate organisation (e.g., the CAA) so that any remedial action can be taken without delay.

Some 12 - 15 accidents a year (one a month) result in a formal Inspector's Investigation culminating in the submission of a report to the Secretary of State for Transport which, in the normal course of events, is published.

Public Inquiries, when all the evidence is presented in open court with full legal involvement, are fairly rare in the UK: the last one involved an accident that occurred 11 years ago.

The purpose of aircraft accident investigation is defined quite clearly in the UK Regulations as follows: `The fundamental purpose of investigating accidents under these Regulations shall be to determine the circumstances and causes of the accident with the view to the preservation of live and the avoidance of accidents in the future; it is not the purpose to apportion blame or liability.' The UK Regulations also stipulate that investigations should be carried out in private....

Whilst I am against secrecy for the sake of secrecy there is, in my view, a need to ensure that information to the media should be released in its correct context and present a balanced viewpoint. There is a very real danger in ending up with a major investigation being conducted in the full glare of media publicity (*vide* the Air Florida accident at Washington National) which does nothing to advance the cause of aviation safety as in my experience this treatment tends to inhibit the acquisition of evidence....

> When the Secretary of State orders a Public Inquiry to be held into an accident the Chief Inspector of Accidents provides such services as are required by the Attorney General. In practical terms, this means the AIB conducts an investigation into the accident in its normal way and produces the evidence it has gathered to the Attorney General. The evidence is then examined in open court which consists of a Commissioner appointed by the Lord Chancellor sitting with at least two technical assessors. The Commissioner, in due course, presents his report to the Secretary of State....
>
> Some superficially attractive arguments are regularly put forward saying, in effect, that manufacturers, operators and airworthiness authorities, to name but a few, would, due to commercial pressures, not respond in a responsible manner to criticisms and recommendations without the immense pressures that are applied to them both collectively and individually after a major aircraft accident by lawyers acting for interested parties. This is nonsense, in fact, the reverse is much closer to reality. People who manufacture, operate and certify modern transport aircraft are generally responsible professionals who are concerned to give of their best.[9]

K. CANADIAN AIRCRAFT ACCIDENT INVESTIGATION PROCEDURES

The Canadian Department of Transport was formed in 1938 and at that time assumed responsibility for investigation of Civil Aviation accidents from the Minister of National Defense. Part time investigators appointed by the Minister of Transport conducted investigations until 1958, when the complexity and volume of aviation and accidents required full-time and highly qualified investigators. The Minister formed

[9] G.C. Wilkinson, U.K. Aircraft Accident Investigation Procedures, in IX Air Law 35-7 (1984).

the Accident Investigation Division, staffed by members of the Department of Transport. In 1975 the Accident Investigation Division and Aviation Safety Division were united within the Department as The Aviation Safety Bureau. This Bureau conducted investigations, which were reviewed by a newly established Aircraft Accident Review Board. The Investigative Report was then published with the Investigative Team's findings and recommendations, and a summary of the Review Board's comments. The published report became available to the public and to regulatory agencies, law enforcement agencies, and to persons harmed who might seek civil liability of a wrongdoer. The Canadian Manual of Aircraft Accident Investigation permitted the Department of Transport to retain and not release certain documents, including witness statements, records, photographs, and transcripts of electronic and mechanical recordings, unless by an order of a court. Discovery against retained documents etc., and the testimony of an investigator as a witness was to be for accident prevention or use in a coroner's inquest.[10] Since its adoption as an International standard, Canada has complied with the policies and procedures of The Chicago Convention. In June of 1989, a new Canadian law, The Canadian Transportation Accident Investigation and Safety Board Act, received Royal Assent and was proclaimed on March 29, 1990. This Act established a new and independent agency and includes the new investigation board

[10] Masao Sekiguchi, Aircraft Accident Investigation in Canada, the United States and Japan, (Unpublished LL.M. thesis, McGill University (Montreal)).

designated the Transportation Safety Board of Canada.[11] The Act, 38 Elizabeth II, Chapter 3 states the Boards object to be:

> The object of the Board is to advance transportation safety
> - by conducting independent investigation and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
> - by reporting publicly on its investigations and on the findings in relation thereto;
> - by identifying safety deficiencies as evidenced by transportation occurrences;
> - by making recommendations designed to eliminate or reduce any such safety deficiencies; and
> - by initiating and conducting special studies and special investigations on matters pertaining to safety in transportation.

The language of the Act places conditions and limitations on the use of Board findings.

> In making its findings as to the causes and contributing factors of a transportation occurrence, it is not the function of the Board to assign fault or determine civil or criminal liability, but the Board shall not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.
>
> No finding of the Board shall be construed as assigning fault or determining civil or criminal liability.
>
> The findings of the Board are not binding on the parties to any legal, disciplinary or other proceedings.

Functionally, the Board has power over specified civil transportation accidents and designates Directors of Investigation for Air, Marine, Rail and Commodity Pipelines.

---

[11] Transportation Safety Board of Canada, Ministry of Supply and Services, Annual Report (1990).

Investigators have the power to enter, search, and seize evidence without warrant if exigent circumstances make it not practical to obtain one. Sec. 19 (1), (2). Where evidence has been seized, the investigator may have examinations and tests performed, including tests which would result in destruction of evidence, and may protect and preserve evidence by limiting access to it. Sec 19 (5) and (6). When an investigator believes other documents and materials are necessary he may, by notice in writing, require productions. He can also require medical examinations of persons involved in an accident. Sec. 19 (9). Observer status for interested parties is available under provisions of Sec. 23, and paragraph (c) recognizes the rights of Annex 13 of The Chicago Convention for foreign State participation. On-board recorder tapes, communications records, and statements are given legal privilege. Sec. 28, 29, 30. Other evidence of investigators is limited in use and distribution and his opinion as to any person's fault or civil or criminal liability is not admissible in any proceeding, civil or criminal. Sec. 33. The Act provides for criminal sanctions against any persons frustrating discovery by an investigator or giving false or misleading information. Sec. 35. At Sec.63 the Act provides for a review of its operation on Transportation Safety in January of 1993. The Canadian Act can well serve as an International Model for national law for the investigation of aircraft accidents, to promote aviation safety and to support the letter and spirit of The Chicago Convention.

The Investigation Board is headquartered in Ottawa and has Regional Offices throughout Canada. It is independent of all other Federal and Provincial departments and agencies. It has Engineering, Safety Medicine, Human Performance, and Safety Analysis offices with full-time staffs in the needed technical areas. Where further specialities are required, the Board may employ them. About five hundred aircraft accidents occur each year in Canada now, a substantial improvement over the seven hundred accidents per year ten years ago.[12]

In its Annual Report, the Board publishes tables showing numbers and trends in all transportation accidents in its authority. In addition, the Board continues to publish Aviation Occurrence Reports that had been published by the former Canadian Aviation Safety Board.[13] Canada experiences the same pressures to disclose accident investigation evidence and conclusions for purposes of civil litigation as other nations. Canada is participating in the investigation of an airliner crash in Saudi Arabia, about which the following press comments were published:

> *The Gazette*
> Montreal, Feb. 16, 1992
>
> Transport Canada should make public the findings of a safety review of Nationair done after one of the airline's DC-8's jets crashed in Saudi Arabia last July, killing 261 people, opposition transport critics say.
>
> "In the interests of the public confidence, as much

[12] Transportation Safety Board of Canada, Annual Report, 29 (1990).

[13] See Appendix Two.

information as there is available about whether this airline is safe to travel on has to be made public," Liberal MP John Manley said yesterday.

New Democrat MP Ian Angus also said it is in the best interests of the traveling public and Nationair that the report be made public.

Transport Canada has refused to disclose the report, saying it contains personal opinions Nationair employees gave in confidence to government officials.

Angus and Manley were responding to articles about the July 11 crash and the charter airline's safety record in yesterday's *Gazette*. The articles said Nationair mechanics wanted to change two tires on the jet the day before it crashed, but didn't because replacement tires were under lock and key and unavailable until too late.

One of the tires that was to be changed blew the next day, and crash investigators say that triggered a series of events that caused the plane to crash.

Nationair president Robert Obadia and other officials did not return reporter's calls yesterday.

Michael McGowan, a Toronto lawyer representing families of two flight attendants who died in the crash said, "A court could conclude that Nationair was negligent in failing to change tires after it was known they ought to be changed." But, he said, "the families of the deceased crew members have difficulty suing Nationair because of the workers' compensation law, which takes away the right of an employee to sue an employer in many cases."

Other possibilities are being considered, he said. "It's possible that the wheels or the tires were defective and that companies other than Nationair were responsible. If so, those other companies might be held liable for contributing to the accident and those companies would probably not be protected by the workers' compensation law."

Saudi Arabian aviation authorities are investigating the crash with assistance from the Transportation

Safety Board of Canada.[14]

This article also illuminates the routine legal analysis which includes "who can pay?" Manufacturers sometimes feel a noose is closing around their neck before proof of wrongdoing.

The Transportation Safety Board of Canada also investigates dangerous incidents in Canada where an accident did not occur. An example is an incident of an October 11, 1990 flight of a jet liner which recovered safely after multiple instrument- and missed apprcaches in extremely poor weather conditions at the destination and departure airports. The departure airfield was also the alternate airfield and the aircraft safely landed there, but with insufficient fuel for another approach. The Board publishes special subject studies important to aviation safety that are helpful in investigations.[15]

L. INVESTIGATING AIRCRAFT ACCIDENTS OVER THE HIGH SEAS AND OTHER FOREIGN STATES

Accident investigation sources described in paragraph A above will be a source of information as well as their counterparts in other foreign states. ICAO assists and cooperates with member States concerning their International Air incidents and accidents just as it does with NTSB. ICAO can draw experts from internal staff and outside consultants,

[14] Rod MacDonell and Andrew McIntosh, The Gazette, February 16, 1992.

[15] See Appendix Three.

for all of the Technical disciplines involved in aviation.

Annex 13 to the Chicago Convention requires that the State of occurrence investigate, unless it delegates that duty to the State of Registry or the State of the Operator. If the location of the accident is on the high seas, then it is the State of registry which has the duty. The State of registry and of the operator have a right to participate. The State of manufacture may participate if it is believed that its participation in the investigation could be useful or result in increased safety. There is no stated right in Annex 13 for the operator or manufacturer of the aircraft involved in the accident to participate. In practice, they are frequently allowed to be present and to participate in limited ways. States having suffered fatalities to its citizens have no right to participate under the Convention but may specifically request and justify participation.[16]

The admissibility of foreign state accident investigation reports in United States Courts is uncertain. Litigants seeking to admit reports must lay a strong foundation of reliability and trustworthiness. Those portions of a report containing only factual information may be easier to admit than those containing opinions and conclusions of probable cause. In American Airline, Inc. v. United States, the court upheld admission of two Civil Aeronautics Board documents - a graph

[16] Tom Lenhart, A modest proposal to encourage wider participation in investigations, in IX Air Law 50, 52 (1984).

plotting altitude and a flight-recorder readout.[17] The court stated,

> The primary thrust of the provision (of 49 U.S.C. § 1441 (c)) is to exclude CAB reports which express agency views as to the probable cause of the accident. Exhibits 58 and 89 are not the report of the CAB and do not reflect the Board's evaluation of the data they contain or the emphasis placed on the data in reaching a decision on probable cause. Further, the NTSB's present regulations make clear that it's only the 'Board's accident report' containing its statement as to probable cause (see 49 C.F.R., § 835.2 (a)), not the factual accident report prepared by the Board's investigators (see 49 C.F.R., § 835.2 (b), which is proscribed by § 1903 (c) from admission in evidence.)

Annex 13, part II, Article 5, of the Chicago Convention requires that a copy of the Final Report of the investigation of an aircraft accident be sent to:

a. ICAO

b. The State of Registry

c. The State of the Operation

d. The State of the aircraft manufacturer

e. The State having suffered fatalities to its citizens, if it participated in the investigation.

f. Any State which provided relevant information and significant facilities or experts.

M. PERSONAL INVESTIGATION OF AIRCRAFT ACCIDENTS

Few aircraft accidents have a single cause or even a few causes. The NTSB or other investigator's factual report

[17] American Airline, Inc. v. United States, 418 F.2d 180, 187 (5th Cir. 1969) (citing Berguido v. Eastern Airlines, Inc., 317 F. 2d. 628,632 (3rd Cir. 1963)).

will help identify possible causes. The NTSB "findings of probable cause" can be misleading as they relate to pilot actions, because the pilot's errors will be stated but their underlying causes may not have been stated in the report or identified in the investigation. NTSB investigations remain open for revision. The following is a summary of NTSB reconsideration in the crash of a commuter airliner:

> RESPONSE TO PETITION FOR RECONSIDERATION
>
> In accordance with the National Transportation Safety Board's rules (Title 49 Code of Federal Regulations Part 845), the Safety Board has reviewed the petition for reconsideration of probable cause of the aircraft accident involving Cumberland Airlines flight 302, a Piper PA-31, N6629L, that crashed near Cumberland, Maryland, on March 5, 1984. Based on its review of the petition received on August 10, 1988, the National Transportation Safety Board hereby grants the petition.
>
> The Safety Board's original investigation of the accident determined that the airplane had crashed about 10 miles northeast of the Cumberland airport along the localizer course for runway 23. The airplane had been cleared by air traffic control for the approach to the airport. The pilot and two passengers aboard the flight were killed in the accident.
>
> As a result of its investigation, the Safety Board had determined that the probable cause of the accident was:
>
> > IFR Procedure--Not Followed--Pilot in Command
> > Proper Altitude--Not Maintained--Pilot in Command
>
> The Safety Board also cited factors related to the accident as:
>
> > Weather Condition--Clouds

Weather Condition--Fog

The petitioner challenged the "pilot error" findings and stated that certain information had not been addressed in the Safety Board's report and findings. That is, that the pilot's blood carboxyhemoglobin level of 20% found at autopsy was sufficient to impair the pilot's flying abilities. He also stated that the autopsy results indicated that the pilot had not survived the impact and thus could not have inhaled the carbon monoxide after the crash. Lastly, the petitioner cited the findings of products of combustion (soot) in the fresh air passage between the cabin heater burner can and the heater shroud as evidence that there had been a source of carbon monoxide while the airplane was in flight. The petitioner delivered the cabin heater to the Safety Board's laboratory for examination along with the petition.

As part of its review of the record of this case, the Safety Board re-evaluated the autopsy findings that showed multiple extreme impact injuries. Although not totally conclusive, the autopsy findings suggest strongly that the pilot had died instantly from multiple extreme impact type injuries. If this were the case it would have been virtually impossible for the carbon monoxide to have been inhaled after the accident.

The Safety Board's re-evaluation also included an examination of the cabin heater, which had been thrown clear of the main wreckage, away from the ground fire area, and not exposed to external ground fire. The Safety Board's examination of the cabin heater revealed evidence of sooting in the fresh air passage where no combustion should occur during heater operation. There were no other areas of external sooting. Samples of the soot material were examined with the Safety Board's x-ray energy dispersive analysis equipment and the presence of lead (Pb) was found. The lead is evidence of the by-products of combustion of aviation fuel.

Neither the petitioner nor the Safety Board were able to determine the source of the soot material; however, it was determined that the source was not a hole or leak through the heat exchanger from the combustion chamber. This was determined by

> pressure/leak test that showed no leaks. The one possibility considered, but not proven, was that there had been a small leak of fuel from the fuel supply line fittings that ignited in the hot heater chamber and caused the carbon monoxide to enter the cabin. The leak would have to have been very small to not indicate a severe fire or to generate large amounts of smoke in the cabin. However, even slight amounts of carbon monoxide, which is colorless and odorless, can be absorbed by the blood of a person inhaling it.
>
> Consequently, based on the information presented in the petition, and based on the Safety Board's review of the evidence, it has revised its original report findings to include:
>
> Physical Impairment (Carbon Monoxide)--Pilot in Command
>
> AirCond/heating/pressurization--Leak
>
> Accordingly, the petition for reconsideration of the probable cause of the aviation accident involving Cumberland Airlines, flight 302, a Piper PA-31, N6629L, near Cumberland, Maryland, on March 5, 1984 has been granted. Revised portions of the factual report and Brief of Accident are attached.[18]

The evidence of a high blood-carbon monoxide level and the discovery of the source of the carbon monoxide, as uncovered by expert witnesses, were important in the outcome of this case, which settled during trial.

In other accidents the probable cause may be stated in equally simple terms. 'Aircraft flight path failed to clear rising terrain--Pilot in Command.' The attorney evaluating the case must look at all of the possible factors for the pilot's error. He may well have miscalculated, or failed to calculate

[18] NTSB Response to Petition for Reconsideration (1990). *See also* Appendix Four for complete reply.

his climb performance such that even Chuck Yeager flying the airplane could not have cleared the ridge. He may also have experienced a malfunction of his airplane caused by maintenance or product defect or, the manufacturer's aircraft performance charts may have been in error and relied on by the pilot, unexpected wind, turbulence and temperature may have been factors, the plotted elevation on charts the pilot used may have been in error.

Accidents involving in-flight structural failure of a general aviation aircraft, most of which have no flight recorders, present the most difficult cases for attorneys and professional investigators to evaluate. Often there is no conclusive physical evidence and rarely is there a survivor. Evaluation of these accidents demand that the investigations of other and similar accidents in this model aircraft be included. Airplanes should not break up in flight, thus, when it happens more than a few times to the same model, there is more than a pilot problem. Strong stable airplanes successfully penetrate thunderstorms although that also requires a combination of high pilot skills and luck. Unless the structural failure accident is associated with thunderstorms or, intentional abrupt maneuvers not approved for the airplane such as aerobatics, the person evaluating the case should suspect product defect as well as pilot errors. Some aircraft models produced in the thousands have rarely or never experienced in-flight structural failure, other models manufactured in small numbers accumulate many failures. NTSB and FAA have data to identify accident cause trends by aircraft model. When it becomes a notable problem, private organizations such as the Aircraft Owner's and Pilot's Association (AOPA) will have quantified and analyzed the problem.

When a product defect is identified or suspected, evidence must be developed to allege and prove the defect as a cause of the accident. This may be possible by the expert testimony of a person qualified and employed full-time to render such services. The government investigations and those done by other parties such as the aircraft owner, operator, or manufacturers may carry this burden at minimum cost. Otherwise a party plaintiff must find and employ his own experts to prove his case of product liability, with all of the expense that entails.

The NTSB investigation will not likely have found an aircraft design or manufacturing defect as a probable cause of a general aviation aircraft accident. The reasons are speculative and would vary by the individuals offering them but they might include as reasons:

(1) All U.S. certificated airplanes have been designed to and have met Federal minimum standards of strength, reliability of components, controllability, stability, performance, and user-friendliness. Certified aircraft have some standardization of pilot controls, instruments, communications and navigation equipment that has grown up with the industry such that pilots may move into different types and models of aircraft reasonably and safely. The investigators

know and are influenced by this.

(2) Survivors are not always available to describe an observed defect. Even when the pilot survives, his account of a problem may not identify a product defect, since many factors, including pilot procedure and technique, go into aircraft performance. For example a failure of the airplane to take off or climb properly.

(3) The most prominent reason may be a lack of time and technical expertise for the investigator. If he is assigned five or six accidents a month to investigate, then he may have only a few days or fewer of accident scene and witness interview time for each investigation. He will usually be a pilot but probably will not have familiarity with the model of the crashed aircraft.

Statistically, there is no correlation between NTSB findings of product defects in general aviation accidents and plaintiff's litigation alleging product defect as a cause. This is illustrated by the following findings by Robert Martin in The Liability Maze:

> In 1987, at the request of the House Aviation Subcommittee of the Public Works and Transportation Committee, Beech performed an analysis of 203 litigations and claims for damages pending at any time during the four years January 1, 1983, through December 31, 1986. The data were accounted for on an occurrence basis; that is, one accident was treated as a single occurrence and a single claim or litigation even if the accident in fact resulted in several claims or lawsuits. The following data from this study are indicative of the situation faced by general aviation manufacturers:
>
> - There were 599 people on board airplanes involved in 203 accidents, for an average of approximately 3

occupied seats per accident.

- Of the persons on board, 42 percent were the owner-operator or employees of the owner-operator of the airplane; 44 percent were guests of the owner-operator or non-paying passengers; and only 14 percent were paying passengers.

- All general aviation accidents are investigated by the National Transportation Safety Board or the FAA or both. These investigations by trained experts, with engineering and laboratory support as required, produced the following determinations of probable cause (if more than one contributing cause was found, all causes are tabulated):

Probable Cause	*Accidents*
Pilot error	118
Design or manufacturing defect	0
Maintenance	22
Weather	21
Air traffic control	1
Other	1
Unknown or undetermined	63

- The average amount claimed, per occurrence, was approximately $10 million.

- The average cost to the manufacturer (the total of losses and defense expenses paid, plus reserves actually booked by Beech and its insurers) was $530,000 per accident.

- Obviously, something is amiss: trained, experienced accident investigators dispatched by the government agency charged by Congress with finding the probable cause of aircraft accidents find that a design or manufacturing defect in the airplanes caused none of the accidents. They also find that pilot error and other factors, not related to the design or manufacturer of the aircraft, were the actual cause of 70 percent of the accidents. Yet plaintiffs and their lawyers file lawsuits claiming that design or manufacturing effects caused 100 percent of the same accidents. In these circumstances, no industry should be expected to respond affirmatively, or place any credence in

> lawyers' claims about design defects in products or in the novel and often bizarre theories of their expert witnesses as to how and why the accidents occurred.[19]

N. AIRCRAFT PRODUCT IMPROVEMENT

The American Tort law system hinders product improvements to the extent that if a manufacturer admits defect as a cause of injury in one accident, such admission can adversely affect his defense in future cases. Even improvement or modification of a product may be construed or misconstrued as an admission against interest of a prior defect. Courts try to alleviate this problem, because it deters safety improvements, by limiting evidence of or argument about subsequent improvements but juries get the information. Manufacturer reluctance to modify his product because of product liability concerns may have been a factor in the in-flight structural breakup of more than 230 aircraft of one general aviation model. The same manufacturer produced different models of similar design, differing mainly in the arrangement and strength of the tail surfaces and in the period 1964 - 1977 the original model had an in-flight structural failure record twenty-four times greater than the revised models.[20] The original model continued in production and many owners and users had modifications done by after-market

---

[19] Robert Martin, General Aviation Manufacturing: An Industry Under Seige, in IX The Liability Maze 485 (1991).

[20] Andrew Craig, Product Liability and Safety in General Aviation in XII The Liability Maze, 467 (1991).

manufacturers to strengthen the tail surfaces of the model. Subsequently, the original manufacturer developed and offered its own tail modifications to the aircraft, which is now out of production.

The following sources are offered as a starting point for counsel investigating and evaluating an aircraft accident.

(1) NTSB or national factual reports;

(2) Aircraft wreckage;

(3) Component part testing and inspection reports;

(4) Aircraft documents: owner, manufacturer and modifier, maintainer and FAA;

(5) Accident scene witnesses: fire-rescue, police investigators, media, photos;

(6) Pilot: documents of flight and medical history, condition and impairments of any cause, possible errors and omissions, pilot's reports and statements;

(7) Air Traffic Control: clearances, communications, actions, recordings, required procedures, pilot and controller errors and admissions, Agency investigation, reports, actions;

(8) Weather reports and forecasts prior to and at the accident site: Pilot preflight and in-flight weather briefings;

(9) Other investigations: FAA, agencies such as Armed Services, state, province, local authorities, and private companies and organizations;

(10) Personal witness interviews;

(11) NTSB or other Probable Cause Reports;

(12) Independent evaluation by experts.

When taking the above actions, if a need is seen to protect evidence or to participate in component testing and inspection, ask NTSB, the national government's investigator, ICAO, or a court for the protection and opportunity to observe and participate.

Accident records over the years show recurring trends and principal causes. All involve human and mechanical failures and weaknesses, with weather a routine factor. No cause can be excluded without careful consideration.

1. Loss of control or ground contact on takeoff, climb, approach, landing, and attempted go-arounds.

The pilot is flying and should not lose control - if he loses it, he will most likely be blamed. Factors which may have contributed to the loss of control includes: binding, restricted, mistrimmed, or misrigged flight control or lifting surfaces, failed cockpit indications of aircraft configuration, failed tires or brakes, engine or propeller problems, and natural or man-made wind gusts associated with thunderstorms, fronts, and winds generated by larger aircraft from their wings, jets, propellers or rotors. Pilots are expected to recognize, avoid and/or compensate for these problems, but it should be emphasized the one who crashes may not be wholly to blame. Weather, turbulence, traffic control, manufacturing defect may have also contributed to the accident. A Boeing Aircraft Company study indicates that in airline operations, these take-off and climb, approach and landing maneuvers comprise about 6% of flight time and involve about 70% of the accidents.[21]

2. Flight through overpowering turbulent air or icing conditions.

The best civil and military aircraft flown by the most capable pilots can encounter weather where a flight cannot be maintained. Pilots are expected to know their own and their equipment limitations and avoid catastrophic weather encounters. United States Air Force policy is that no peacetime mission justifies flight into a thunderstorm. This applies to fighter aircraft built to withstand the stress of nine times their own weight, equipped with irreversible, hydraulically assisted flight controls, stability augmentation systems, and flown by the world's finest pilots. Airliners have thunderstorm detection equipment, anti-icing and deicing equipment and are stressed for turbulent air flight but can encounter impossible flight conditions. Most general aviation aircraft have quite limited structural strength in turbulence unless speed can be controlled, and, most significantly, no airframe anti-icing or deicing equipment. Typically, the only such equipment on light aircraft available is a device which heats the pitot to permit pressure readings for the air speed indicator, and carburetor air heat - which when applied reduces engine power. It is unlawful for a U.S. civil pilot to fly

[21] Boeing Commercial Airplane Group, Safety Study, <u>ICAO Journal</u>, Montreal, 11, October 1990; <u>see also</u> Appendix Five.

into reported icing conditions with an aircraft so equipped. Nevertheless, many civil aircraft are flown into overpowering turbulence or icing conditions each year. Some of these aircraft crash and the injuries are often severe or fatal.

3. Flight into visual conditions restricted by weather or darkness.

This would not seem to be dangerous because even the smallest, oldest, and most modest airplanes, when properly equipped and flown by qualified and proficient pilots, are routinely flown safely at night and in clouds. When pilots disregard the limiting terms "properly equipped and qualified and proficient," flying by reference to instruments becomes exceedingly dangerous and accounts for many serious general aviation accidents. These accidents usually cause such severe aircraft damage that it is difficult to establish equipment failure or defect as a cause.

4. In-flight structural failure, not associated with thunderstorms or prohibited aerobatics, and mid-air collisions.

Such accidents are relatively infrequent, are often fatal, and are usually assigned to pilot error. They deserve the most careful evaluation. Manufacturers can sharply reduce the incidence of these aircraft accidents by good design and, most important, by acknowledging and fixing problems in existing aircraft. Some aircraft fly today with wing and tail surface modifications found necessary to add strength and provide additional structural load paths. All pilots have flown or will fly their airplane outside of the desired flight path or designed flight envelope. Such occurrences are usually inadvertent and are quickly recovered from with only a momentary loss of dignity. Airframes can and should be designed and built to accommodate these momentary pilot lapses. Some aircraft do not aid the pilot in recovering from unusual attitudes, but, rather, seem to assist entry and make recovery problematic. Good aerodynamic design, structural strength, redundant equipment, such as dual attitude instruments and instrument power, and full-time wing leveler systems are well known and cost effective measurers which can be implemented in aircraft intended for flight in instrument weather conditions.

5. In-flight Collisions.

Pilots are expected to visually see and avoid other aircraft, except when operating in controlled airspace and under air traffic control in instrument flight conditions. Today's dense air traffic patterns, ever-increasing speeds, and disparities in speed between the slowest and fastest aircraft, put a premium on good cockpit visibility with minimum distortion and obstructions. This is hard to correct in a badly designed or manufactured cockpit. Tighter annual inspection standards, and available and affordable replacement windshields and windows are a positive step. Pilot alertness is essential, as is proper communication, navigation and crew coordination.

6. Aircraft performance as an accident factor.

Overloading and misloading of the aircraft are often factors in takeoff and climb accidents. Light aircraft can be remarkably tolerant to overloading where long runways and moderate temperatures prevail. These types of aircraft are routinely overloaded up to 25% over their maximum certificated gross weight for over ocean ferry flights. These flights are also routinely made by experienced professionals who understand and apply center of gravity and density altitude calculations in their takeoff and climb planning, and who also accept the risks involved in such activities.

Most aircraft are built such that the pilot must select between a full load of fuel, passengers or cargo. Probably no general aviation aircraft are built that lawfully permit the pilot to fill the tanks, all seats with average persons, and the cargo compartments. The pilot must also consider the weight distribution of his total load to remain within an acceptable center of gravity (C.G.). The center of lift on a single wing aircraft is located about one-third of the way back from the wing leading edge. Wings on different aircraft also differ in their sweep and angle back from the perpendicular of the fuselage. The aircraft must be loaded so that it balances at a point no farther aft than the center of lift, and preferably well forward of that point. The manufacturer provides numerical reference points for center of lift and C.G calculations.

All FAA certified pilots initially pass written, oral and flight examinations administered by FAA employees or designated examiners, which include loading problems for given manufacturer center of lift and center of gravity information. Therefore, even very inexperienced pilots have been found qualified to perform complex calculations regarding aircraft performance involving all of the factors which affect it, for the aircraft used in their initial training and flight checks. These are usually training aircraft with fixed landing gear, adjustable wing flaps, a fixed pitch propeller, and a carbureted gasoline engine. In his preflight preparations the conscientious pilot will have obtained existing information on temperature, pressure altitude, density altitude (which is calculated from the two previous numbers), runway length and gradient for the runway in use or which best favors his departure route and obstacles, as well as climb profile temperatures and winds. After obtaining all of the variable data on aircraft load, weather factors, the airfield, and enroute obstacle positions and elevations, the pilot must enter manufacturer charts prepared for the capabilities of his particular aircraft. Chart examples for the Cessna 337 are typical of performance charts provided by manufacturers. See Appendix Six. All of the pilot's calculations must show at least possible safe flight. Some larger aircraft and all commercially operated aircraft must comply with additional safety factors to fly the mission lawfully. For these purposes, aircraft descent, approach and landing performance data can and should be calculated by pilots, using existing conditions and manufacturer charts. All pilots are required by Federal Air Regulations to safely preflight plan every flight.

When an accident occurs, investigators seldom find that the pilot has actually gathered and calculated all of this data by the books and his negligence may be a cause.

Mechanical problems and unforeseen weather are often factors in performance-related accidents. Errors in manufacturer charts showing performance that is not actually possible or feasible, and navigation chart elevation errors should be considered.

The investigative report will probably have found pilot error and credited it as a cause in performance error accidents. The burden of proof will likely be on the pilot, or others, to show other causes.

7. Accidents caused by improper control and switch positions.

Aircraft accident investigations often disclose pilot misplaced cockpit electrical switches, control knobs and levers. The damage may only be to property: e.g., a forced landing without fuel to the engines but plenty in the tanks, a landing with the gear up. If the error caused wing flaps or slats to be mispositioned for take-off or landing, anti-icing equipment not turned on when required, navigation equipment mistuned or programmed, or aircrew warning devices inactivated, the only evidence of error and accident cause may be revealed upon examination of wreckage or accident reconstruction by use of aircraft performance computations and flight simulators. Cockpit design, failure or absence of pilot warning devices, incorrect or incomplete crew checklists and procedures, and faulty pilot training and supervision may be factors in pilot error accidents.

8. Accidents caused by ground servicing.

Pilots are required to inspect and determine that their aircraft are safe for intended flight. They also must rely on the work of others who repair, inspect, refuel, deice, and move their aircraft on the ground. All of these ground functions cause accidents and must be evaluated. Possible problem areas include mechanical, hydraulic, and electrical connections, misfueling and contaminated fuel, physical damage, installation of components beyond specified life, and failure to comply with required maintenance or modifications.

9. Accidents caused by the pressure of time.

At a recent Certified Flight Instructor refresher course the FAA lecturer asked the class for the significance of a series of slides he then projected. The first of each set showed the NTSB accident investigator's report of data, including aircraft and pilot information, time, date, place, and weather for this accident, followed by a picture of the accident scene. He showed a number of sets of these slides and no instructor pilot-student picked up on any significant and related factor. The lecturer then told the class to note the time and weather for each accident and compare that with the photo of the accident scene. The significance was immediate and striking for every accident. The accident scene photos, usually taken the following day on team arrival, showed a fine, sunny day. The accidents, occurring within the previous twenty-four hours, happened in night or in bad weather. What was the hurry? All too often pilots, aircraft owners, and operators place themselves under significant pressure to move people and cargo promptly and on time. Many people and organizations rely on rapid airplane transport. Airlines are tied to each others' routes and schedules. The pressure of time sometimes intrudes on good judgment. Although it may be obscured by more obvious factors such as weather, pilot error and equipment malfunctions. Faulty judgment from schedule pressures is a principal cause of aircraft accidents.

10. Accidents caused by physiological, psychological, and communication problems.

Routinely, the accident investigator examines pilot performance as it may have been affected by these problems. They can intrude on and even drive the performance of others who are in a position to cause accidents. On occasion, mechanics do not properly complete repairs, ground service personnel pump jet fuel into gasoline powered airplanes, Chief Pilots and Military Commanders launch the young pilot on missions they would not fly themselves, business executives decide at 3:00 a.m. to move their party by company plane to a new location without regard to weather and crew rest. Flight controllers give ambiguous instructions, weather briefers give bad information, manufacturers adopt an aircraft design to enhance style that degrades performance and stability. Government regulators fail to direct and enforce safety measures that seem unequivocally needed.

Out of expedience, any and all of these problems may appear in the investigative report as pilot error. The pilot has the ultimate authority and responsibility for safe operation of his aircraft. He may, by law, override any decisions or directives of any one else for safety, including refusing to fly and grounding the airplane. It is easy to attribute most accidents to pilot error, it is not always correct to do so.

In evaluating pilot human factors reported to have been an accident cause, the attorney should have the accident report reviewed by an FAA Designated Medical Examiner. This doctor will usually be a physician practicing in any branch of medicine whose personal interest and involvement in flying nas led him into aviation medicine as a side speciality. If the client is the pilot, he, too, should be examined by the physician. The combination of medical and flying skills, knowledge and interest in aviation clearly make Medical Examiners splendid sleuths in analyzing human factors in aircraft accidents. Because of their experience and formal certification in Aviation Medicine by FAA, these experts have superior credibility in court. Many of them have former Armed Services experience as flight surgeons. The medical examiner can help put into perspective the pilot's performance with that of other human errors and causes.

11. Ego as a cause of aircraft accidents

There are and always will be emotional, and even spiritual and mystical appeals to flying. It is a compelling craft. The memories of Lindbergh, St. Exupery, Earhart, Magee and Gagarin live on. For some pilots there is a compulsion to fly themselves and their machines to the outer limit. This is positive and rational, even essential to a nation. The young captain on an aerial demonstration team, who is hanging onto the wing of his leader with blind faith at five hundred knots and two hundred feet above the runway in an aileron roll, when the only hope in his heart is that this Saturday there is a kid in the crowd watching who will be captured by the love and thrill of flying, is a rational man. The old pilot waking his reluctant, long-of-tooth radial engine in predawn darkness for instrument flight over desolate, frozen lands and seas ruled by polar bears may be a sensible businessman. One would probably find these to be cautious, skilled, self-disciplined pilots in love with their jobs. Avocational pilots can also become cautious, and self-disciplined in their flying.

There are also many pilots, drawn to flying by its glamour, who do not have the resources or inclination to become skilled and who let bravado substitute for skill and daring.

There is a profound professional and ethical burden on aviation attorneys to independently, carefully, and scrupulously investigate and evaluate their cases. The burden is equally on plaintiff's and defendant's counsel to screen out specious cases, to settle those with merit, and to litigate only those with genuinely disputed facts.

12. Economics as a cause of Aircraft Accidents

Modern, well-equipped and maintained aircraft, flown by highly qualified pilots who are closely supervised and supported by good management produce a balance of the most efficient and safe transportation ever known to mankind. The very real economic pressures of a free market, however, can compromise safety. In the United States, Federal deregulation of the airline industry commenced in the late 1970's and continued into the next decade, transforming an industry which had operated almost from its inception with restrictions and protections. The transformation has approached laissez-faire, with all of its known advantages and disadvantages and cruelties. An airline accident that has been used to illustrate economic problems as they affect safety occurred on February 19, 1988, near the Raleigh-Durham International Airport in North Carolina. The commuter airliner departed to the south-east in night instrument weather conditions, and commenced a right-turn, as instructed by departure control toward a heading of 290°. The aircraft climbed to about 260 feet above ground level and then descended, while still in the turn, crashing into a reservoir near the shoreline. All aboard were killed, the aircraft was airborne for less than one minute. The only aircraft malfunction identified in the NTSB investigation was that the stall avoidance system (SAS) clutch switch was found in the disengage position and a filament in one of the annunciator panel's two SAS fault indicator light bulbs were found to have been stretched at impact, indicating the bulb was most likely illuminated at the time of crash. The light should illuminate with an SAS fault or when the clutch switch is moved to disengage.

The Board found no SAS malfunction from wreckage examination, so it was not determined why the pilots turned off the switch. The Board believed that the first pilot was making the takeoff and departure and that the captain was performing first officer (co-pilot) duties, since the captain was making the radio transmissions, and company policy divides crew duties accordingly. The company was operating under Chapter 11 of Federal Bankruptcy law as a feeder commuter airline for a major air carrier, and was using the major carrier's tail insignia, advertising, reservations and ticketing. The little commuter was experiencing many difficulties: turnover in management and pilots, aircraft and route changes, interruptions in pilot training and utilization. In its report NTSB stated the airline's management,

> created extraordinary conditions for the company, from early 1987 to the time of the accident, which limited its ability to adequately oversee its operations. During that time, the carrier moved its operations base several hundred miles, experienced considerable turnover in the management of its pilot operations as well as in its pilot ranks, acquired and then phased out a new and considerably more complex aircraft type, dramatically increased its number of pilots, intensively trained pilots, furloughed pilots, significantly expanded its route structure, significantly reduced its route structure, sustained a major accident (on December 17, 1987, the carrier's Metro II, on approach to Washington Dulles International Airport, experienced a dual engine failure and made a forced landing short of the airport during which one passenger was seriously injured and the aircraft was substantially damaged; the crew had failed to carry out proper inflight engine anti-icing procedures), and finally filed for bankruptcy. These factors suggested that the carrier's management significantly misjudged critical

> aspects of financial and operational planning. These misjudgements ..... extended to the oversight of the first officer (of Flight 33781).

NTSB found pilot errors as causes of the accident, stating in part:

> [T]he first officer allowed the airplane to descend due to the distracting effects of a perceived SAS malfunction, possible vertigo from the climb-out in IMC, a highly stressful situation, and relative inexperience in the type of instrument conditions that existed on the night of the accident.
>
> [T]he captain failed to adequately monitor the flight instruments, possibly due to his performing routine cockpit duties and the possible degradation of his sinus and gastrointestinal difficulties. The captain may also have been distracted by the need to respond to the perceived SAS fault.

The first officer was relatively inexperienced, had demonstrated marginal ability to fly this type aircraft in airline operations, and was paid an annual salary of about $11,000.00. The captain was well qualified and experienced in the airplane and had telephoned to his company earlier in the day of illness with flu symptoms, however he did not ask to be relieved of his flight. Both had been recently furloughed and recalled. NTSB also faulted the carrier's management and FAA surveillance of its operations. An interesting side note in this case study is the struggle to survive at the bottom end of this business pyramid, where a top executive of the major carrier may receive annual compensation one hundred times greater than that of the first officer who must fly the line in difficult weather, with aircraft and aircrew member problems, for an airline operating in bankruptcy.[22]

O. ICAO STUDIES AND ACTIONS RELATING TO AVIATION SAFETY

ICAO continuously promotes and participates in studies to improve every aspect of aviation safety. When problem areas are noted they are discussed in articles. When promising improvements are developed, ICAO helps to have them implemented by all concerned. Publicity is achieved in part through the ICAO Journal, published monthly, and available by subscription[23] The subjects covered may be very technical, however, they are addressed in language useful to a lay person, lawyer and experts alike. The journal and its sources can help with knowledge to evaluate accident factors not practically available because of the range of specialties involved and the costs of consultation. ICAO also produces many technical publications relating to air safety that are helpful in accident investigations.[24]

P. INTERNATIONAL FEDERATION OF AIRLINE PILOTS ASSOCIATIONS (IFALPA)

IFALPA is an International private association of

[22] Seth B. Golbey, Retrospective, AOPA Pilot Magazine, June 1989 at 3; and see NTSB Report of Accident: Fairchild Metro III N622 AV, Cary, N.C., February 19, 1988.

[23] ICAO Document Sales Unit, 1000 Sherbrooke Street West, Montreal, Quebec, Canada, H3A-2R2.

[24] Journal Articles concerning safety are listed in Appendix Seven. An example of an ICAO Journal Article reporting safety, a Boeing Company analysis of airliner accidents is included.

organizations, including the U.S. Air Line Pilots Association, that represent professional airline pilots from around the globe. As those first at the scene of an airliner accident, airline pilots are intensely interested in aviation safety. Airline pilot associations from seventy nations were represented at the 1990 IFALPA annual conference, which met in Washington, D.C. Almost all of the agenda items at this conference, more than fifty, addressed issues of aviation safety. Observer organizations included Aircraft Engineers International (AIE), Airport Associations Coordinating Council (AACC), European Flight Engineers Organization (EFEO), International Air Transport Association, (IATA), ICAO, International Federation of Air Traffic Controllers Association (IFATSEA), and the International Transport Worker's Federation (ITWF).

IFALPA can be a valuable source of information for evaluating airline accidents and safety hazards because their members gather their information in daily flying operations.[25]

Q. GENERAL AVIATION INFORMATIONAL SOURCES

In the United States, private organizations, such as the Aircraft Owners and Pilots Association (AOPA), and the AOPA-sponsored Air Safety Foundation, can provide information useful in evaluating accident reports and in making an independent investigation and evaluation of an accident. Their

[25] IFALFA may be contacted through the American office of ALPA: 1625 Massachusetts Ave. N.W. Washington, D.C. 20036. Tel. 703-689-2270.

services are provided to organization members, their publications are available to the general public. Where a chronic safety problem or a trend concerning aircraft, components, avionics, aviation services, government operations, and the pilot force has been identified, it is likely that AOPA will have reviewed and commented on it.[26]

The General Aviation counterpart of AOPA for manufacturers is The General Aviation Manufacturers Association (GAMA). This industry group represents thirty-six member companies, ranging from industry giants like United Technologies, the parent company of Cessna, to relatively small component manufacturers. GAMA's mission is to promote safe and efficient use of aircraft for business and pleasure in America, and in foreign markets world wide. It is possible that no other industry segment in America is more sensitive and responsive to safety concerns than that of General Aviation. The reasons for this are varied. First, GAMA member customers include the most successful "Fortune 500" companies. Next, an equivalent General Aviation aircraft in every category produced domestically is available from a foreign supplier. Finally, GAMA members fly in their own products and their customers will not tolerate dangerous products. GAMA can help attorneys who are trying to resolve product liability questions and problems and as a liaison with the manufacturer.[27]

---

[26] AOPA's address is AOPA , 421 Aviation Way, Frederick, Maryland, 21701.

[27] GAMA's address is 1400 K Street, N.W., Suite 801, Washington, D.C., 20005.

R. CONCLUSIONS ABOUT INVESTIGATING AND EVALUATING AIRCRAFT ACCIDENT CASES.

These are difficult cases requiring extraordinary work by counsel to investigate and evaluate. One experienced attorney sums up the need for independent inquiry as follows:

> Inexperienced lawyers will tend not to make an independent investigation into the facts and circumstances of an accident, believing that the Federal government, through the National Transportation Safety Board (NTSB) or the Federal Aviation Administration (FAA), will make a thorough examination. Unfortunately, such is rarely the case. The attorney cannot and must not rely on the Federal Government to do an adequate investigation. This is true even in the major airline disaster accidents. Many times the National Transportation Safety Board and Federal Aviation Administration investigators lack the expertise to conduct a complete investigation. Board personnel are frequently overloaded with case assignments so that the depth of their investigation is determined by the amount of time and personnel available. An in-depth search for causative factors may not be conducted. It has been the author's experience that many investigators are satisfied with "filling the squares," without verifying the accuracy of the information going into the squares. The factual aircraft accident report prepared by the field investigator should not be relied upon as factually accurate. Every item of consequence should be independently verified.[28]

General aviation accidents generate most product liability lawsuits for fairly obvious reasons. More of these airplanes fly and crash and there is usually less owner and operator insurance to pay claims as compared with major airlines. Pilots flying general aviation airplanes often have

---

[28] Boeing Commercial Airplane Group, Safety Study, ICAO Journal, Montreal, 11 (1990).

less supervision, experience, training, and developed skills to avoid problems and to cope with them when they occur. General aviation airplanes are seldom maintained to the standards of airliners, although they are comparatively much older. Product liability actions have impacted most adversely on general aviation manufacturers, and out of proportion to fault.

Aviation Tort Law is for practical purposes a specialization. Many practicing attorneys are experienced and active pilots themselves, which unquestionably that helps in accident litigation.

Aircraft accident investigation can draw on the knowledge of experts in almost every field. For most accidents, well qualified pilots, mechanics, physicians, engineers, air traffic controllers and weather personnel can address all of the questions presented. Some of this expert assistance is available to all parties at minimum cost, as the experts will have had some duty to evaluate the accident in the course of their employment. All parties should use these experts, to the extent they will cooperate, to evaluate the facts and suspected causes before litigation and the employment of party experts is begun.

If independent experts are needed, major universities, companies wholly independent of potential parties, professional consultants, and former employees of potential parties are frequently used sources.

After gathering and evaluating the best available information on cause and comparing it with potential defendants, the threshold decision of choosing the appropriate defendants can be made. Determining the theory of liability and selecting the proper forum are the next logical steps, and are usually interlinked.

A comprehensive source of legal and factual information for attorneys is the three Volume Treatise, Aviation Tort Law by Stuart M. Speiser and Charles F. Krause.[29] For the Sixth National Institute on Litigation in Aviation, sponsored by the American Bar Association Tort and Insurance Section, Mr. Krause suggested the following steps for attorneys investigating and evaluating a general aviation aircraft accident case.

A checklist of persons or agencies whose fault may have been a cause, is given in Aviation Tort Law:

1. Aircraft manufacturer and distributor, §19:1 *et seq.*
2. Subcontractors
3. Component parts manufacturers, §20:4
4. Aircraft operator, §13:5 *et seq.*
5. Aircraft owner, §14:3 *et seq.*
6. Commercial lessor, §§ 14:7 and § 20:6
7. Maintenance, repair, modification and overhaul, §§13:1 *et seq.* and 20:7 - 8
8. Corporate officers and other individuals, §20.9
9. United States of America, §§15:1 *et seq.* and 17:1 *et seq.*

[29] Stuart M. Speiser and Charles F. Krause, Aviation Tort Law, (1978).

10. Airport operator, §§21:1 *et seq.* and 17:1 et seq.

11. Flight training school, §14:10 *et seq.*

If a product defect is determined to be a cause the following legal foundations for an action are to be considered:

1. Negligence
2. Strict liability
3. Warranty
4. Statutory provisions (guest statutes, product liability, etc.)
5. Disclaimer
6. Contribution and indemnity
7. Damages
8. Releases
9. Statutes of limitations

If the decision is made that a product liability or other action is appropriate, the considerations of those who are appropriate parties and in which court the suit should be brought become important. In discussing this, Mr. Krause suggests:

> The selection of the proper forum, of course is, a critical decision. Subject matter and personal jurisdiction must exist. Sometimes it may be necessary to select two forums for purposes of getting proper jurisdiction and to combine the cases under §28 U.S.C. §1407 for purposes of consolidating the defendants on the issue of liability.

In selection of forum, counsel should also consider other courts to which the action may be removed for convenience or, which may be directed by a multidistrict litigation panel.

Critical to the selection of the jurisdiction, of course, is the choice of law rules of the selected forum, § 2.1 *et seq.* This will dictate a determination of whether or not your theory of liability can be successfully pursued.

Venue is also something that must be considered at length. Where you have more than one potential forum the calendar congestion, of course, can be significant. Also, as noted in Piper v. Reyno, 102 S.Ct. 2252 (1981), the choice of forum may very well dictate whether or not you have the opportunity to pursue the litigation to any extent in a U.S. jurisdiction.

Evidentiary considerations must also be in the forefront. What proof can be put in the case concerning damages and post-accident changes? For example, proof of inflation, use of experts, etc., can vary from jurisdiction to jurisdiction and should be considered before filing a complaint.

Contribution and indemnity are also significant when you have multi-defendant cases. Partial settlements must also be examined carefully. What effect can settlement with one joint tortfeasor have upon the remaining claims? For example, in New York the settlement with one potential defendant can be devastating to the ultimate collection of a full judgment in the event the settling tortfeasor turns out to be the one having primary responsibility.

Discovery rules also must be considered if you have a situation where the facts are going to be hard to uncover. For example, New York State court rules vary widely from the Federal Rules of Civil Procedure.

Insurance questions must be identified early and analyzed for the impact upon the proposed litigation, § 22:1 *et seq.*

Do not sell short the importance of analyzing your case thoroughly before filing a complaint. The prejudice to your lawsuit can be irreversible, damaging, and even fatal.[30]

If the litigation is commenced alleging product liability and the use of evidence already developed is not expected to suffice, then independent proof through experts, physical evidence and demonstrative tests must be developed. Sources of expert consultants have been discussed. If tests of components in laboratory or flight tests are needed, consideration must be given to what the tests will prove and their admissibility. Testing is expensive, and if the court is not satisfied that the conditions of test equate to those existing at the time of the accident, there will be problems of admissibility.

[30] Charles F. Krause, Threshold Decisions in General Aviation Litigation, American Bar Association Sixth National Institute on Litigation in Aviation, Washington, D.C. (1991).

The costs of products liability to the general aviation aircraft manufacturer have ended the production of new American aircraft historically used by young men and women to commence aviation careers. These entry-level aircraft, manufactured by such companies as Cessna, Piper and Beechcraft, set the world standard for safety and utility, and can no longer be economically manufactured. The costs of product liability insurance and lawsuits exceeds, in some instances, the total costs of labor, materials, and industrial capacity to produce the aircraft. The following BILL is proposed to the United States Congress to provide essential tort reform in this area of American enterprise which is vital to American commerce and national security. The BILL fully provides for compensation of persons injured by defective general aviation products.

H.R.________________________

S.________________________

A BILL

To regulate and promote interstate commerce by providing for uniform standards of liability for harm arising out of general aviation accidents. This bill applies to aircraft designated by the Secretary for Transportation through the Federal Aviation Agency and its Administrator as general aviation aircraft.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the "General Aviation Accident Liability Standards Act of 199_."

FINDINGS AND PURPOSE

Sec. 1. The Congress finds that:

(a) The manufacture of new general aviation aircraft in the United States has fallen almost ninety percent over the last ten years, the average age of such aircraft exceeds twenty years, and present production levels are not sufficient to replenish the fleet.

(b) There is a present shortage of training and other entry level general aviation aircraft that is not being met by United States production of new aircraft. These aircraft are essential to the vital need for training and flight experience of new young pilots for United States defense, other governmental, and commercial operations.

(c) The present system for determining liability and for compensating individuals injured and damaged by general aviation accidents are inadequate and inefficient, and vary widely throughout the United States and its Territories

(d) The costs of the present liability systems preclude profitable manufacture of new training and entry level general aviation aircraft that have proved through service to be the most safe and efficient.

(e) New innovation and development in the general aviation industry both as to aircraft and aircraft components is being unreasonably burdened by products liability litigation.

(f) The Federal Government has established uniform standards for design, function, materials, workmanship, testing, certification, maintenance, repair and modification of general aviation aircraft and their components.

(g) The Federal Government has established uniform standards of training and technical competence for persons engaged in the manufacture, testing, maintenance, repair, modification, and flying operations of general aviation aircraft and their components.

(h) The Federal Government has established uniform standards for those ancillary and support operations for general aviation aircraft, including navigation aids, ground facilities, air traffic control, weather observation and reporting, aviation medicine, enforcement, accident investigation. and safety actions.

(i) The Federal system of aviation regulation is uniform and exclusive for aviation operations and safety. Present costs of the widely varying liability systems have a severe and adverse affect on the production of new aircraft and recruitment and training of persons essential to future aviation operations and safety.

(j) It is the purpose of this Act to establish uniform standards for determining liability and for assessing damages for harm arising out of general aviation accidents.

DEFINITIONS

Sec. 2. As used in this Act, the terms:

(a) "Administrator" means the Administrator of the of the Federal Aviation Administration;

(b) "claimant" means any person who brings a general aviation accident liability action subject to this Act, and any person on whose behalf such an action is brought, including---

(1) the claimant's decedent; and

(2) the claimant's parent or guardian, if the action is brought through or on behalf of a minor or incompetent;

(c) "general aviation accident" means any accident which arises out of the operation of any general aviation aircraft and which results in harm;

(d) "general aviation aircraft" means any powered aircraft for which a type certificate or a worthiness certificate has been issued by the Administrator under the Federal Aviation Act of 1958 (49 App. U.S.C. 1301 et seq.) which, at the time such certificate was originally issued, had a maximum seating capacity of fewer than twenty passengers, and which is not, at the time of the accident, engaged in scheduled passenger carrying operations as defined in regulations issued under the Federal Aviation Act of 1958 (49 App. U.S.C. 1301 et seq..);

(e) "general aviation manufacturer" means---

(1) the builder or manufacturer of the airframe of a general aviation aircraft; and

(2) the manufacturer of the engine of a general aviation aircraft; and

(3) the manufacturer of any system, component, subassembly, or other part of a general aviation aircraft.

(f) "harm" means---

(1) property damage or bodily injury sustained

by a person;

(2) death resulting from such bodily injury;

(3) pain and suffering which is caused by such bodily injury; and

(g) "product" means a general aviation aircraft and any system, component, subassembly, or other part of a general aviation aircraft; and

(h) "property damage" means physical injury to tangible property, including loss of use of tangible property.

PREEMPTION; APPLICABILITY

Sec.3. (a) This act supersedes any State law regarding recovery, under any legal theory, for harm arising out of a general aviation accident, to the extent that this Act establishes a rule of law or procedure applicable to the claim.

(b) Nothing in this Act shall be construed to supersede or waive or affect any defense of sovereign immunity asserted by the United States or any State.

(c) Nothing in this Act shall be construed to affect the liability of a manufacturer, owner, or operator of any aircraft that is not a general aviation aircraft, or a person who repairs, maintains, or provides any other support for any aircraft that is not a general aviation aircraft, or for damages for harm arising out of the operation of an aircraft that is not a general aviation aircraft.

(d) No right of action for harm exists under this Act if that right would be inconsistent with the provisions of any applicable workers' compensation laws.

(e) The provisions of this Act shall apply only to---

(1) any manufacturer, owner, or operator of any general aviation aircraft, and any person who repairs, maintains, or provides any other support for such an aircraft;

(2) any occupant of a general aviation aircraft at the time of a general aviation accident, and any person who brings an action of harm caused by such accident on behalf of such occupant; and

(3) any non-occupant of a general aviation

aircraft at the time of a general aviation accident, only if such occupant is bringing an action for harm caused to an occupant of such aircraft at the time of such accident.

UNIFORM STANDARDS OF LIABILITY FOR GENERAL AVIATION ACCIDENTS

Sec. 4 (a) Any person claiming damages for harm arising out of a general aviation accident may bring an action against a party and may recover damages from such party, if such party was negligent and such negligence is a proximate cause of the claimant's harm.

(b)(1) Any person claiming damages for harm arising out of a general aviation accident may bring an action against a general aviation manufacturer of a product and may recover damages from such general aviation manufacturer if---

(A) the product, when it left the control of the manufacturer, was in a defective condition unreasonably dangerous for its intended purpose, according to engineering and manufacturing practices which were reasonably feasible, and/or if the product failed to meet the federal certification standards for such product.

(B) the defective and/or non-standard condition is a proximate cause of the claimant's harm; and

(C) the general aviation aircraft was being used at the time of the accident for the purpose and in a manner for which it was designed and manufactured.

(2) Any person claiming damages for harm arising out of a general aviation accident may bring an action against a general aviation manufacturer of a product and may recover damages from such general aviation manufacturer if---

(A) at the time the product left the control of the manufacturer, the manufacturer

(i) knew, or in the exercise of reasonable care should have known, about a danger connected with the product that caused the claimant's harm; and

(ii) failed to provide the warnings or instructions that a person exercising reasonable care would have provided with respect to the danger which caused the harm alleged by the claimant, unless such warnings or instruction if provided, would not have materially affected the conduct of the user of the product; or

(B) after the product left the control of general aviation manufacturer, the manufacturer--

(i) knew, or in the exercise of reasonable care should have known, about the danger which caused the claimant's harm; and

(ii) failed to take reasonable steps to provide warnings or instructions, after the manufacture of the product, which would have been provided by a person exercising reasonable care, unless such warnings or instructions, if provided, would not have materially affected the conduct of the product user; and the failure to provide warnings or instructions described in subparagraph (A) or (B) of this paragraph is a proximate cause of the claimant's harm.

(3) Any person claiming damages for harm arising out of general aviation accident may bring an action against a general aviation manufacturer of a product and may recover damages from such general aviation manufacturer if---

(A) the manufacturer made an express warranty with respect to the product;

(B) such warranty relates to that aspect of the product which caused the harm;

(C) the product failed to conform to such warranty; and

(D) the failure of the product to conform to such warranty is the proximate cause of the claimant's harm.

(c)(1) In an action governed by subsection (b) of this section, a general aviation manufacturer shall not be liable if such manufacturer proves, by a preponderance of the evidence, that

(A) the defective condition could have been corrected by compliance with action described in an airworthiness directive issued by the Administrator; and

(B) such directive was issued at a

reasonable time before the date of the accident and after the product left the control of the general aviation manufacturer.

(2) In any action governed by subsection (b) of this section, evidence of compliance with standards, conditions or specifications established, adopted and/or approved by the Federal Aviation Administration shall be admissible with regard to whether the product was defective and unreasonably dangerous for its intended purpose.

COMPARATIVE NEGLIGENCE AND RESPONSIBILITY

Sec.5. All actions for harm arising out of a general aviation accident shall be governed by the principles of comparative responsibility. Where claimant's conduct is found to be a cause of his harm it shall not preclude a recovery, but it shall reduce any damages awarded to the claimant proportionate to the negligence and responsibility of the claimant. The trier of fact shall make findings of causes, damages, and of comparative negligence and responsibility, indicating the percentage of total responsibility for the claimant's harm attributable to the claimant, each defendant, and any other person not a party to the action.

JOINT AND SEVERAL LIABILITY

Sec. 6. In any action for harm arising out of a general aviation accident---

(a) The manufacturer who is the builder or the manufacturer of the airframe of the general aviation aircraft causing harm is jointly and severely liable for harm caused by it and by any defective system, component subassembly or other parts that the manufacturer installed and or certified as part of the original type certificate approved and issued by the Administrator.

(b) The manufacturer of any defective system, component, subassembly or part of a general aviation aircraft causing harm is jointly and severally liable for damages caused by such defect.

(c) Any manufacturer and any other person liable under (a) and (b) of this section shall have the right to join, and/or to bring an action for indemnity contribution against any person with whom they are jointly liable for product defect.

TIME LIMITATION ON LIABILITY AND STATUTE OF REPOSE

Sec. 7. (a) Except that a manufacturer and seller has published and provided to the original purchaser an express warranty for a longer period of calendar time,no general aviation manufacturer shall be liable for a product defect causing harm that occurs more than twenty years from the date of delivery of the original product to the original purchaser, or lessee if the manufacturer leases the product. Where the product is a system, component, subassembly or part of a general aviation aircraft the twenty-year time limitation shall be determined from date of installation in the aircraft.

(b) This section does not limit by time a manufacturer or person's duty to replace, repair and/or modify defective parts and to warn an aircraft user of said defects where the Administrator has required such actions.

ADMISSIBILITY OF EVIDENCE

Sec. 8. Evidence of fault and of damages shall be that permitted by The Federal Rules of Evidence.

DAMAGES

Sec. 9. Claimants may recover compensatory money damages for harm caused by general aviation aircraft product defect without limit or cap, except as provided herein, in Sections 5 and 6. Punitive actions for general aviation product defect shall be taken by the Administrator, or where criminal provisions are implicated by appropriate Federal or State law enforcement agencies.

RULES OF COURT

Sec. 10. All actions brought under this Act shall be governed by The Federal Rules of Civil Procedure, Evidence, and other rules of court not in conflict with the spirit and purpose of this Act.

JURISDICTION

Sec. 11. (a) The District Courts of the United States, concurrently with the state courts, shall have original jurisdiction in all civil actions where the matter in controversy exceeds the sum or value of fifty thousand dollars ($ 50,000), exclusive of interests and costs for harm arising out of a general aviation accident and actions for indemnity or contribution pertaining thereto.

(b) A civil action under this Act which is brought by a claimant in a state court, may be removed to a federal district court for the district embracing the place where the action is pending, by any defendant named therein.

(c) Actions brought under this Act are the sole and exclusive products liability remedy for claimants seeking money damages for harms arising out of a general aviation accident.

(d) United State District Courts have jurisdiction under subsection (a) of this section where the accident giving rise to the claim occurred or where any plaintiff or defendant resides. On its own motion or, that of any party, the district court may consolidate actions arising from the same accident and may transfer an action to any other district for the convenience of parties and witnesses and in the interest of justice.

SEVERABILITY

Sec. 12. If any provision of this Act or its application is held invalid, the remainder of the Act and application of its provisions shall not be affected by such invalidation.

BIBLIOGRAPHY

TREATISES

57A Am. Jur. 2d §27.

63 Am. Jur. 2d Products Liability §§ 1, 5, & 537-8 (1984).

Black's Law Dictionary 1173 (5th Ed. 1979).

GAMA, General Aviation Statistical Databook (1990).

Fowler V. Harper et al., The Law of Torts, (2d ed. & Supp. 1986).

7b Michie's Jurisprudence of Virginia and West Virginia § 10.
Restatement (Second) of Torts §395 (1964).

STATUTES

Foreign Sovereign Immunities Act (FSIA) 24 U.S.C. § 1330 et. seq.

Mulitdistrict Litigation Act § 28 U.S.C. § 1407 (1988).

Hague Convention on Product Liability, 1972, 1056 U.N.T.S. 187.

OTHER AUTHORITIES

James B. Ames, Law and Morals, 22 Harv.L.Rev. 97 (1908).

Ian Awford, Developments in Aviation Products Liability, (1985).

Boeing Commercial Airplane Group, Safety Study, ICAO Journal, Montreal, 11, October 1990.

Kyle Brackin, Salvaging the Wreckage, Multidistrict Litigation and Aviation, 57 J.Air L.& Commerce 665 (1992).

Benjamin N. Cardozo, Law is Justice: Notable Opinions of Mr. Justice Cardozo.

Andrew Craig, Product Liability and Safety in General Aviation, in The Liability Maze (1991).

James S. Dillman, Aircraft Accident Investigation Procedures in the U.S.A., in IX Air Law 39 (1984).

Peter Garrison, Aftermath, Loose Needle, Flying Magazine, March 1992.

Patricia K. Gilmore and Julia A. Day, Litigation in Aviation; Litigating the Aviation Case (1988).

Seth B. Golbey, Retrospective, AOPA Pilot Magazine, June 1989, 3.

Patricia A. Goldman, NTSB Procedures, in IX Air Law 42 (1984).

James D. Gormley, Speech before the Canadian Aircraft Owners and Pilots Association, Edmonton, Canada, June 22, 1991.

Stanley J. Green, The Public Hearing: Should it Prevail?, in IX Air Law 47 (1984).

Leslie C. Green, Judge & Jury (1930).

William Kimble and Robert O. Lesher, Products Liability, Foreseeability, §73.

David Klein and Julian A. Waller, Causation, Culpability, and Deterrence in Highway Crashes, in U.S. Department of Transportation, Automobile Insurance and Compensation Study (1970).

Charles F. Krause, Threshold Decisions in General Aviation Litigation, American Bar Association Sixth National Institute on Litigation in Aviation, Washington, D.C. (1991).

Tom Lenhart, A modest proposal to encourage wider participation in investigations, in Air Law 50 (1984).

Beryl H. Levy, Cardozo and the Frontiers of Legal Thinking (1939).

James E. Link, II, Placards, Warning Labels and Operation Manuals: An Aircraft Manufacturer's Duty to Warn, 5 J.Air L. & Commerce 265 (1990).

Rod MacDonell and Andrew McIntosh, The Gazette, February 16, 1992.

Robert Martin, General Aviation Manufacturing; An Industry Under Seige, in IX The Liability Maze 485 (1991).

Michael Milde, Aircraft Accident Investigations in International Law, in IX Air Law 61 (1984).

NTSB Report of Accident: Fairchild Metro III N622 AV, Cary, N.C., February 19, 1988

NTSB Response to Petition for Reconsideration, (1990).

Scott Gordon Night, Products Liability: Component Part Manufacturer's Liability for Design and Warning Defects, 54 J.Air L. & Commerce 215 (1989).

Note, Boulineaux v. City of Knoxville, 13 U.S.Av.Rev. 145 (1937).

Joseph P. Pollard, Mr. Justice Cardozo (1935).

William L. Prosser, Strict Liability to the Consumer, 69 Yale L.J. 1099.

Teruo Sakamoto, Aircraft Accident Investigation Procedures, in IX Air Law 9 (1984).

Michael J. Sehr, Recent Developments in Aviation Case Law, 53 J.Air L. & Commerce 85 (1987).

Masao Sekiguchi, Aircraft Accident Investigation in Canada, the United States and Japan, (Unpublished LL.M. thesis, McGill University (Montreal)).

Frederick B. Sontag, GAMA, Annual Industry Review, (1991).

Stuart M. Speiser & Charles F. Krause, Aviation Tort Law (1978).

Thomas A. Street, Foundations of Legal Liability (1906).

Transportation Safety Board of Canada, Ministry of Supply and Services, Annual Report (1990).

Windle Turley, Aviation Litigation (1986).

M. Vigier, Aircraft Accident Investigation Procedures: The French System, in IX Air Law 5 (1984).

John H. Wigmore, Responsibility for Tortious Acts, 7 Harv.L.Rev. 441 (1894).

G.C. Wilkinson, U.K. Aircraft Accident Investigation Procedures, in IX Air Law 35 (1984).

Richard K. Willard, Report, Tort Policy Working Group, (1986).

Perez H. Winfield, History of Negligence, 42 Law Q.Rev. 184 (1926).

TABLE OF CASES

FEDERAL CASES

Held v. Mitsubishi Aircraft International, Inc., 672 F.Supp. 369 (D.Minn. 1987).

Huff v. White Motor Company, 565 F.2d 104 (7th Cir. 1977).

Huset v. J.I. Case Threshing Machine Co., 120 F.2d 865 (8th Cir. 1903).

In re Air Crash Disaster Near New Orleans, Louisiana, on July 9, 1982, 789 F.2d. 1092 (5th Cir. 1986).

In re Aircraft Crash Litigation, Frederick, Maryland, May 6, 1981, 752 F.Supp. 1326 (S.D. Ohio 1990).

In re Korean Air Lines Disaster of Sept. 1st, 1983, 932 F.2d. 1475 (D.C. Cir. 1991).

Lacy v. Cessna Aircraft Co., 932 F.2d. 170 (3rd. Cir. 1991).

Larson v. General Motors Corp., 391 F.2d 495 (8th Cir. 1968).

Lewis-DeBoer v. Mooney Aircraft Corporation, 728 F.Supp. 642 (D. Col. 1990).

Lindsay v. McDonnel Douglas Aircraft Corp., 352 F.Supp. 633 (D.Mo. 1972), affd. 485 F.2d 1388 (8th Cir. 1973).

Maguire v. Hughes Aircraft Corp., 912 F.2d. 67 (3rd. Cir. 1990).

Manos v. Trans-World Airlines, Inc., 324 F.Supp. 470 (D.Ill. 1971).

Middleton v. United Aircraft Corp., 204 F.Supp 856 (D.N.Y. 1960).

North American Aviation, Inc. v. Hughes, 247 F.2d 517 (9th Cir. 1957), cert. denied, 355 U.S. 914 (1958).

Novick. v. Textron, Inc., 375 So.2d 730 (4th Cir. 1979).

Off Shore Logistics, Inc. v. Tallentire, 106 S.Ct. 2485 (1986).

Passwaters v. General Motors Corp., 454 F.2d 1270 (8th Cir. 1972).

Polk v. Ford Motor Co., 529 F.2d 259 (8th Cir. 1976).

Petroleum Helicopters, Inc. v. AVCO Corporation, 930 F.2d.

389 (5th Cir. 1991).

Piper Aircraft Co. v. Reyno, 102 S.Ct. 252 (1981), reh. denied 102 S.Ct. 1296 (1982).

Rehler v. Beech Aircraft Corp., 777 F.2d 1072 (5th Cir. 1985).

Ross v. Up Right Inc., 402 F.2d 943 (5th Cir. 1978).

Tarwacki v. Royal Crown Bottling Co., 330 F.2d 253 (2d Cir. 1976).

Trump Taj Mahal Associates v. Costruzioni Aeronautiche Giovanni Augusta, S.P.A., 761 F.Supp. 1143 (D.N.J. 1991).

STATE CASES

Armour and Co. v. Leisure, 177 A. 393 (Md. 1939).

Barker v. Lull Engineering Co., 573 P.2d 443 (Cal. 1978).

Benedick v. Potts, 88 Md. 52 (Md. 1898).

Berkebile v. Brantly Helicopter, 337 A.2d 893 (Penn. 1975).

Cronin v. J.B.E. Olsen Corp., 501 P.2d 1153 (Cal.1972).

Campo v. Scofield, 95 N.E. 802 (N.Y. 1950).

Duncan v. Rockwell Manufacturing Co., 567 P.2d 936 (Mont. 1977).

Ford Motor Co. v. Simpson, 233 So.2d 797 (Miss. 1970).

Gayda v. USSR , 3 Av.L.Rep (CCH) (20 Av. Cas.) 17,634 (E.D.N.Y. Feb. 3, 1987).

Greenman v. Yuba Power Products, Inc., 377 P.2d. 897 (Cal. 1962).

Gelsumino v. E.W. Bliss Co., 295 N.E.2d 110 (Ill. 1973).

General Motors Corp. v. Hopkins, 548 S.W. 2d 344 (Texas 1977).

General Motors Corporation v. Howard, 244 So.2d 726 (Miss.

FOREIGN CASES

PRODUCT LIABILITY of UNITED STATES'

AIRCRAFT and COMPONENT MANUFACTURERS

VOLUME II - APPENDICES

Robert M. Byrom
Institute of Air and Space Law
McGill University, Montreal, P.Q., Canada
April 1993

A thesis submitted to the Faculty of Graduate Research in partial fulfillment of the requirements for the degree of Masters of Laws

III-A

"Product Liability Crisis Threatens U.S. General Aviation"

General Aviation Manufacturers Association

Suite 801
1400 K Street N.W.
Washington D.C. 20005-2485
(202) 393-1500

Product Liability Crisis Threatens U.S. General Aviation

The Problem

Unfair and exorbitant product liability costs have devastated U.S. general aviation manufacturers, consumers and service organizations. Claims paid by the industry have soared from $24 million to over $210 million in the past decade, even though the general aviation safety record has steadily improved. (1989 was the best year for general aviation safety in history.) These costs result in higher prices and put the purchase of a general aviation aircraft beyond the means of many potential consumers

The costs are being driven by an expansion of liability theory and an increase in the size of awards. Since manufacturers are primarily or wholly self-insured, the burden of awards, settlements and rapidly increasing defense costs falls directly on the manufacturers and, ultimately, the consumer.

" In Piper's case alone, defense costs -- exclusive of settlements and judgments -- average a quarter of a million dollars every month."

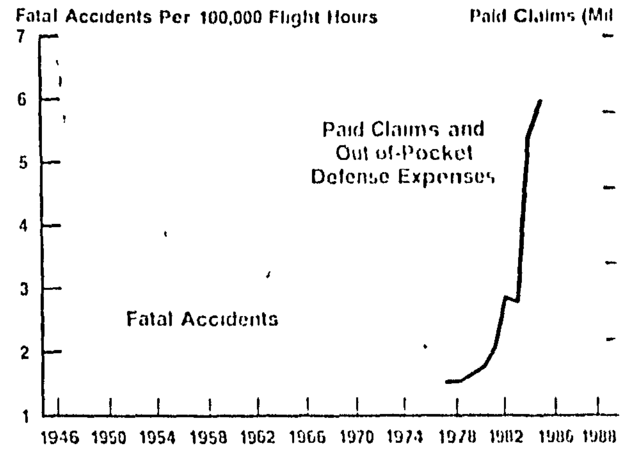
M. Stuart Millar, Owner, Piper Aircraft Corporation, Vero Beach, Florida

The U.S. industry remains liable in most states for over 200,000 domestic airplanes still in service -- a risk exposure not shared by our foreign competitors. This is an unreasonable burden, especially considering these airplanes average over 23 years of service and have been subject to modifications, maintenance and operation beyond the control of the manufacturer, and it gives the foreigners a competitive edge

" The safety record of general aviation improves every year as we continue to build excellent aircraft and emphasize professional pilot training and good pilot judgement. However, product liability costs continue to increase without regard to our current safety record."

Russell W. Meyer, Jr., Chairman and CEO, Cessna Aircraft Company, Wichita, Kansas

General Aviation Fatal Accidents and Paid Claims



The Consequences

- Entire aircraft model lines have been discontinue and factories closed
- Product liability costs are the largest single factor the price of a new single engine airplane
- Employment by aircraft manufacturers ha plummeted by more than 65 percent, for instance Cessna employment has fallen from over 20,000 i 1981 to fewer than 4,000 today
- Manufacturers are forced to spend more o defending lawsuits and less on technolo development
- Sales of domestic aircraft have declined from almo 18,000 units in 1978 to only 1,535 units in 1989.
- Foreign manufacturers are moving rapidly to fill th void left by the product liability crisis.
- The average age of the U.S. general aviation fleet i over 23 years

- Recently, my company scrapped a year's research on a totally new electronic ignition system The reason was not economic or technical--it was the potential product liability risk of being the pioneer of an innovative product

If we don't change the system to allow small businesses to innovate, more future products will come from overseas As an American entrepreneur, I'd like to get on with the business of building America We must solve the product liability problem that is suffocating the creativity of small business "

Rick Sontag, President, Unison Industries, Rockford, Illinois

The Solution

" I believe that it is absolutely vital that we enact tort reform legislation this year. General aviation, in particular, which is a major part of our air transportation system, is today facing a crisis of unprecedented proportions Its very survival is threatened."

Senator Nancy Kassebaum (R-KS).

General aviation liability reform legislation has been introduced in the United States Senate (S. 640) and House of Representatives (H R 1307). These bills would

- Establish uniform federal standards that would apply to an already **totally federally regulated industry**
- Apply <u>only</u> to general aviation aircraft seating fewer than 20 passengers and <u>not</u> involved in scheduled service.
- Establish comparative fault, so that manufacturers are no longer held financially responsible for the actions of others beyond their control.
- Limit manufacturers' liability to a fair and realistic time period, but not change their responsibility to prescribe corrections for defects and notify owners.
- Not limit awards or limit attorney's fees.

" . this legislation is a moderate approach. It does not cap damages nor does it cap attorney's fees. It is based on careful studies and consideration of the various measures that have been considered in the past, plus the special issues that are involved in aircraft accidents It is designed with the interests of both those who use and those who manufacture planes in mind It is fair and balanced legislation."

Representative Dan Glickman (D-KS).

Why a Separate General Aviation Bill

General Aviation is totally regulated by the feder. government: from the design and manufacture (aircraft and component parts to federal licensing (pilots and mechanics to the control of air traffic an even accident investigation Yet, liability after a accident is decided based upon laws which diffe significantly from state to state

The inherent and serious conflicts between feder regulatory standards and widely divergent state liabilit laws can only be resolved through the establishmer of federal standards of liability by Congress.

Who Supports the Bill?

S. 640 and H.R 1307 are supported by *all majo general aviation consumer, manufacturer and servic organizations* including the Aircraft Owners and Pilot: Association, the Experimental Aircraft Association, the General Aviation Manufacturers Association, the Helicopter Association International, the Nationa Agricultural Aviation Association, the Nationa Aeronautic Association, the National Air Transportatior Association and the National Business Aircraf Association.

General aviation tort reform has also been supported during the 99th and 100th Congresses by the U S. Department of Transportation, the U S. Department of Justice, and the U.S. Department of Commerce.

What Others Say

" Welcome to an industry killed by lawyers" -- *The Economist*

" (The industry) was in large measure destroyed by our courts" -- *New Jersey Star-Ledger*

" Foreign manufacturers don't have that liability anchor around their necks " -- FAA

" There is an international market advantage at hand for European companies if the issue is handled with vision." -- *Air Pictorial* (Great Britain)

" Congress should act promptly to prevent further erosion in this segment of the U.S. aerospace business base." *Aviation Week & Space Technology*

Historically, the United States Air Force and Navy have relied on United States aircraft manufacturers for its training and combat aircraft. These are sources that are the most secure in wartime and the least susceptible to interference for replacement parts and technical support. All of the aircraft candidates for the replacement, entry level trainers, of the trainers now in service with the Navy and Air Force are of foreign design and manufacture. These foreign manufacturers are Pilatus (Switzerland), Agusta (Italy), Aermacchi (Italy), MBB (Germany), and FMA (Argentina). Earlier, the USAF selected a British aircraft, by Slingsby Aviation Ltd., as its new flight screening airplane for lack of an available, new American aircraft.

They can't fly very high, fast, or far. Their cockpits aren't pressurized, and some even lack ejection seats. They have antiquated, steam-gauge-type instruments. Their pilots suffer a disproportionate number of in-flight physical problems.

Such are the shortcomings of the Air Force T-37 and Navy T-34, the services' two primary aircraft training systems (PATS) and the reason the two services are looking for something new. One need not be an expert to see that the Air Force must soon field a replacement PATS. It has flown the T-37 since 1958, and all agree that it is outmoded. The same is true of the Navy's T-34C.

After mulling the problem over for several years, the services are now moving briskly to solve it. They will keep the old planes flying a while longer, but the Air Force and Navy have come to terms on, and are accelerating the pace of, a multibillion-dollar drive to produce the Joint Primary Aircraft Training System (JPATS), which shapes up as one of the largest aircraft programs of the next decade. Plans call for JPATS to be a small, nondevelopmental aircraft capable of flying at 250 knots at low level. The program includes simulators.

In high-level meetings this year, the Air Force and Navy reached agreement on official JPATS requirements, giving the plan added momentum. The Pentagon scheduled a May meeting of the Defense Acquisition Board, its highest review body, to examine JPATS and give it official program status. The Pentagon also planned to release an operational requirements document.

Money has begun to flow into the effort. In Fiscal 1992, the Air Force is spending $3 million on JPATS. The service plans to allocate another $3 million in Fiscal 1993 and then, in Fiscal 1994, boost spending to $60 million. USAF's new Program Objective Memorandum for Fiscal 1994–99, now being formed, will set funding levels for the rest of the 1990s.

At Air Training Command headquarters, Randolph AFB, Tex., officers welcome these actions. Maj. Gen. Larry L. Henry, deputy chief of staff for Plans and Requirements, sums up the attitude with this rhetorical question: "If you had a son or daughter in pilot training and they were going out to do aerobatics ten years from now, would you want them in a forty-five-year-old airplane?"

Initially, the Air Force planned to buy 535 air vehicles. That figure has since been reduced three times. Now, plans call for buying 417 air vehicles with associated simulators, which the Air Force unofficially says will number about forty.

The current Navy plan calls for buying 347 aircraft. That number, however, was set before changes in the undergraduate naval flight officer syllabus, which essentially doubled T-34 flight hours. Thus, the Navy buy could increase. Says the Navy's JPATS Requirements Officer Lt. Cmdr. Clay Umbach, "We know we'll need somewhere around 350."

Service officials are reluctant to hang a price tag on the program. One rough estimate, given by General Henry but only with many qualifiers attached, is that the Air Force could spend about $4 billion for the total system. The Navy provides no overall figure, but signs are that its part of the program could come close to $4 billion.

In its 1988 Trainer Master Plan, the Air Force identified the need for a new PATS. A short time later, the Navy also began to search for its own new system. The Department of Defense suggested that the Air Force and Navy go for a single plane. The result was JPATS.

By Frank Oliveri, Associate Editor

III-B

AOPA Brief on Piper Accident,

and Continental Engines lawsuit

PRODUCT LIABILITY ON TRIAL, CONTINUED

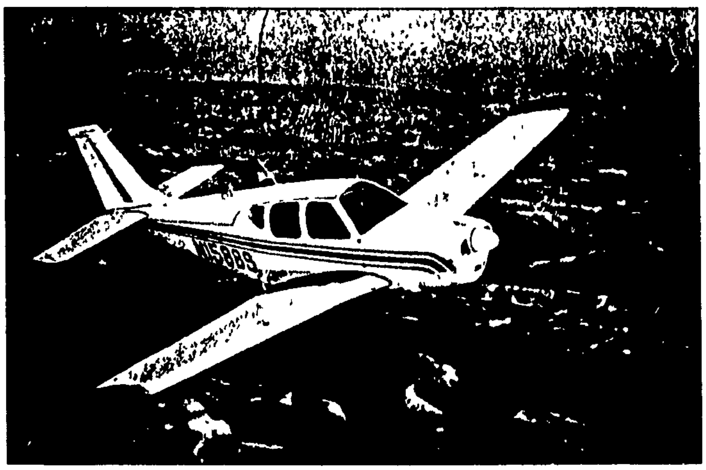
BY JOHN S. YODICE

In the December 1992 *AOPA Pilot*, we reported on a product liability case that has caused quite a stir ("Pilot Counsel: Product Liability: A Case Study"). A New Mexico jury returned a $2.5-million verdict against Piper Aircraft Corporation and others, in favor of an injured pilot whose Super Cub collided with a van intentionally parked on the runway to prevent his takeoff. The lawsuit alleged that Piper was negligent in the design of the Super Cub because the tailwheel Cub had inadequate rear-seat forward visibility during takeoff. The lawsuit also alleged that Piper was negligent because it did not install a rear-seat shoulder harness. Our column stirred up quite a bit of mail from our members, indicating a high degree of interest in the subject.

So this month, we are reporting on two other recent and celebrated general aviation product liability cases. One is famous because it produced what is probably the largest product liability verdict in aviation history—$107.3 million against Teledyne Continental Motors. The other is heralded by the *National Law Journal* as one of 1992's most outstanding defense wins in a product liability case—a jury verdict in favor of Beech Aircraft Corporation. The cases are similar in that they both involved a tragic ending to an instrument approach in weather conditions down to minimums, seemingly unrelated to any product defect. Yet the juries reached vastly different conclusions.

The $107.3 million jury verdict was awarded last February because of a 1986 crash of a Beechcraft Debonair near the Smith Reynolds Airport in Winston-Salem, North Carolina. What we know of the case comes from the report of the accident by the NTSB, as well as a press release issued by the plaintiffs' attorneys.

The flight started out fairly routinely. The husband and wife, both research scientists for Eastman Kodak and both instrument-rated private pilots, were traveling with their two young sons from their home in Rochester, New York, to their southern Virginia farm for Thanksgiving. They had made the trip several times before and were familiar with the Winston-Salem airport. The husband checked weather with the Buffalo Flight Service Station twice that morning and filed an instrument flight plan.



Beech Debonair

The flight departed and proceeded uneventfully. As the flight approached Winston-Salem, the wife asked the tower to advise the rental car agency that they would be about 30 minutes late. She had been unable to raise anybody on unicom. She also asked, "Are people making it in on your approach okay?" The tower replied, "Yes, ma'am, so far every aircraft that's attempted the approach has made it at some time or the other."

Ultimately, the flight was cleared for an ILS approach to Runway 33 at Winston-Salem. The decision height for the approach was 200 feet agl, and the required visibility minimum was one-half mile. The weather at the time was indefinite ceiling of 200 feet, sky obscured, and visibility one-half mile in fog.

The pilot reported outer marker inbound on the ILS. There was no indication of any trouble. The flight was cleared to land. It never made it. It crashed about one-fourth mile right of the localizer course about 2 miles south of the runway. All on board were killed.

The NTSB investigation faulted the pilot for a poor approach and for probably descending below decision height without having the required visibility. The NTSB investigation report went on to state, "The engine examination failed to disclose any system malfunction or failures. The engine was mounted and operated normally after the essential repairs were completed."

Suit was brought in federal court in Rochester. The plaintiffs' attorneys were extremely critical of the NTSB investigation, terming it "superficial." The plaintiffs' attorneys were able to prove to the satisfaction of the jury that what caused the accident was a fire that erupted when fuel leaked from one of the aircraft engine's injection nozzles and dripped onto the airplane's hot exhaust pipes during the approach. They were able to satisfy the jury that Teledyne Continental Motors was negligent and responsible for the fire. According to the plaintiffs' attorneys, after the hot fuel ignited, the fire spread into the passenger cabin and burned the family to death. The attorneys charged that Continental was aware of the problems with this engine from ongoing written communication and in fact supplied the owner with the remanufactured engine that was in the aircraft at the time of the crash.

The $107.3 million verdict comprised only compensatory damages. There were no punitive damages. Members of the jury said that they wanted to send a "clear-cut" message to the manufacturer for what they considered negligence.

The beneficiaries of the family estate are the sister of the husband pilot and the mother of the wife-pilot.

The other case involved the crash of a Beech King Air F90 near the Sierra Blanca Regional Airport near Ruidoso, New Mexico. The husband, a multiengine and instrument-rated private pilot, and his wife were flying from Carlsbad, California, on an IFR flight plan to Ruidoso. The pilot obtained a telephone weather briefing prior to departure.

As the flight approached Ruidoso, it was cleared for an NDB approach to Runway 24 by Albuquerque Center. When some 30 miles out, the pilot asked Sierra Blanca Tower for the weather and was told that the ceiling was 800 feet, sky obscured, and visibility less than 1.5 miles in blowing snow. The minimum descent altitude for the approach was 700 feet, and the required visibility was 1 mile. The King Air was instructed to report the NDB inbound on the approach. The report was never made. The airplane crashed on a ridge, killing both persons on board. Witnesses saw the aircraft come out of the clouds, pointed straight down. The aircraft struck the ground in a near vertical, nose-down attitude.

The NTSB determined that the probable cause of the accident was "loss of control due to pilot disorientation while conducting a non-precision instrument approach. Contributing to the accident was the pilot's lack of instrument and multiengine experience, and the existing adverse weather."

The heirs of the pilot and his wife filed a wrongful death product liability action in state court in California against three manufacturers: Pratt & Whitney Canada, Allied-Signal, and Beech Aircraft, charging that the accident was caused by a malfunctioning fuel control unit. They contended that contamination in this unit hampered the supply of fuel to the engines, causing a loss of power, which in turn caused the pilot to lose control of the airplane on the approach.

The fuel control unit was made by Allied-Signal, the engines were made by Pratt & Whitney Canada, and the aircraft manufactured by Beech. Shortly before trial, Allied-Signal and Pratt & Whitney settled for a total of $600,000. Beech ended up as the main target. The potential for a large verdict was high. The pilot, then 51 years old, was the owner of a real estate development company. He had a yearly income in excess of $1 million, plus other real estate deals that had been bringing in more. The plaintiffs' lawyers were seeking $40 million in compensatory damages and $50 million in punitive damages.

Beech vigorously defended the suit. Beech acknowledged the plaintiffs' evidence of contaminants but countered that these contaminants "either could not have been in the system while the plane was operating, or that the amount of the contaminants was so minute, so microscopic, that they could not have caused any problem." The defense contended that the accident was caused by bad weather and the pilot's inexperience. "Our belief was that he became disoriented and lost control of the aircraft."

The jury agreed and, on September 27, 1992, found no cause for action against Beech.

Beech's cost of defending this suit was in the millions.

Both of these cases, as well as the Piper case reported in December, give us a good insight into the product liability problems in general aviation, how they come about, and the uncertainty of the results. We keep struggling for solutions. □

IV-A

Annex 13 to the Convention on International Civil Aviation

INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES

AIRCRAFT ACCIDENT INVESTIGATION

ANNEX 13

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

SEVENTH EDITION — MAY 1988

This edition incorporates all amendments adopted by the Council prior to 23 January 1988 and supersedes, on 17 November 1988, all previous editions of Annex 13.

For information regarding the applicability of the Standards and Recommended Practices, *see* Chapter 2 and the Foreword.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

AMENDMENTS

The issue of amendments is announced regularly in the *ICAO Bulletin* and in the monthly *Supplement to the Catalogue of ICAO Publications*, which holders of this publication should consult. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS				CORRIGENDA			
No	Date Applicable	Date entered	Entered by	No.	Date of issue	Date entered	Entered by
18	Incorporated in this edition						

TABLE OF CONTENTS

ATTACHMENTS TO ANNEX 13

FOREWORD

Historical Background

Standards and Recommended Practices for Aircraft Accident Inquiries were first adopted by the Council on 11 April 1951 pursuant to Article 37 of the Convention on International Civil Aviation (Chicago, 1944) and were designated as Annex 13 to the Convention. The Standards and Recommended Practices were based on recommendations of the Accident Investigation Division at its First Session in February 1946 which were further developed at the Second Session of the Division in February 1947.

The Fourteenth Session of the Assembly (Rome, August-September 1962) considered the subject of aircraft accident investigation and adopted Resolutions A14-22 and A14-27, Appendix P.* The first of these

1) *directed* "the Council to:

"a) study the possibility of initiating a uniform procedure to be used by States to make available promptly the reports of aircraft accident investigations and inquiries, particularly when related to large modern transport aircraft, so that the dissemination of such reports by all Contracting States may be improved;

"b) study whether it is practicable to establish procedures by which the State of Manufacture or the State that first certificated the aircraft type, would, in appropriate cases and upon invitation, make available competent experts for advice or consultation in the investigation of accidents, and in the light of the results of such study,

"i) determine the most practicable means of ensuring that the fullest possible advantage will be taken of the specialized knowledge of such experts and notify all Contracting States accordingly, and

"ii) urge all Contracting States to co-operate in the use of such experts so as to contribute to the safety of air navigation;"

and

2) *urged* "all Contracting States to provide timely notification of aircraft accidents, especially those involving large modern transport aircraft, to the State of Manufacture or the State that first certificated the aircraft type, whenever it is considered that such action would be appropriate."

In addition, by Resolution A14-27, Appendix P, the Assembly resolved that, "in respect of accident investigation, that it is of great importance for the general improvement of the safety of air navigation that, to the greatest practicable extent, a Contracting State in which an accident has occurred involving aircraft other than of its manufacture communicate to the State of Manufacture as soon as possible any pertinent information which results from the inquiry and which may reflect on the airworthiness of the aircraft type or its equipment, or which might be used to effect improvement in safety."

Table A shows the origin of subsequent amendments together with a list of the principal subjects involved and the dates on which the Annex and the amendments were adopted by the Council, when they became effective and when they became applicable.

Applicability

While the Annex has been adopted pursuant to the provisions of Article 37 of the Convention, Aircraft Accident Inquiry is itself the subject of Article 26 of the Convention. This Article imposes an obligation on the State in which the aircraft accident occurs to institute an inquiry in certain circumstances and, as far as its laws permit, to conduct the inquiry in accordance with ICAO procedure. However, Article 26 does not preclude the taking of further action in the field of aircraft accident investigation and the procedures set forth in this Annex are not limited solely to an inquiry instituted under the requirements of Article 26, but under prescribed circumstances apply in the event of an inquiry into any "aircraft accident" within the terms of the definition herein. In order to maintain the correct relationship between the provisions of Article 26 and those of the Annex, the following principles have been observed:

a) Article 37 of the Convention is the Controlling Article in the development of an Aircraft Accident Inquiry Annex, but nothing in the Annex must contravene the express terms of Article 26, or any

* The Fifteenth Session of the Assembly (Montreal, June-July, 1965) subsequently adopted Resolution A15-8, Appendix P which consolidated and superseded resolving clause 2 of Resolution A14-22 and Resolution A14-27, Appendix P.

other Article of the Convention, nor should it contain any provision which would do violence to the spirit and intent of the Convention

b) Subject to a) the Annex may deal with any relevant matter whether or not expressly dealt with by Article 26 or by any other Article of the Convention. For instance it is not a contravention of the Convention for the Annex to deal with the rights or obligations of States other than the State of Registry and the State in which the accident occurred; similarly the Annex may deal with the privileges to be accorded to observers entitled by Article 26 to be "present" at the inquiry. These are matters upon which Article 26 is silent The Annex may also deal with accidents of a kind which do not fall within the provisions of Article 26.

Relationship between Annex 13 and Article 26 of the Convention

In order to clarify the relationship between the provisions of Article 26 and those of the present Annex the Council, at the 20th meeting of its Twelfth Session on 13 April 1951, adopted the following additional resolution.

"*Whereas* Article 26 of the Convention provides that a State in which an accident to an aircraft occurs within the terms of the Article, 'will institute an inquiry into the circumstances of the accident in accordance, in so far as its laws permit, with the procedure which may be recommended by the International Civil Aviation Organization', and

"*Whereas* the Council, at the 18th meeting of its Twelfth Session on 11 April 1951, adopted Annex 13 on Aircraft Accident Inquiry,

"*The Council recommends* the Standards and Recommended Practices for Aircraft Accident Inquiry contained in Annex 13 to the Convention, as the procedure to be followed by Contracting States for inquiries into accidents involving death or serious injury and instituted in accordance with the provisions of Article 26,

"*It being understood:*

"1) that States may in accordance with Article 38 of the Convention, deviate from any provision of Annex 13, except that, with respect to accidents covered by terms of Article 26 of the Convention and pursuant to this Article, 'the State in which the accident occurs will institute an inquiry', 'the State in which the aircraft is registered shall be given the opportunity to appoint observers to be present at the inquiry' and 'the State holding the inquiry shall communicate the report and findings in the matter to that State'; and

"2) that the procedure here recommended is not applicable when an accident to an aircraft not involving death or serious injury 'indicates serious technical defect in the aircraft or air navigation facilities', in which cases and until ICAO recommends a procedure to this effect, the inquiry shall be conducted in accordance with the national procedure of the State concerned, subject to the obligations deriving from the provisions of Article 26."

The accredited representative and the advisers referred to in the Annex together comprise the observers that are given the right to be present at an inquiry under Article 26.

Action by Contracting States

Notification of differences. The attention of Contracting States is drawn to the obligation imposed by Article 38 of the Convention by which Contracting States are required to notify the Organization of any differences between their national regulations and practices and the International Standards contained in this Annex and any amendments thereto. Contracting States are invited to extend such notification to any differences from the Recommended Practices contained in this Annex and any amendments thereto, when the notification of such differences is important for the safety of air navigation. Further, Contracting States are invited to keep the Organization currently informed of any differences which may subsequently occur, or of the withdrawal of any differences previously notified. A specific request for notification of differences will be sent to Contracting States immediately after the adoption of each amendment to this Annex.

Attention of States is also drawn to the provisions of Annex 15 related to the publication of differences between their national regulations and practices and the related ICAO Standards and Recommended Practices through the Aeronautical Information Service, in addition to the obligation of States under Article 38 of the Convention.

Use of the text of the Annex in national regulations. The Council, on 13 April 1948, adopted a resolution inviting the attention of Contracting States to the desirability of using in their own national regulations, as far as is practicable, the precise language of those ICAO Standards that are of a regulatory character and also of indicating departures from the Standards, including any additional national regulations that were important for the safety or regularity of air navigation. However, the

Standards and Recommended Practices of Annex 13 while of general applicability will, in many cases, require amplification in order to enable a complete national code to be formulated.

Status of Annex Components

An Annex is made up of the following component parts, not all of which, however, are necessarily found in every Annex; they have the status indicated.

1.—Material comprising the Annex proper.

a) *Standards* and *Recommended Practices* adopted by the Council under the provisions of the Convention. They are defined as follows:

Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.

Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interests of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.

b) *Appendices* comprising material grouped separately for convenience but forming part of the Standards and Recommended Practices adopted by the Council.

c) *Provisions* governing the applicability of the Standards and Recommended Practices.

d) *Definitions* of terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

2.—Material approved by the Council for publication in association with the Standards and Recommended Practices.

a) *Forewords* comprising historical and explanatory material based on the action of the Council and including an explanation of the obligations of States with regard to the application of the Standards and Recommended Practices ensuing from the Convention and the Resolution of Adoption.

b) *Introductions* comprising explanatory material introduced at the beginning of parts, chapters or sections of the Annex to assist in the understanding of the application of the text.

c) *Notes* included in the text, where appropriate, to give factual information or references bearing on the Standards or Recommended Practices in question, but not constituting part of the Standards or Recommended Practices.

d) *Attachments* comprising material supplementary to the Standards and Recommended Practices, or included as a guide to their application.

Selection of Language

This Annex has been adopted in four languages — English, French, Russian and Spanish. Each Contracting State is requested to select one of those texts for the purpose of national implementation and for other effects provided for in the Convention, either through direct use or through translation into its own national language, and to notify the Organization accordingly.

Editorial Practices

The following practice has been adhered to in order to indicate at a glance the status of each statement: *Standards* have been printed in light face roman; *Recommended Practices* have been printed in light face italics, the status being indicated by the prefix **Recommendation**; *Notes* have been printed in light face italics, the status being indicated by the prefix *Note*.

The following editorial practice has been followed in the writing of specifications: for Standards the operative verb "shall" is used, and for Recommended Practices the operative verb "should" is used.

Any reference to a portion of this document which is identified by a number includes all subdivisions of that portion.

Table A. Amendments to Annex 13

Amendment	*Source(s)*	*Subject*	*Adopted Effective Applicable*
1st Edition	First and Second Sessions of the Accident Investigation Division		11 April 1951 1 September 1951 1 December 1951
1 (2nd Edition)	Assembly Resolutions A14-22 and A14-27, Appendix P Third Session of the Accident Investigation Division	New definitions, rights and obligations of the State of Manufacture, initial and subsequent notification of an accident, attendance of representatives of the operator, report on the inquiry, summary of the Report and its format	24 November 1965 24 March 1966 25 August 1966
2	Third Session of the Accident Investigation Division	Communication procedures for sending aircraft accident notification	5 December 1966 5 April 1967 24 August 1967
3	Personnel Licensing/ Training Practices/ Medical Divisional Meeting (1970)	Autopsy of victims of aircraft accidents and reporting of the results	27 March 1972 27 July 1972 7 December 1972
4 (3rd Edition)	Air Navigation Commission study	Notification of all accidents to multi-engined aircraft of over 2 250 kg (5 000 lb), notification and exchange of information on incidents	12 December 1972 12 April 1973 16 August 1973
5 (4th Edition)	Accident Investigation and Prevention Divisional Meeting (AIG/1974) Committee on Unlawful Interference	Change of title, deletion and addition of definitions, objective of an investigation, use of flight recorders and privileged status to be granted to certain investigation records, action to be taken by a State receiving safety recommendations, responsibility of the State of Registry to participate in the investigation of certain accidents when requested, to provide flight recorders under certain circumstances and to request participation of the State of Manufacture when the former State conducts the investigation and matters of airworthiness are involved, rights and obligations of the State of Manufacture to participate in certain investigations, rights and entitlement of the State having special interest in an accident by virtue of fatalities to its citizens, the Accident/Incident Data Reporting (ADREP) system, Investigator-in-charge to inform aviation security authorities, when necessary	18 December 1975 18 April 1976 12 August 1976
6 (5th Edition)	Accident Investigation and Prevention Divisional Meeting (AIG/1974)	Addition of the words "on the basis of his qualifications" in the definitions of accredited representative, adviser and investigator-in-charge, new definition and specifications regarding the State of the Operator in the case of aircraft leased, chartered or interchanged, responsibility of the State of Registry for sending accident notification any time that State institutes the investigation, co-ordination between investigator-in-charge and judicial authorities, elimination of reference to number of engines; new specification for publication of the Final Report	24 November 1978 24 March 1979 29 November 1979
7 (6th Edition)	Accident Investigation and Prevention Divisional Meeting (AIG/1979)	Addition, in the definition of accident, of injuries inflicted by parts of an aircraft or by jet blast, strengthening of the general specification concerning the conduct of the investigation, strengthening of the specification regarding disclosure of records, strengthening of the specification for consultation on the Final Report, deletion of the specifications regarding a "Summary of the Final Report" and references thereto, change of the specification concerning the forwarding to ICAO of the Final Report, expansion of the specification on publication of the Final Report or related documents, new chapter on accident prevention measures, new attachment regarding exchange of Final Reports between States and a list of Final Reports available in States	24 November 1980 24 March 1981 26 November 1981

Amendment	*Source(s)*	*Subject*	*Adopted Effective Applicable*
8 (7th Edition)	Air Navigation Commission	Addition, in the definition of serious injury, of exposure to infectious substances and injurious radiation, new attachment regarding disclosure of records, editorial changes	22 January 1988 22 May 1988 17 November 198

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

CHAPTER 1. DEFINITIONS

When the following terms are used in the Standards and Recommended practices for Aircraft Accident Investigation they have the following meaning.

Accident. An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

a) a person is fatally or seriously injured as a result of:

- being in the aircraft, or
- direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
- direct exposure to jet blast,

except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew, or

b) the aircraft sustains damage or structural failure which

- adversely affects the structural strength, performance or flight characteristics of the aircraft, and
- would normally require major repair or replacement of the affected component,

except for engine failure or damage, when the damage is limited to the engine, its cowlings or accessories, or for damage limited to propellers, wing tips, antennas, tires, brakes, fairings, small dents or puncture holes in the aircraft skin, or

c) the aircraft is missing or is completely inaccessible.

Note 1. — For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified as a fatal injury by ICAO.

Note 2. — An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located.

Accredited representative. A person designated by State, on the basis of his qualifications, for the purpose c participating in an investigation conducted by anothe State.

Adviser. A person appointed by a State, on the basis o his qualifications, for the purpose of assisting it accredited representative at an investigation.

Aircraft. Any machine that can derive support in th atmosphere from the reactions of the air other than th reactions of the air against the earth's surface.

Cause. Action(s), omission(s), event(s), condition(s), o a combination thereof, which led to the accident o incident.

Flight recorder. Any type of recorder installed in th aircraft for the purpose of complementing accident/ incident investigation.

Note.— See Annex 6, Parts I, II and III, for specifi cations relating to flight recorders.

Incident. An occurrence, other than an accident associated with the operation of an aircraft which affect or could affect the safety of operation.

Note.— The type of incidents which are of main interes to the International Civil Aviation Organization for accident prevention studies are listed in the ICAO Accident/Incident Reporting Manual *(Doc 9156).*

Investigation. A process conducted for the purpose of accident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of cause(s) and, when appropriate, the making of safety recommendations.

Investigator-in-charge. A person charged, on the basis of his qualifications, with the responsibility for the organization, conduct and control of an investigation.

Note.— Nothing in the above definition is intended to preclude the functions of an investigator-in-charge being assigned to a commission or other body.

Maximum mass. Maximum certificated take-off mass.

Operator. A person, organization or enterprise engaged in or offering to engage in aircraft operation.

Preliminary Report. The communication used for the prompt dissemination of data obtained during the early stages of the investigation.

Safety recommendation. A proposal of the accident investigation authority of the State conducting the investigation, based on information derived from the investigation, made with the intention of preventing accidents or incidents.

Serious injury. An injury which is sustained by a person in an accident and which:

a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received, or

b) results in a fracture of any bone (except simple fractures of fingers, toes, or nose), or

c) involves lacerations which cause severe haemorrhage, nerve, muscle or tendon damage, or

d) involves injury to any internal organ, or

e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface, or

f) involves verified exposure to infectious substances or injurious radiation.

State of Manufacture. The State(s) responsible for the certification as to the airworthiness of the prototype.

State of Occurrence. The State in the territory of which an accident or incident occurs.

State of the Operator. The State in which the operator has his principal place of business or, if he has no such place of business, his permanent residence.

State of Registry. The State on whose register the aircraft is entered.

Note — In the case of the registration of aircraft of an international operating agency on other than a national basis, the States constituting the agency are jointly and severally bound to assume the obligations which, under the Chicago Convention, attach to a State of Registry. See, in this regard, the Council Resolution of 14 December 1967 on Nationality and Registration of Aircraft Operated by International Operating Agencies (Doc 8722).

CHAPTER 2. APPLICABILITY

2.1 Unless otherwise stated, the specifications in this Annex apply to activities following accidents and incidents occurring in the territory of a Contracting State to aircraft registered in another Contracting State.

Note.— Nothing in this Annex is intended to impose an obligation on States to conduct an investigation into an incident.

2.2 In this Annex the specifications concerning the State of the Operator apply only when an aircraft is leased, chartered or interchanged and when that State is not the State of Registry and if it discharges, in respect of this Annex, in part or in whole, the functions and obligations of the State of Registry.

CHAPTER 3. GENERAL

Note.— Guidance material relating to the rights and obligations of the State of the Operator in respect of accidents involving leased, chartered or interchanged aircraft is provided in Attachment A.

OBJECTIVE OF THE INVESTIGATION

3.1 The fundamental objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

PROTECTION OF EVIDENCE, CUSTODY AND REMOVAL OF AIRCRAFT

RESPONSIBILITY OF THE STATE OF OCCURRENCE

General

3.2 The State of Occurrence shall take all reasonable measures to protect the evidence and to maintain safe custody of the aircraft and its contents for such a period as may be necessary for the purposes of an investigation. Protection of evidence shall include the preservation, by photographic or other means of any evidence which might be removed, effaced, lost or destroyed. Safe custody shall include protection against further damage, access by unauthorized persons, pilfering and deterioration.

Note 1.— Control over the wreckage is dealt with in 5.6.

Note 2.— Protection of flight recorder evidence requires that the recovery and handling of the recorder and its recordings be assigned only to qualified personnel.

Request from State of Registry or State of the Operator.

3.3 If a request is received from the State of Registry or the State of the Operator that the aircraft, its contents, and any other evidence remain undisturbed pending inspection by an accredited representative of the requesting State, the State of Occurrence shall take all necessary steps to comply with such request, so far as this is reasonably practicable and compatible with the proper conduct of the investigation; provided that the aircraft may be moved to the extent necessary to extricate persons, animals, mails and valuables, to prevent destruction by fire or other causes, or to eliminate any danger or obstruction to air navigation, to other transport or to the public.

Request from State of Manufacture

3.4 **Recommendation.—** *If a request is received from the State of Manufacture that the aircraft remain undisturbed pending inspection by an accredited representative of that State, the State of Occurrence should take all reasonable steps to comply with such a request so far as this is reasonably practicable and compatible with the proper conduct of the investigation and does not result in undue delay in returning the aircraft to service where this is practicable.*

Release from custody

3.5 Subject to the provisions of 3.2, 3.3 and 3.4, the State of Occurrence shall release custody of the aircraft, its contents or any parts thereof which are no longer required in the investigation, to any person or persons duly designated by the State of Registry or the State of the Operator, as applicable. For this purpose the State of Occurrence shall facilitate access to the aircraft, its contents or any parts thereof, provided that, if the aircraft, its contents, or any parts thereof, lie in an area within which the State finds it impracticable to grant such access, it shall itself effect removal to a point where access can be given.

CHAPTER 4. NOTIFICATION

Note — Attachment B provides a notification and reporting checklist.

ACCIDENTS IN THE TERRITORY OF A CONTRACTING STATE TO AIRCRAFT OF ANOTHER CONTRACTING STATE

RESPONSIBILITY OF THE STATE OF OCCURRENCE

Forwarding

4.1 The State of Occurrence shall forward a notification with a minimum of delay and by the most suitable and quickest means available to

a) the State of Registry,

b) the State of the Operator,

c) the State of Manufacture

Note 1 — The Aeronautical Fixed Telecommunication Network (AFTN) will in most cases constitute "the most suitable and quickest means available"

Note 2 — Provision for the notification of a distress phase to the State of Registry by the Rescue Co-ordination Centre is contained in Annex 12

Format and content

4.2 The notification shall be in plain language and contain as much of the following information as is readily available, but its dispatch shall not be delayed due to the lack of complete information

a) the identifying abbreviation ACCID,

b) manufacturer, model, nationality and registration marks of the aircraft,

c) name of owner, operator and hirer, if any, of the aircraft,

d) name of the pilot-in-command,

e) date and time (local time or UTC) of the accident,

f) last point of departure and point of intended landing of the aircraft;

g) position of the aircraft with reference to some easily defined geographical point and latitude and longitude;

h) number of crew and passengers; aboard, killed and seriously injured; others, killed and seriously injured;

i) nature of the accident and the extent of damage to the aircraft so far as is known;

j) an indication to what extent the investigation will be conducted or is proposed to be delegated by the State of Occurrence;

k) physical characteristics of the accident area;

l) identification of the originating authority.

Note 1.— The 2-letter designator "YL" in association with an ICAO 4-letter location indicator forms the 6-letter addressee indicator for messages sent over the AFTN to authorities responsible for aircraft accident investigations. For messages sent over the public telecommunication service the addressee indicator cannot be used and a postal or telegraphic address must be substituted.

The 6-letter addressee indicators and the corresponding postal and telegraphic addresses, when notified to ICAO, are published in the ICAO Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services *(Doc 8585).*

Note 2.— The ICAO Manual of Aircraft Accident Investigation *(Doc 6920) contains guidance material concerning the preparation of notification messages and the arrangements to be made for their prompt delivery to the addressee.*

Language

4.3 **Recommendation.—** *The notification should be prepared in one of the working languages of ICAO whenever it is possible to do so without causing undue delay*

Additional information

4.4 As soon as it is possible to do so, the State of Occurrence shall dispatch the details omitted from the notification as well as other known relevant information.

RESPONSIBILITY OF THE STATE OF REGISTRY AND THE STATE OF THE OPERATOR

Information — Participation

4.5 Upon receipt of the notification the State of Registry and the State of the Operator shall, as soon as possible, provide the State of Occurrence with any relevant information available to them regarding the aircraft and flight crew involved in the accident. Each State shall also inform the State of Occurrence whether it intends to be represented at the investigation, and, if so, it shall indicate the probable date of arrival of its accredited representative.

RESPONSIBILITY OF THE STATE OF MANUFACTURE

Participation and attendance

4.6 Upon receipt of the notification and a request by the State of Occurrence for participation, the State of Manufacture shall

a) in the case of an accident to an aircraft of a maximum mass of over 100 000 kg, inform the State of Occurrence of:

1) the name of its accredited representative, and

2) whether the accredited representative will be present at the investigation and, if in the affirmative, the expected date of his arrival,

b) in the case of an accident to aircraft other than those specified in a) above, inform the State of Occurrence whether it will appoint an accredited representative. If such a representative is appointed the same information required under a) 1) and 2) shall be provided.

ACCIDENTS IN THE TERRITORY OF THE STATE OF REGISTRY, IN A NON-CONTRACTING STATE OR OUTSIDE THE TERRITORY OF ANY STATE

RESPONSIBILITY OF THE STATE OF REGISTRY

Forwarding

4.7 **Recommendation.—** *When the State of Registry institutes the investigation of an accident to an aircraft of a maximum mass of over 2 250 kg that State should forward a notification, in accordance with 4.2 and 4.3 above, with a minimum of delay and by the most suitable and quickest means available, to*

a) the State of the Operator,

b) the State of Manufacture when the accident involves matters of airworthiness.

The State of Registry should specify in its notification to the State of Manufacture the areas of airworthiness involved and, if appropriate, request its participation in the investigation.

Note 1 — The Aeronautical Fixed Telecommunication Network (AFTN) will in most cases constitute "the most suitable and quickest means available".

Note 2 — Provision for the notification of a distress phase to the State of Registry by the rescue co-ordination centre is contained in Annex 12.

RESPONSIBILITY OF THE STATE OF THE OPERATOR AND THE STATE OF MANUFACTURE

Information — Participation

4.8 **Recommendation.—** *Upon receipt of the notification the State of the Operator and the State of Manufacture should provide the State of Registry with any relevant information available to them regarding the flight crew and the aircraft involved in the accident. Each State should also inform the State of Registry whether it intends to be represented at the investigation and, if so, should indicate the probable date of arrival of its accredited representative.*

CHAPTER 5. INVESTIGATION

Note — Nothing in this Annex is intended to impose an obligation on States to conduct an investigation into an incident

RESPONSIBILITY FOR INSTITUTING AND CONDUCTING THE INVESTIGATION

ACCIDENTS IN THE TERRITORY OF A CONTRACTING STATE TO AIRCRAFT OF ANOTHER CONTRACTING STATE

State of Occurrence

5.1 The State of Occurrence shall institute an investigation into the circumstances of the accident. Such State shall also be responsible for the conduct of the investigation, but it may delegate the whole or any part of the conducting of such investigation to the State of Registry or the State of the Operator. In any event the State of Occurrence shall use every means to facilitate the investigation.

ACCIDENTS IN THE TERRITORY OF A NON-CONTRACTING STATE

State of Registry

5.2 **Recommendation.—** *When the accident has occurred in the territory of a non-Contracting State, the State of Registry should endeavour to institute and conduct an investigation in co-operation with the State of Occurrence but, failing such co-operation, should itself conduct an investigation with such information as is available*

ACCIDENTS OUTSIDE THE TERRITORY OF ANY STATE

State of Registry

5.3 When the location of the accident cannot definitely be established as being in the territory of any State, the State of Registry shall institute and conduct any necessary investigation of the accident However, it may delegate the whole or any part of the investigation to another State by mutual arrangement and consent

ORGANIZATION AND CONDUCT OF THE INVESTIGATION

Note — The ICAO Manual of Aircraft Accident Inve tigation *(Doc 6920) contains guidance material for t organization, conduct and control of an investigatio. Further, those States which may provide expert assistan and facilities for the investigation of major accidents a listed in an appendix to this manual.*

RESPONSIBILITY OF THE STATE CONDUCTINC THE INVESTIGATION

Note.— Nothing in the following specifications intended to preclude the State conducting the investigatic from calling upon the best technical expertise from ai source.

General

5.4 The accident investigation authority shall hav independence in the conduct of the investigation and hav unrestricted authority over its conduct. The investigatio shall include the gathering, recording and analysis of a available relevant information, if possible tl determination of the cause(s), and the completion of tl Final Report followed, if appropriate, by safet recommendations. When possible the scene of the accider shall be visited, the wreckage examined and statemen taken from witnesses.

Investigator-in-charge — Initiation

5.5 The State conducting the investigation sha designate the investigator-in-charge of the investigatio and shall initiate the investigation immediately.

Investigator-in-charge — Access and control

5.6 The investigator-in-charge shall have unhampere access to the wreckage and unrestricted control over i to ensure that a detailed examination can be mad without delay by authorized personnel participating in th investigation.

Flight recorders — Accidents

5.7 Maximum use shall be made of flight recorders i the inve .tigation of an accident wherever it occurred.

Flight recorders — Incidents

5.8 **Recommendation.—** *Maximum use should be made of flight recorders in the investigation of an incident wherever it occurred.*

Autopsy examinations

5.9 **Recommendation.—** *The State conducting the investigation into a fatal accident should, subject to the particular circumstances, encourage internal autopsy examination of the fatalities by a pathologist, preferably experienced in accident investigation. These examinations should be expeditious and complete*

Co-ordination — Judicial authorities

5.10 **Recommendation.—** *The State conducting the investigation should recognize the need for co-ordination between the investigator-in-charge and the judicial authorities. Particular attention should be given to evidence which requires prompt recording and analysis for the investigation to be successful, such as the examination and identification of victims and read-outs of flight recorder recordings.*

Note 1.— The responsibility of the State of Occurrence for such co-ordination is set out in 5.1.

Note 2.— Possible conflicts between investigating and judicial authorities regarding the custody of flight recorders and their recordings may be resolved by an official of the judicial authority carrying the recordings to the place of read-out, thus maintaining custody.

Informing aviation security authorities

5.11 If, in the course of an investigation it becomes known, or it is suspected, that an act of unlawful interference was involved, the investigator-in-charge shall immediately initiate action to ensure that the aviation security authorities of the State(s) concerned are so informed

Disclosure of records

5.12 When the State conducting the investigation of an accident or incident, wherever it occurred, considers that disclosure of any of the records, described below, might have an adverse effect on the availability of information in that or any future investigation then such records shall not be made available for purposes other than accident or incident investigation:

a) statements from persons responsible for the safe operation of the aircraft,

b) communications between persons having responsibility for the safe operation of the aircraft,

c) medical or private information regarding persons involved in the accident or incident,

d) cockpit voice recordings and transcripts from such recordings,

e) opinions expressed in the analysis of information, including flight recorder information

Note — Attachment D provides guidance in the application of 5.12 — Disclosure of records

Re-opening of investigation

5.13 If, after the investigation has been closed, new and significant evidence becomes available, the State which conducted the investigation shall re-open it. However, when the State which conducted the investigation did not institute it, that State shall first obtain the consent of the State which instituted the investigation

RESPONSIBILITY OF ANY OTHER STATE

Information — Accidents

5.14 Any State shall, on request from the State conducting the investigation of an accident wherever it occurred, provide that State with all the relevant information available to it.

Note.— See also 5.17

Information — Incidents

5.15 **Recommendation.—** *Any State should, on request from the State conducting the investigation of an incident, furnish that State with all the relevant information available to it*

Note.— See also 5.18

Pertinent information — Accidents/Incidents

5.16 **Recommendation.—** *Any State, the facilities or services of which have been, or would normally have been used by an aircraft prior to an accident or an incident wherever it occurred, and which has information pertinent to the investigation, should provide such information to the State conducting the investigation*

RESPONSIBILITY OF THE STATE OF REGISTRY AND THE STATE OF THE OPERATOR

Flight recorders — Accidents

5.17 When an aircraft involved in an accident lands in a State other than the State of Occurrence, the State of

Registry or the State of the Operator shall, on request from the State conducting the investigation, furnish the latter State with the flight recorder records, and if necessary, the associated flight recorders.

Flight recorders — Incidents

5.18 **Recommendation.—** *When an aircraft involved in an incident lands in a State other than the State of Occurrence, the State of Registry or the State of the Operator should, on request from the State conducting the investigation, furnish the latter State with the flight recorder records, and if necessary, the associated flight recorders.*

Note.— In implementing 5.17 and 5.18 above, the State of Registry or the State of the Operator may request the co-operation of any other State in the retrieval of the flight recorder records.

PARTICIPATION IN THE INVESTIGATION

Note.— Nothing in this Annex is intended to imply that the accredited representative and advisers of a State have to be always present in the State in which the investigation is conducted.

PARTICIPATION OF THE STATE OF REGISTRY AND THE STATE OF THE OPERATOR

Rights

5.19 The State of Registry and the State of the Operator shall be entitled to appoint an accredited representative to participate in the investigation.

Operator — Adviser

5.20 **Recommendation.—** *When it is believed that the Operator can make a useful contribution to the investigation, the State of Registry or the State of the Operator should appoint an adviser nominated by the operator, to assist its accredited representative.*

Note.— Nothing in this Recommendation is intended to preclude the attendance of the operator at an investigation when the State of Registry or the State of the Operator does not appoint an accredited representative or an adviser nominated by the operator to assist him. Under such circumstances the form and extent of the participation of the operator will be subject to the procedures of the State conducting the investigation.

Obligations

5.21 When the State conducting an investigation into an accident to an aircraft of a maximum mass of over 2 250 kg specifically requests participation by the State of Registry and/or the State of the Operator, the State(s) concerned shall provide an accredited representative.

PARTICIPATION OF THE STATE OF MANUFACTURE

Rights

5.22 The State of Manufacture shall be entitled to appoint an accredited representative to participate in the investigation of an accident whenever it is believed that its participation in the investigation could be useful or result in increased safety.

Note.— Nothing in this Standard is intended to preclude:

a) the State that constructed the aircraft (for example, under licence),

b) the State that assembled the major components as an aircraft, and

c) the State that manufactured major components of the aircraft

from requesting participation in the investigation of an accident when it is believed that a useful contribution can be made to the investigation, or when such participation might result in increased safety.

5.22.1 **Recommendation.—** *When the State of Registry conducts an investigation of an accident to an aircraft of a maximum mass of over 2 250 kg which occurred in its territory and when the accident involves matters of airworthiness the State of Manufacture should, upon its specific request, be permitted to appoint an accredited representative to participate in the investigation. The State of Manufacture should inform the State of Registry of the specific reasons for requesting participation.*

Obligations

5.23 When the State conducting an investigation of an accident to an aircraft of a maximum mass of over 100 000 kg specifically requests participation by the State of Manufacture because the former State finds it apparent that airworthiness matters are or might be involved in the accident, the latter State shall appoint an accredited representative.

5.23.1 **Recommendation.—** *When the State conducting an investigation of an accident to an aircraft of a maximum mass of over 2 250 kg but not exceeding 100 000 kg specifically requests participation by the State of Manufacture, the latter State should appoint an accredited representative.*

Note 1.— Nothing in 5.23 and 5.23.1 is intended to preclude the State conducting an investigation from requesting:

a) the State of Manufacture,

b) the State that constructed the aircraft (for example, under licence),

c) the State that assembled the major components as an aircraft, and

d) the State that manufactured major components of the aircraft

to appoint an accredited representative whenever the former State believes that a useful contribution can be made to the investigation or, when such participation might result in increased safety.

Note 2.— Nothing in 5.23 and 5.23.1 is intended to preclude the State conducting an investigation from requesting the State of Manufacture to give assistance in the investigation of accidents other than those in 5.23 and 5.23.1.

PARTICIPATION OF OTHER STATES

Rights

5.24 Any State which on request provides information, facilities or experts to the State conducting the investigation shall be entitled to appoint an accredited representative to participate in the investigation.

ENTITLEMENT OF ACCREDITED REPRESENTATIVES

Advisers

5.25 A State entitled to appoint an accredited representative shall also be entitled to appoint advisers to assist him at the investigation.

Note 1.— Nothing in the above specifications is intended to preclude a State participating in an investigation from calling upon the best technical expert(s) from any source and appointing such expert(s) as adviser(s) to its accredited representative.

Note 2.— Facilitation of the entry of the accredited representatives, their advisers and equipment, is covered in Annex 9 — Facilitation

5.25.1 **Recommendation.—** *Advisers assisting an accredited representative should be permitted, under his supervision, to participate in the investigation to the extent necessary to enable the accredited representative to make his participation effective.*

Participation

5.26 **Recommendation.—** *Participation in the investigation should confer entitlement to*

a) visit the scene of the accident,

b) examine the wreckage,

c) question witnesses,

d) have full access to all relevant evidence,

e) receive copies of all pertinent documents, and

f) make submissions in respect of the various elements of the investigation.

However, participation of States other than the State of Registry, the State of the Operator and the State of Manufacture may be limited to those matters which entitled such States to participation under 5.24

Note 1.— It is recognized that the form of participation would be subject to the procedures of the State in which the investigation, or part thereof, is being conducted.

Note 2.— The collection and recording of information need not be delayed to await the arrival of an accredited representative.

Note 3.— Nothing in this Recommendation precludes the State conducting the investigation from extending participation beyond the entitlement enumerated.

PARTICIPATION OF STATES HAVING SUFFERED FATALITIES TO ITS CITIZENS

Rights and entitlement

5.27 **Recommendation.—** *A State which has a special interest in an accident, wherever it occurred, by virtue of fatalities to its citizens should, upon making a request to do so, be permitted by the State conducting the* *investigation to appoint an expert to participate in the investigation to facilitate the availability of factual information to the former State. The entitlement to participation of this expert should be limited to:*

a) visiting the scene of the accident;

b) having access to the relevant factual information;

c) providing assistance and information concerning the identification of the victims; and

d) receiving a copy of the Final Report.

The State requesting such participation should justify to the State conducting the investigation the basis for its request.

CHAPTER 6. REPORTING

Note 1.— Attachment B provides a notification and reporting checklist.

Note 2.— The specifications of this chapter may require three separate reports for any one accident or incident. They are:

Preliminary Report
Accident/Incident Data Report
Final Report

Note 3.— Guidance for preparing the Preliminary Report and the Accident/Incident Data Report is given in the ICAO Accident/Incident Reporting Manual *(Doc 9156).*

Note 4.— The Final Report may be prepared in the format considered to be the most appropriate in the circumstances. However, the format presented in the Appendix may be used to good advantage.

PRELIMINARY REPORT

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION — ACCIDENTS WHEREVER THEY OCCURRED

Aircraft over 5 700 kg

6.1 When the aircraft involved in an accident, wherever it occurred, is an aircraft of a maximum mass of over 5 700 kg, the State conducting the investigation shall send the Preliminary Report to:

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Manufacture;

d) any State which provided relevant information, significant facilities or experts;

e) the International Civil Aviation Organization.

Aircraft between 5 700 kg and 2 250 kg

6.2 **Recommendation.—** *When the aircraft involved in an accident, wherever it occurred, is an aircraft of a maximum mass of over 2 250 kg but not exceeding 5 700 kg, the State conducting the investigation should send the Preliminary Report to*

a) the State of Registry or the State of Occurrence as appropriate,

b) the State of the Operator,

c) the State of Manufacture;

d) any State which provided relevant information, significant facilities or experts,

e) the International Civil Aviation Organization

Aircraft of 2 250 kg or less

6.3 **Recommendation.—** *When an aircraft, not covered by 6.1 or 6.2 above, is involved in an accident, wherever it occurred and when airworthiness or matters considered to be of interest to other States are involved, the State conducting the investigation should forward the Preliminary Report to:*

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Manufacture,

d) any State which provided relevant information, significant facilities or experts

FORM AND DISPATCH OF THE PRELIMINARY REPORT

Note.— See Introductory Note 3 to Chapter 6

Language

6.4 The Preliminary Report shall be submitted to appropriate States and to the International Civil Aviation Organization in one of the working languages of ICAO

Coding

6.5 **Recommendation.—** *Preliminary Reports addressed to the International Civil Aviation Organization should also be submitted in code*

Dispatch

6.6 The Preliminary Report shall be sent by airmail within thirty days of the date of the accident unless the Accident/Incident Data Report has been sent by that time. When matters directly affecting safety are involved it shall be sent as soon as the information is available and by the most suitable and quickest means available.

ACCIDENT/INCIDENT DATA REPORT

Note.— See Introductory Note 3 to Chapter 6.

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION — ACCIDENTS WHEREVER THEY OCCURRED

Aircraft over 5 700 kg

6.7 Wherever an accident occurs and when the aircraft involved is an aircraft of a maximum mass of over 5 700 kg, the State conducting the investigation shall send, as soon as practicable after the investigation, the Accident Data Report to the International Civil Aviation Organization.

Aircraft between 5 700 kg and 2 250 kg

6.8 **Recommendation.—** *Wherever an accident occurs and when the aircraft involved is an aircraft of a maximum mass of over 2 250 kg but not exceeding 5 700 kg the State conducting the investigation should send, as soon as practicable after the investigation, the Accident Data Report to the International Civil Aviation Organization.*

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION — INCIDENTS WHEREVER THEY OCCURRED

Note.— The type of incidents which are of main interest to the International Civil Aviation Organization for accident prevention studies are listed in the ICAO Accident/Incident Reporting Manual *(Doc 9156)*

Aircraft over 5 700 kg

6.9 **Recommendation.—** *If a State conducts an investigation into an incident to an aircraft of a maximum mass of over 5 700 kg that State should send, as soon as is practicable after the investigation, the Incident Data Report to the International Civil Aviation Organization, when the investigation has revealed matters considered to be of interest to other States*

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION — ADDITIONAL INFORMATION

Accidents and incidents wherever they occurred

6.10 **Recommendation.—** *The State conducting the investigation should, upon request, provide other States with pertinent information additional to that made available in the Accident/Incident Data Report.*

FINAL REPORT

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION

Consultation

6.11 **Recommendation.—** *The State conducting the investigation should send a copy of the draft Final Report to the State which instituted the investigation and to all States that participated in the investigation, inviting their significant and substantiated comments on the report as soon as possible. If the State conducting the investigation receives comments within sixty days of the date of the transmittal letter it should either amend the draft Final Report to include the substance of the comments received, or append the comments to the Final Report. If the State conducting the investigation receives no comments within sixty days, it should issue the Final Report in accordance with 6.12, unless an extension of that period has been agreed by the States concerned.*

Note.— Comments to be appended to the Final Report are restricted to non-editorial specific technical aspects of the Final Report upon which no agreement could be reached.

Recipient States

6.12 The Final Report of the investigation of an accident shall be sent with a minimum of delay by the State conducting the investigation to:

a) the State which instituted the investigation;

b) the State of Registry;

c) the State of the Operator;

d) the State of Manufacture;

e) the State having suffered fatalities to its citizens, if it participated in the investigation;

f) any State which provided relevant information, significant facilities or experts

Publication of the Final Report

6.13 **Recommendation.—** *In the interest of accident prevention, the State conducting the investigation should publish the Final Report as soon as possible.*

International dissemination of the Final Report

6.14 **Recommendation.—** *When the State which has conducted an investigation into an accident, wherever it occurred, has published a Final Report and considers that the international dissemination of the information contained in the Final Report is of value due to:*

a) its contribution to accident prevention; or

b) the successful employment of useful or effective investigative techniques

that State should send to the International Civil Aviation Organization three copies of the Final Report, prepared in one of the working languages of the Organization and in the form shown in the Appendix using, as far as possible, the terminology contained in the ICAO Lexicon *(Doc 9294). That State should also indicate in the covering letter which of the two criteria a) or b) applies to that report.*

RESPONSIBILITY OF ANY STATE

Publication — Consent

6.15 States shall not circulate, publish or give access to a Final Report or any part thereof, draft reports or any documents obtained during an investigation of an accident or incident, without the express consent of the State which conducted the investigation, unless such reports or documents have already been released by that latter State.

FORWARDING OF INCIDENT INFORMATION

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION

Matters of interest to other States

6.16 **Recommendation.—** *If a State conducts an investigation into an incident which involves matters considered to be of interest to other States, that State should forward to them the related information as soon as possible.*

CHAPTER 7. ACCIDENT PREVENTION MEASURES

Note.— The specifications in this Chapter apply only to accidents and those incidents on which an investigation has been conducted. The objective of these specifications is to promote accident prevention by a prompt exchange of information.

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION

Prompt preventive action

7.1 **Recommendation.—** *At any stage of the investigation of an accident or incident, wherever it occurred, the accident investigation authority of the State conducting the investigation should recommend to the appropriate authorities, including those in other States, any preventive action which needs to be taken promptly to prevent similar occurrences.*

Report analysis — Preventive actions

7.2 **Recommendation.—** *A State conducting investigations of accidents or incidents, wherever they occurred, should analyse the information contained in its accident/incident reports to determine the preventive actions required.*

Safety recommendations — Dispatch

7.3 **Recommendation.—** *A State conducting investigations of accidents or incidents, wherever they occurred, should address, when appropriate, any safety recommendations of its investigations to the accident investigation authorities of other State(s) concerned and, when ICAO documents are involved, to ICAO.*

Note.— When Final Reports contain safety recommendations addressed to ICAO, because ICAO documents are involved, these reports must be accompanied by a letter outlining the specific action proposed.

RESPONSIBILITY OF A STATE RECEIVING SAFETY RECOMMENDATIONS

Action on safety recommendations

7.4 **Recommendation.—** *A State which receives safety recommendations from another State should inform the State conducting the investigation of the preventive action taken or under consideration, or that no action is contemplated.*

APPENDIX. FORMAT OF THE FINAL REPORT

(See Chapter 6)

PURPOSE

The purpose of this format is to present the Final Report in a convenient and uniform manner.

Detailed guidance on completing each section of the Final Report is found in the ICAO *Manual of Aircraft Accident Investigation* (Doc 6920).

FORMAT

Title. The Final Report begins with a title comprising:

name of the operator, manufacturer, model, nationality and registration marks of the aircraft, place and date of the accident or incident.

Synopsis. Following the title is a synopsis describing briefly all relevant information regarding:

notification of accident to national and foreign authorities, identification of the accident investigation authority and accredited representation, organization of the investigation, authority releasing the report and date of publication;

and concluding with a brief resume of the circumstances leading to the accident.

Body. The body of the Final Report comprises the following main headings:

1. Factual information
2. Analysis
3. Conclusions
4. Safety recommendations

each heading consisting of a number of sub-headings as outlined in the following.

Appendices. Include as appropriate.

Note — In preparing a Final Report, using this format, ensure that:

a) all information relevant to an understanding of t factual information, analysis and conclusions included under each appropriate heading;

b) where information in respect of any of the ite in 1 — Factual information is not available, or irrelevant to the circumstances leading to t accident, a note to this effect is included under t appropriate sub-headings.

1. FACTUAL INFORMATION

1.1 ***History of the flight.*** A brief narrative giving t following information:

— Flight number, type of operation, last point o departure, time of departure (local time or UTC point of intended landing.

— Flight preparation, description of the flight an events leading to the accident, including recon struction of the significant portion of the flight pat if appropriate.

— Location (latitude, longitude, elevation), time of th accident (local time or UTC), whether day or nigh

1.2 ***Injuries to persons.*** Completion of the followin (in numbers):

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious			
Minor/None			

Note — Fatal injuries include all deaths determined to be a direct result of injuries sustained in the accident. Serious injury is defined in Chapter 1 of the Annex.

1.3 ***Damage to aircraft.*** Brief statement of the damag sustained by aircraft in the accident (destroyed, substan tially damaged, slightly damaged, no damage).

1.4 ***Other damage.*** Brief description of damage sustained by objects other than the aircraft

1.5 ***Personnel information:***

a) Pertinent information concerning each of the flight crew members including: age, validity of licences, ratings, mandatory checks, flying experience (total and on type) and relevant information on duty time.

b) Brief statement of qualifications and experience of other crew members

c) Pertinent information regarding other personnel, such as air traffic services, maintenance, etc., when relevant.

1.6 ***Aircraft information:***

a) Brief statement on airworthiness and maintenance of the aircraft (indication of deficiencies known prior to and during the flight to be included, if having any bearing on the accident).

b) Brief statement on performance, if relevant, and whether the mass and centre of gravity were within the prescribed limits during the phase of operation related to the accident. (If not and if of any bearing on the accident give details.)

c) Type of fuel used.

1.7 ***Meteorological information:***

a) Brief statement on the meteorological conditions appropriate to the circumstances including both forecast and actual conditions, and the availability of meteorological information to the crew.

b) Natural light conditions at the time of the accident (sunlight, moonlight, twilight, etc.).

1.8 ***Aids to navigation.*** Pertinent information on navigation aids available, including landing aids such as ILS, MLS, NDB, PAR, VOR, visual ground aids, etc., and their effectiveness at the time.

1.9 ***Communications.*** Pertinent information on aeronautical mobile and fixed service communications and their effectiveness

1.10 ***Aerodrome information.*** Pertinent information associated with the aerodrome, its facilities and condition, or with the take-off or landing area if other than an aerodrome.

1.11 ***Flight recorders.*** Location of the flight recorder installations in the aircraft, their condition on recovery and pertinent data available therefrom

1.12 ***Wreckage and impact information.*** General information on the site of the accident and the distribution pattern of the wreckage; detected material failures or component malfunctions. Details concerning the location and state of the different pieces of the wreckage are not normally required unless it is necessary to indicate a break-up of the aircraft prior to impact. Diagrams, charts and photographs may be included in this section or attached in the Appendices.

1.13 ***Medical and pathological information.*** Brief description of the results of the investigation undertaken and pertinent data available therefrom.

Note.— Medical information related to flight crew licences should be included in 1.5 — Personnel information.

1.14 ***Fire.*** If fire occurred, information on the nature of the occurrence, and of the fire fighting equipment used and its effectiveness.

1.15 ***Survival aspects.*** Brief description of search, evacuation and rescue, location of crew and passengers in relation to injuries sustained, failure of structures such as seats and seat-belt attachments.

1.16 ***Tests and research.*** Brief statements regarding the results of tests and research.

1.17 ***Additional information.*** Relevant information not already included in 1.1 to 1.16 above.

1.18 ***Useful or effective investigation techniques.*** When useful or effective investigation techniques have been used during the investigation, briefly indicate the reason for using these techniques and refer here to the main features as well as describing the results under the appropriate sub-headings 1.1 to 1.17

2. ANALYSIS

Analyse, as appropriate, only the information documented in 1. — Factual information and which is relevant to the determination of conclusions and cause(s).

3. CONCLUSIONS

State the findings and cause(s) established in the investigation.

4. SAFETY RECOMMENDATIONS

As appropriate, briefly state any recommendations made for the purpose of accident prevention and any resultant corrective action.

APPENDICES

Include, as appropriate, any other pertinent information considered necessary for the understanding of t report.

ATTACHMENTS TO ANNEX 13

These Attachments do not constitute a part of Annex 13 — Aircraft Accident Investigation
The material contained herein is intended to assist in the application of Annex 13.

ATTACHMENT A. RIGHTS AND OBLIGATIONS OF THE STATE OF THE OPERATOR IN RESPECT OF ACCIDENTS INVOLVING LEASED, CHARTERED OR INTERCHANGED AIRCRAFT

The Standards and Recommended Practices of Annex 13 — Aircraft Accident Investigation were developed when the State of Registry and the State of the Operator normally were the same. In recent years, however, international aircraft leasing and interchanging arrangements have developed so that in many instances the State of the Operator is different from the State of Registry.

Leasing or interchange arrangements sometimes include the provision of flight crews from the State of Registry. However, more often, flight crews are provided by the State of the Operator and the aircraft operated under national legislation of the State of the Operator. Similarly, a variety of arrangements for airworthiness can emerge from these arrangements. Airworthiness responsibility may rest, wholly or partly, with the State of the Operator or State of Registry Sometimes the operator, in conformity with an airworthiness control system specified by the State of Registry, carries out maintenance and keeps records.

In the event of an accident, it is important that any State which has assumed responsibility for the safety of an aircraft has the right to participate in an investigation, at least in respect of that responsibility. It is also important that the State conducting the investigation should have speedy access to all documents and other information relevant to that investigation.

When the location of an accident cannot definitely be established as being in the territory of another State, the State of the Operator, after consultation with the State of Registry, should accept full or partial responsibility for the conduct of the accident investigation.

ATTACHMENT B. NOTIFICATION AND REPORTING CHECKLIST

Note — In this checklist the following terms have the meaning indicated below:
— International accidents: *accidents occurring in the territory of a Contracting State to aircraft registered in another Contracting State;*
— Domestic accidents: *accidents occurring in the territory of the State of Registry;*
— Other accidents: *accidents occurring in the territory of a non-Contracting State, or outside the territory of any State*

1. ACCIDENT NOTIFICATION

From	*For*	*Send to*	*Annex 13 reference*
State of Occurrence	International accidents All aircraft	State of Registry State of the Operator State of Manufacture	4.1
State of Registry	Domestic and other accidents Aircraft over 2 250 kg	State of the Operator State of Manufacture (if airworthiness matters)	4.7

2. ACCIDENT REPORTING

FROM the State CONDUCTING the Investigation

		International accidents		*Domestic other accidents*	
Type of report	*Concerning*	*Send to*	*Annex 13 reference*	*Send to*	*Annex 13 reference*
PRELIMINARY REPORT	Aircraft over 2 250 kg	State of Registry or State of Occurrence State of the Operator State of Manufacture State providing information, significant facilities or experts ICAO	6.1, 6.2	State of Registry State of the Operator State of Manufacture State providing information significant facilities or experts ICAO	6.1 6.2
	Aircraft of 2 250 kg or less if airworthiness or matters of interest	Same as above, *except* ICAO	6.3	Same as above, *except* ICAO	6.3
ACCIDENT DATA REPORT	Aircraft over 2 250 kg	ICAO	6.7 6.8	ICAO	6.7, 6.8
FINAL REPORT	All aircraft	State instituting the investigation State of Registry State of the Operator State of Manufacture State having interest because of fatalities State providing information, significant facilities or experts	6.12	State having interest because of fatalities	6.12
	All aircraft when international dissemination is of value to the promotion of safety	ICAO	6.11	ICAO	6.11

3. INCIDENT REPORTING

INCIDENTS WHEREVER THEY OCCURRED (when investigated)

From	*Type of report*	*Concerning*	*Send to*	*Annex 13 reference*
State conducting the investigation	INCIDENT DATA REPORT	Aircraft over 5 700 kg, if matters of interest to other States are involved	ICAO	6.9
	INCIDENT INFORMATION	All aircraft, if matters of interest to other States are involved	Interested States	6.16

ATTACHMENT C. EXCHANGE OF FINAL REPORTS BETWEEN STATES AND PUBLICATION OF A LIST OF FINAL REPORTS AVAILABLE IN STATES

EXCHANGE OF FINAL REPORTS BETWEEN STATES

Accident prevention to be effective depends greatly on the promptness with which the information on accidents is available.

For a variety of reasons Final Reports on accidents can only be published in the ICAO *Aircraft Accident Digest* some two to three years after the date of the accident.

In an attempt to shorten this delay, some States are disseminating their narrative Final Reports on domestic as well as international accidents, not only to the recipient States specified in 6.12 of the Annex, but also to many other States.

To speed up the exchange of accident/incident information all States are strongly encouraged to disseminate their Final Reports on domestic as well as on international accidents to other States. These reports should preferably be prepared in the format shown in the Appendix to Annex 13 and in one of the working languages of ICAO, or alternatively in the original language used.

LIST OF FINAL REPORTS AVAILABLE IN STATES

With the advent of the Accident/Incident Reporting (ADREP) system, States are normally aware of accidents or incidents, wherever they occurred, through the ICAO ADREP Summary. However, the information contained in this summary is rather brief and it would help States which require more detailed information in a narrative form, to know which Final Reports are available in other States so that they can request copies of such reports.

For that purpose all States are urged to send to ICAO on a six monthly basis a list of the Final Reports which have become available in their own administration during the previous six months and which could be disseminated to other States on request. That list is to be sent in one of the working languages of ICAO and should provide the following information:

— name of the operator concerned (if desired),

— manufacturer, model, registration marks of the aircraft,

— place and date of the occurrence,

— type of occurrence, and

— language(s) in which the Final Report is available.

ATTACHMENT D. DISCLOSURE OF RECORDS

Supplementary to 5.12

1 The material in this Attachment is intended as guidance in the application of 5.12 — Disclosure of records.

General

2. The text of paragraph 5.12 takes account of the following considerations:

a) disclosure of the records specified, for purposes other than accident or incident investigation, may have an adverse effect on the availability of information in such investigations;

b) States are required, in each specific case, to consider whether this adverse effect exists; and

c) if a State considers that the adverse effect might exist then the records must not be made available for purposes other than accident or incident investigation.

3 Information given voluntarily by persons responsible for the safe operation of the aircraft, in the course of accident and incident investigations, is presently inadequately protected and may be utilized for subsequent disciplinary, civil, administrative and criminal proceedings. If this information is distributed, there is a possibility that it will no longer be openly disclosed to investigators. Lack of access to this information would impede the investigative process and seriously affect flight safety.

Practical applications of 5.12

4 States may wish to consider the following:

a) in the spirit of 5.12, the records specified therein should not be made available to civil, administrative or judicial proceedings unless the appropriate authority determines that the proper administration of justice outweighs the adverse domestic and international impact such action may have on that or any future investigations;

b) the records specified in 5.12 should be included in the Final Report or its appendices only when pertinent to the analysis of the accident or incident; and

c) the records specified in 5.12 should not be made public unless included in the Final Report. For example, when certain parts of the cockpit voice recording are relevant to the analysis of the accident, a transcript of those parts would be included in the Final Report. The other parts of the cockpit voice recording, not relevant to the analysis of the accident, should not be disclosed.

— END —

Published in separate English, French, Russian and Spanish editions by the International Civil Aviation Organization. All correspondence, except orders and subscriptions, should be addressed to the Secretary General.

Orders for this publication should be sent to one of the following addresses, together with the appropriate remittance (by bank draft or post office money order) in U.S. dollars or the currency of the country in which the order is placed

Document Sales Unit
International Civil Aviation Organization
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A 2R2

Egypt ICAO Representative, Middle East Office, 16 Hassan Sabri, Zamalek, Cairo

France Représentant de l'OACI, Bureau Europe, 3 bis, villa Émile Bergerat, 92522 Neuilly-sur-Seine (Cedex)

India. Oxford Book and Stationery Co., Scindia House, New Delhi *or* 17 Park Street, Calcutta

Japan. Japan Civil Aviation Promotion Foundation, 15-12, 1-chome, Toranomon, Minato-Ku, Tokyo

Kenya ICAO Representative, Eastern and Southern African Office, United Nations Accommodation, P.O. Box 46294 Nairobi.

Mexico. Representante de la OACI, Oficina Norteamérica, Centroamérica y Caribe, Apartado postal 5-377, C.P. 11590, México 5, D.F.

Peru Representante de la OACI, Oficina Sudamérica, Apartado 4127, Lima 100

Senegal. Représentant de l'OACI, Bureau Afrique occidentale et centrale, Boîte postale 2356, Dakar

Spain. Pilot's, Suministros Aeronauticos, S.A., C. Ulises, 5 Oficina Num. 2, 28043 Madrid

Thailand. ICAO Representative, Asia and Pacific Office, P.O. Box 614, Bangkok

United Kingdom Civil Aviation Authority, Printing and Publications Services, Greville House, 37 Gratton Road, Cheltenham, Glos., GL50 2BN

ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the Aeronautical Chart Catalogue *or the* Meteorological Tables for International Air Navigation.

International Standards and Recommended Practices are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications contained in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

Procedures for Air Navigation Services (PANS) are approved by the Council for world-wide application. They contain, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome.

Regional Supplementary Procedures (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

Technical Manuals provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

Air Navigation Plans detail requirements for facilities and services for international air navigation in the respective ICAO Air Navigation Regions. They are prepared on the authority of the Secretary General on the basis of recommendations of regional air navigation meetings and of the Council action thereon. The plans are amended periodically to reflect changes in requirements and in the status of implementation of the recommended facilities and services.

ICAO Circulars make available specialized information of interest to Contracting States. This includes studies on technical subjects.

IV-B

Aviation Occurance Report: Aguila Air Ltd. (Piper PA 23-2350, Aztec C-FJAI) Nanaimo, British Columbia, May 3, 1993

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION OCCURRENCE REPORT

AQUILA AIR LTD.
PIPER PA 23-250 AZTEC C-FJAI
NANAIMO, BRITISH COLUMBIA 2 MI S
03 MAY 1989

REPORT NUMBER A89P0105

Canada

Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

COMMUNIQUE COMMUNIQUE **COMMUNIQUE** COMMUNIQUE

TSB # 20/91

AQUILA AIR LTD.
PIPER PA 23-250 AZTEC C-FJAI
NANAIMO, BRITISH COLUMBIA
03 MAY 1989

(For release 17 December 1991)

(HULL, Québec) - The Transportation Safety Board of Canada (TSB) has released its report on the fatal accident that occurred 03 May 1989, near Nanaimo, B.C., involving an Aquila Air Ltd., Piper Aztec. All those on board, four passengers and the pilot, died in the crash.

The aircraft had just taken off from runway 16 at Nanaimo Airport when the aircraft's nose baggage door opened. The pilot informed the Nanaimo Flight Service Station that the flight would return to the airport and land on runway 34, the reciprocal of the departure runway. The pilot turned the aircraft left 60 degrees and levelled off at approximately 300 feet above the ground. One and a half minutes into the flight and approximately 1 1/2 miles from the runway, the aircraft nosed down and crashed into the ground. The aircraft was destroyed in the crash and post-crash fire.

The TSB determined that the aircraft stalled, and, because of the low altitude the pilot was unable to recover in time to prevent the accident. The Board also determined that the nose baggage door locking mechanism that allowed the door to open in flight was defective because of inadequate maintenance.

The open baggage door should not have caused insurmountable aircraft control difficulties. The distraction it created may have unduly focused the pilot's attention on the open door to the point that aircraft control was inadvertently sacrificed.

.../2

Over the past number of years, the TSB and its predecessor, the Canadian Aviation Safety Board, have raised concerns about the adequacy of Transport Canada (TC) audits of small companies. Although this accident raised similar concerns, the TSB feels that present initiatives by TC are addressing the problem. The Board will continue to follow the full implementation of the new audit policies and procedures with interest.

The Transportation Safety Board of Canada is an independent agency operating under its own Act of Parliament. Its sole aim is the advancement of transportation safety. The TSB conducts investigations of occurrences, makes findings, identifies safety deficiencies, conducts safety studies, makes recommendations designed to prevent further occurrences, and makes public the results of its investigation. It is not the function of the Board to assign fault or determine civil or criminal liability.

- 30 -

For more information:

Maryse Brunet-Lalonde
Senior Advisor, Communications
(819) 994-8051

Jim Harris
Coordinator, Communications
(819) 994-8053

Transportation Safety Board of Canada

Bureau de la securite des transports du Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Occurrence Report

Aquila Air Ltd.
Piper PA 23-250 Aztec C-FJAI
Nanaimo, British Columbia 2 mi S
03 May 1989

Report Number A89P0105

Synopsis

The Piper Aztec had just become airborne on take-off from runway 16 at Nanaimo, British Columbia when the aircraft's nose baggage door opened The pilot informed the Nanaimo Flight Service Station Specialist that he would return to Nanaimo Airport and land on runway 34, the reciprocal of the departure runway. The pilot then turned left 60 degrees and levelled the aircraft at a height of about 300 feet above the ground. At 1½ miles from the runway and one minute and 30 seconds into the flight, the aircraft nosed down and crashed into the ground All five occupants died in the crash, and the aircraft was destroyed.

The Transportation Safety Board of Canada determined that the nose baggage door locking mechanism was defective because of inadequate maintenance and allowed the door to open in flight. The aircraft stalled, and, because of the low altitude, the pilot was unable to recover in time to prevent the aircraft from crashing to the ground.

20 August 1991

Ce rapport est également disponible en français.

Table of Contents

Illustrations

CHAPTER 6. REPORTING

Note 1.— Attachment B provides a notification and reporting checklist.

Note 2.— The specifications of this chapter may require three separate reports for any one accident or incident. They are:

Preliminary Report
Accident/Incident Data Report
Final Report

Note 3.— Guidance for preparing the Preliminary Report and the Accident/Incident Data Report is given in the ICAO Accident/Incident Reporting Manual *(Doc 9156).*

Note 4.— The Final Report may be prepared in the format considered to be the most appropriate in the circumstances. However, the format presented in the Appendix may be used to good advantage.

PRELIMINARY REPORT

RESPONSIBILITY OF THE STATE CONDUCTING THE INVESTIGATION — ACCIDENTS WHEREVER THEY OCCURRED

Aircraft over 5 700 kg

6.1 When the aircraft involved in an accident, wherever it occurred, is an aircraft of a maximum mass of over 5 700 kg, the State conducting the investigation shall send the Preliminary Report to:

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Manufacture;

d) any State which provided relevant information, significant facilities or experts;

e) the International Civil Aviation Organization.

Aircraft between 5 700 kg and 2 250 kg

6.2 **Recommendation.—** *When the aircraft involved in an accident, wherever it occurred, is an aircraft of a maximum mass of over 2 250 kg but not exceeding 5 700 kg, the State conducting the investigation should send the Preliminary Report to:*

a) the State of Registry or the State of Occurrence as appropriate;

b) the State of the Operator;

c) the State of Manufacture;

d) any State which provided relevant information, significant facilities or experts;

e) the International Civil Aviation Organization

Aircraft of 2 250 kg or less

6.3 **Recommendation.—** *When an aircraft, not covered by 6.1 or 6.2 above, is involved in an accident, wherever it occurred and when airworthiness or matters considered to be of interest to other States are involved, the State conducting the investigation should forward the Preliminary Report to:*

a) the State of Registry or the State of Occurrence, as appropriate;

b) the State of the Operator;

c) the State of Manufacture;

d) any State which provided relevant information, significant facilities or experts

FORM AND DISPATCH OF THE PRELIMINARY REPORT

Note.— See Introductory Note 3 to Chapter 6

Language

6.4 The Preliminary Report shall be submitted to appropriate States and to the International Civil Aviation Organization in one of the working languages of ICAO

Coding

6.5 **Recommendation.—** *Preliminary Reports addressed to the International Civil Aviation Organization should also be submitted in code.*

1.0 Factual Information

1.1 History of the Flight

On the day of the accident, the pilot had already flown one round-trip shuttle in the Piper PA 23-250, C-FJAI, between Nanaimo and Vancouver, British Columbia. The first flight departed Nanaimo at 0630 Pacific daylight time (PDT)[1] and arrived back at Nanaimo at 0730 PDT. There were two passengers on the flight out and five passengers on the return flight. In preparation for his next flight, the pilot loaded the passengers' baggage, stowing some of it in the nose baggage compartment and some in the cabin baggage compartment. He then escorted his four passengers to the aircraft, took his seat, and observed as they entered and secured themselves in their seats.

The pilot started the engines, requested an airport advisory briefing from the Flight Service Station (FSS)[2] Specialist, and taxied north to the entrance to runway 16. After waiting for conflicting traffic to clear, he taxied to the end of the runway, turned, and took off. The aircraft was airborne when it passed the FSS building, located about two-thirds of the way down the runway. About 30 seconds after the pilot started the take-off roll, and about 10 seconds after the aircraft became airborne, the pilot and the FSS Specialist simultaneously radioed that the aircraft's nose baggage door had come open.

The pilot informed the FSS Specialist that he would fly a full circuit and land on runway 16. He immediately called the FSS Specialist again and informed him that he would fly a tear-drop pattern and land on runway 34, the reciprocal of the take-off runway (see "Final Flight Path" on page 2). The aircraft turned left to a heading of about 100 degrees and levelled off at a height between 200 and 400 feet above ground level (agl)[3] as it flew away from the airport. The landing gear was extended and remained extended throughout the flight. Witnesses reported hearing the sound of the aircraft's engines vary in volume as it flew past their vantage points. Then, about 90 seconds after take-off, and as it approached Woodley Mountain, the aircraft rolled sharply left.

The aircraft nosed down, crashed to the ground, and immediately burst into flames. Witnesses reported that the volume of the engine noise increased just before ground impact.

The FSS Specialist observed the aircraft to yaw to the left just before its nose dropped.

The accident occurred at latitude 49°0'N, longitude 123°52'W, at an elevation of 100 feet above sea level (asl), at 0745 PDT, during the hours of daylight.

1.2 Injuries to Persons

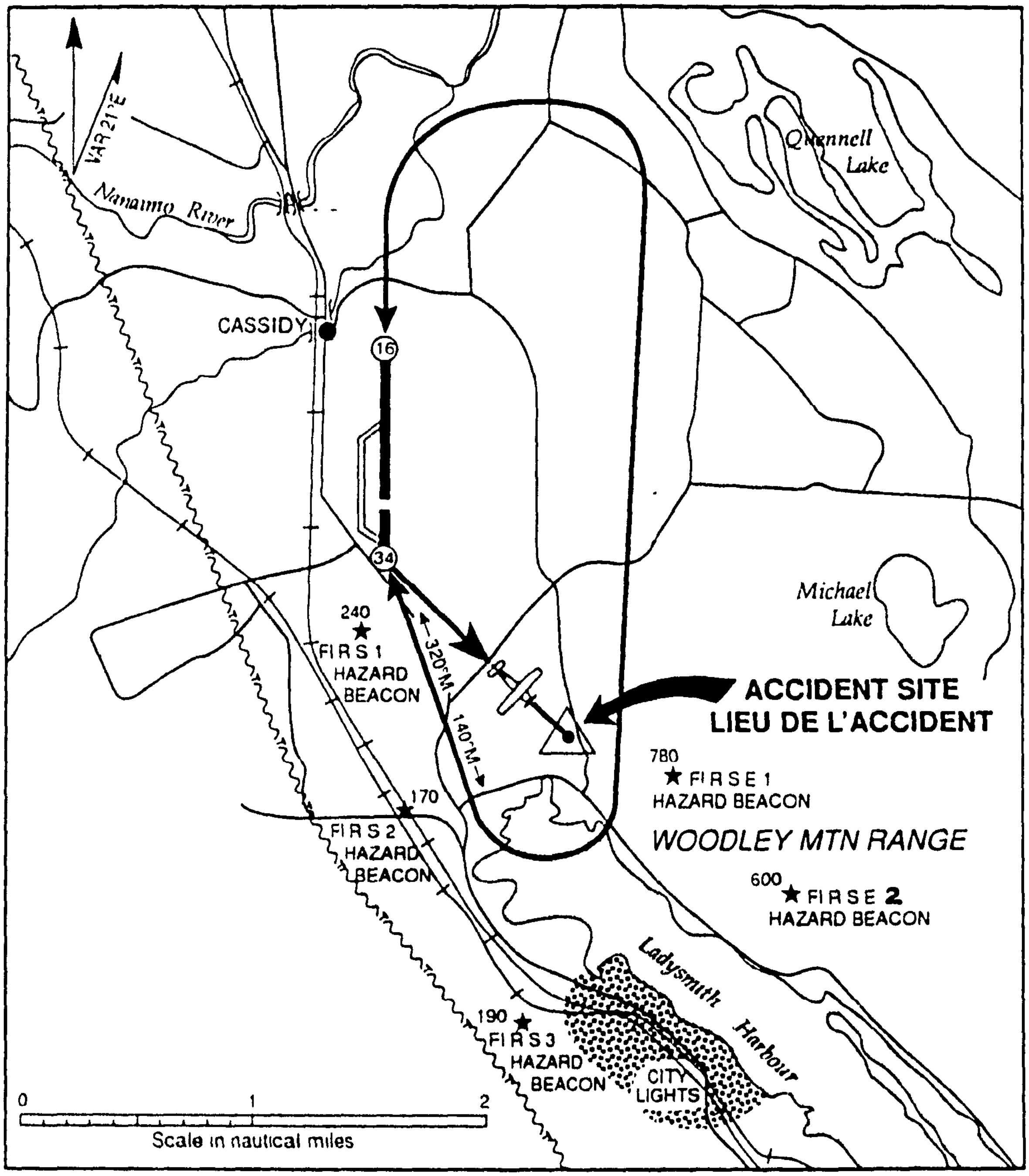
	Crew	Passengers	Others	Total
Fatal	1	4	—	5
Serious	—	—	—	—
Minor/None	—	—	—	—
Total	1	4	—	5

[1] All times are PDT (Coordinated Universal Time (UTC) minus seven hours) unless otherwise stated.

[2] See Appendix B for all abbreviations and acronyms

[3] Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

FINAL FLIGHT PATH
TRAJECTOIRE DE VOL FINALE



1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

	Pilot-In-Command
Age	27
Pilot Licence	Commercial
Medical Expiry Date	01 July 1989
Total Flying Time	728 hr (estimate)
Total on Type	273 hr (estimate)
Total Last 90 Days	75 hr
Total on Type Last 90 Days	73 hr
Hours on Duty Prior to Occurrence	3 hr
Hours off Duty Prior to Work Period	8 hr

On the day before the accident, the pilot left his home in Vancouver at about 1800 PDT and drove to the Vancouver Airport. From there he flew a Cessna 172 to Nanaimo Airport and arrived shortly after 1900 PDT. At 2000 PDT, he departed Nanaimo as the pilot-in-command on a scheduled round-trip passenger flight to Vancouver in C-FJAI.

He landed back at Nanaimo at 2100 PDT and then drove to Qualicum Beach, arriving about 2200 PDT. He slept in accommodations shared with other company pilots and left for work at about 0530 PDT on the day of the accident. He travelled by car from Qualicum to Nanaimo Airport to prepare for his day of flying Piper C-FJAI on shuttle flights to Vancouver.

1.5.1 Pilot Training/Proficiency

The Aquila Air Operations Manual contains a Transport Canada (TC) approved training syllabus. Company records indicate that the pilot had completed the required training, however, the pilot's training file does not contain any assessment of his ability. A pilot proficiency test-flight report and two instrument rating test-flight reports administered by TC were on the training file. The pilot successfully completed a proficiency flight test on a Piper PA 23-250 Aztec in November 1988. He attempted an instrument rating flight test in January 1989; however, the test was terminated before take-off because the pilot accepted an invalid air traffic control (ATC) clearance. He passed the instrument rating flight test on 27 April 1989.

The review of the TC training file also indicated that the pilot had experienced difficulties attaining a passing standard on Private and Commercial written examinations. However, at the time of the accident, he was fully certified and qualified for the flight in accordance with existing regulations

1.5.2 Flying Time

At his civil aviation medical examination in June 1988, the pilot declared his grand total flying time as 385 hours. The pilot's personal log-book was in the aircraft, and it was destroyed by fire.

The company's records of training and revenue flights indicate that the pilot flew 273.3 hours in the Piper Aztec and 69.4 hours in the Cessna 172 between July 1988 and the date of the accident. His flying times are estimates.

1.5.3 Recent Employment

At the time of the accident, the pilot was also employed by Canadian Airlines International Ltd. (CAIL) at Vancouver as a stores keeper. He worked a regular day shift every Friday, Saturday, Sunday, and Monday with CAIL and was available to fly for Aquila Air on the remaining days of the week. This routine had been in place since he began flying for the airline.

1.6 Aircraft Information

Manufacturer	Piper
Type	PA 23-250 Aztec
Year of Manufacture	1962
Serial Number	27-2185
Certificate of Airworthiness	Valid
Total Airframe Time	5,585
Engine Type	Lycoming 0540A1D5
Propeller Type	Hartzel HCA2VK
Maximum Allowable Take-off Weight	4,800 lb
Recommended Fuel Types	100LL

The aircraft was fitted with a visual stall-warning indicator.

1.6.1 Aircraft Maintenance

The aircraft was equipped in accordance with existing regulations. At the time of the occurrence, it was certified by the company maintenance engineer as being airworthy, and there was no record of any outstanding deferred maintenance items or aircraft deficiencies.

A TC audit of Aquila Air conducted in September 1988 resulted in the suspension of the Certificate of Airworthiness (C of A) of aircraft C-FJAI. The inspectors determined that numerous deviations from airworthiness standards found on the aircraft constituted an immediate threat to aviation safety. The defects were rectified, the aircraft was inspected by an airworthiness inspector, and the C of A was reinstated.

Company pilots who had recently flown the aircraft said that it had performed well. One company pilot said that he had been unable to latch the forward baggage compartment door some weeks before the accident. He reported the problem, and a company maintenance person tightened screws associated with the latching mechanism. The door then closed and locked normally.

The pilot identified an apprentice aircraft maintenance engineer as the person who performed the maintenance; however, the apprentice said that he could not remember doing any repairs to the baggage door. He also said that any repairs to the aircraft would have been reported to the company engineer, and that the engineer would be responsible for recording the details in the aircraft maintenance log. There is no maintenance log entry for any baggage door repair work during this period.

One of the defects noted in the September 1988 TC audit was an unauthorized modification to the door locking handle. That same month, following receipt of TC approval (Approval Number P88/309), Aquila Air modified the nose baggage door locking handles on their Piper Aztec aircraft. This modification incorporated a door handle safety latch that, when in the locked position, would prevent the door handle from opening.

The aircraft's weight and centre of gravity were within the prescribed limits.

1.7 Meteorological Information

A weather observation was taken at the Nanaimo Airport about seven minutes after the accident. Scattered cloud was present at 4,000 and 10,000 feet agl, thin-broken cloud at 15,000 feet agl, and the cloud ceiling was estimated at 25,000 feet. The surface wind was 030 degrees magnetic at three knots, and the temperature was nine degrees Celsius. There were no obstructions to vision.

1.8 Aids to Navigation

The Nanaimo non-directional beacon (NDB) operates on a frequency of 251 kilohertz (kHz) and is located 4.1 nautical miles north-northwest of the airport.

1.9 Communications

Very high frequency (VHF) radio communication was established between the pilot and the FSS Specialist on the mandatory frequency, 122.1 megahertz (MHz). A record of the communications was transcribed from the FSS tape recordings.

1.10 Aerodrome Information

The airport is operated under public licence by the city of Nanaimo. The field reference elevation is 99 feet asl. Runway 16/34, the only runway, is 5,000 feet long and 200 feet wide. Fire-fighting services are available for on-aerodrome occurrences.

1.11 Flight Recorders

The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was either required by regulation.

1.12 Wreckage and Impact Information

The aircraft crashed in a steep, nose-low attitude, slightly left-wing low, and yawed a few degrees to the left. After the initial impact, the entire fuselage skidded about four feet to the right. Except for the forward baggage door and some other small pieces that were thrown ahead of the wreckage, the aircraft remained intact. The impact crater was shallow.

The cockpit and the forward cabin were severely damaged. Examination of the wreckage revealed that the flaps were up and the landing gear was down at impact. The aircraft was badly burned, and the positions of the landing gear and flap levers could not be determined. Other than the nose baggage door coming open, there was no evidence of any aircraft malfunction prior to the accident. The impact airspeed could not be determined from examination of the aircraft instruments.

1.13 Medical Information

There was no evidence that incapacitation or physiological factors affected the pilot's performance.

1.14 *Fire*

An intense fuel-fed fire occurred moments after impact. Local fire-fighters were at the site minutes after the accident; however, they arrived too late to prevent the fire from destroying most of the fuselage.

1.15 *Survival Aspects*

Because of the impact forces, the accident was not survivable.

1.16 *Tests and Research*

1.16.1 *Engine Examination*

Both engines and propellers were disassembled and examined after the accident; no pre-existing deficiencies were found in either system. Examination of the damage to both propellers indicated that both engines were producing considerable power at impact. The drive shaft to the right propeller was broken in torsional overload, also an indication of high power at impact. The aircraft was yawed slightly to the left at impact, and the left engine was subject to less severe impact forces than the right one. The left and right engines had operated 704 hours and 1,598 hours respectively since overhaul. It was concluded that both engines were capable of producing rated power.

1.16.2 *Nose Baggage Compartment Door Examination*

The nose compartment baggage door opens upward and is located on the right-hand side of the aircraft's nose (see "Piper Parts Catalog" on page 7) The door latch mechanism operates two lock arms that, when in the locked position, protrude from the fore and aft edges of the door and fit into recesses in the frame. Two coil springs hold the lock arms at full travel in either the latched or unlatched position. A third coil spring helps to absorb the linkage slack at the latching handle.

The nose baggage door was examined at the TSB Engineering Laboratory to establish the door's condition before the accident and to determine why the door opened during flight.

The nose baggage door was torn from the aircraft by impact forces, and it was found about 20 feet in front of the wreckage. The door handle was still in its recess and locked position; however, the aerodynamic device that would prevent the handle from coming out of its recess was not in the locked position. While the aircraft is in flight, this device is held in the locked position by slipstream air loads. Without these air loads, the locking device is easily rotated to the unlocked position. The door was subject to severe impact forces during the accident sequence, and the locking device was found in a random, unlocked position.

The spring at the forward lock position was broken, the aft lock spring was missing, and the spring at the handle was permanently set in an over-stretched condition. Two screws were missing from the forward lock arm bracket, and the one remaining screw was loose. The internal threads in the two missing screw holes were relatively clean and free of thread damage, indicating that they were not pulled out in the crash sequence. Two and three-quarter turns were required to tighten fully the remaining screw. All

Extrait du catalogue des pièces Piper
Figure 15 - Porte de soute à bagages et porte cabine (réf. no 27-1 à 27-7554168 inclusivement)

PIPER PARTS CATALOG

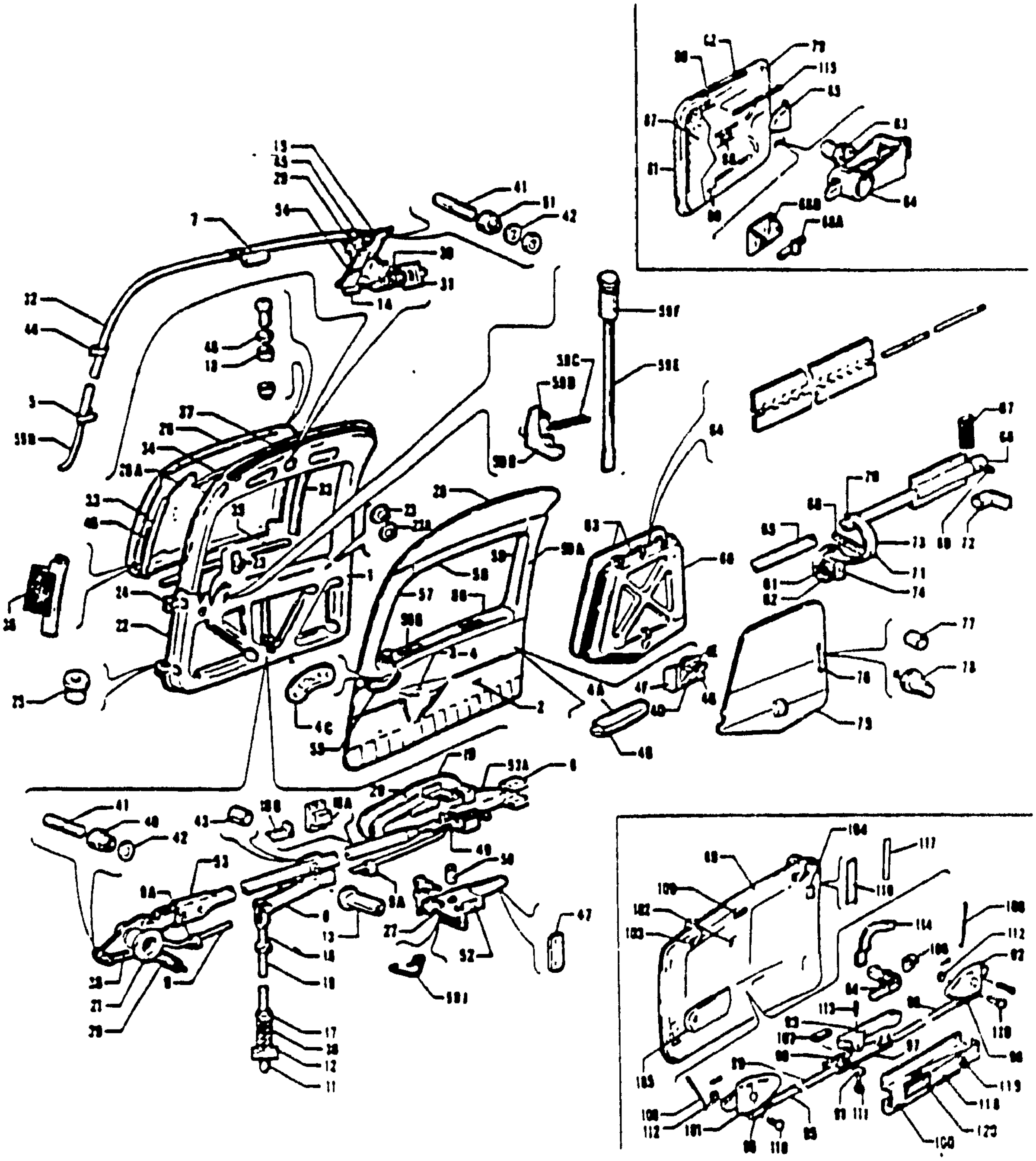


Figure 15 Baggage Door Assembly and Cabin Door Assembly
(Serial Nos. 27-1 to 27-7554168 Inclusive)

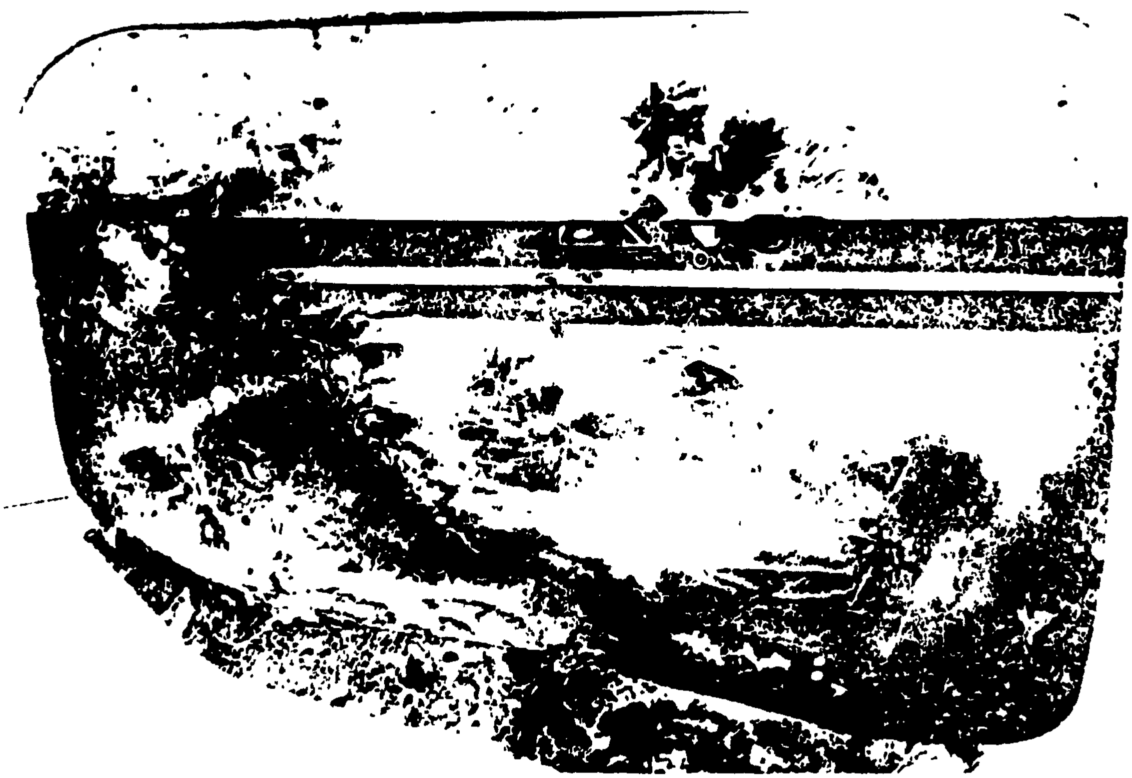


PHOTO 1. Nose baggage door assembly outer surface.

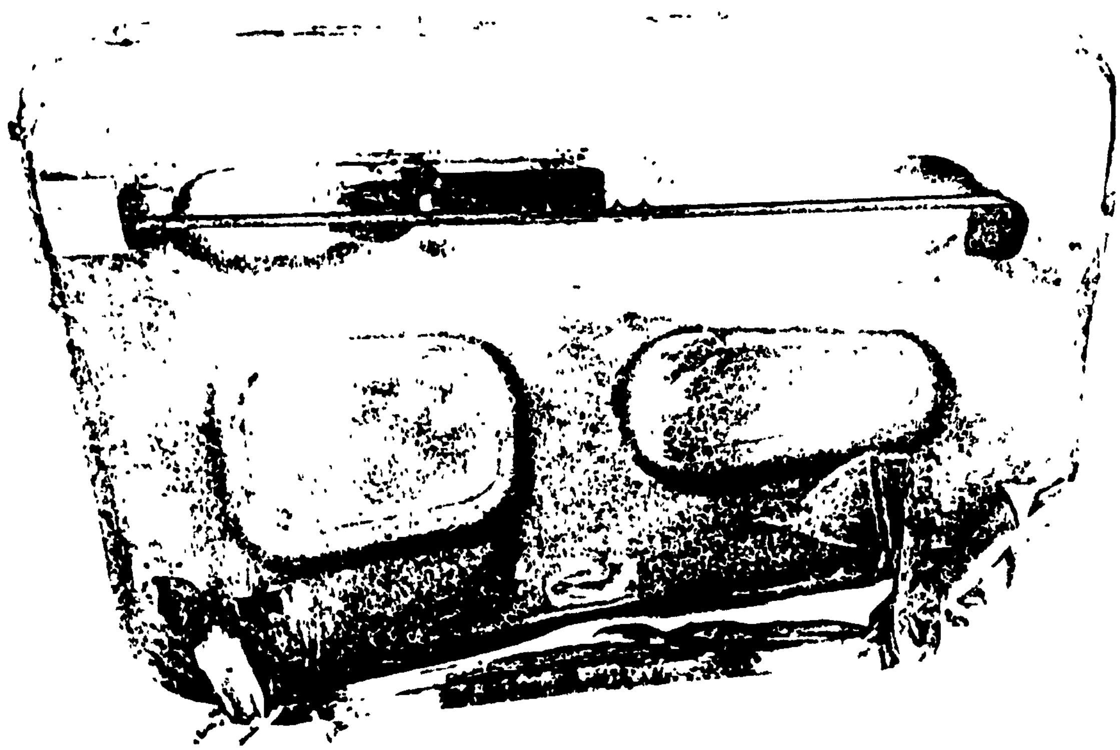


PHOTO 2. Nose baggage door assembly inner surface.

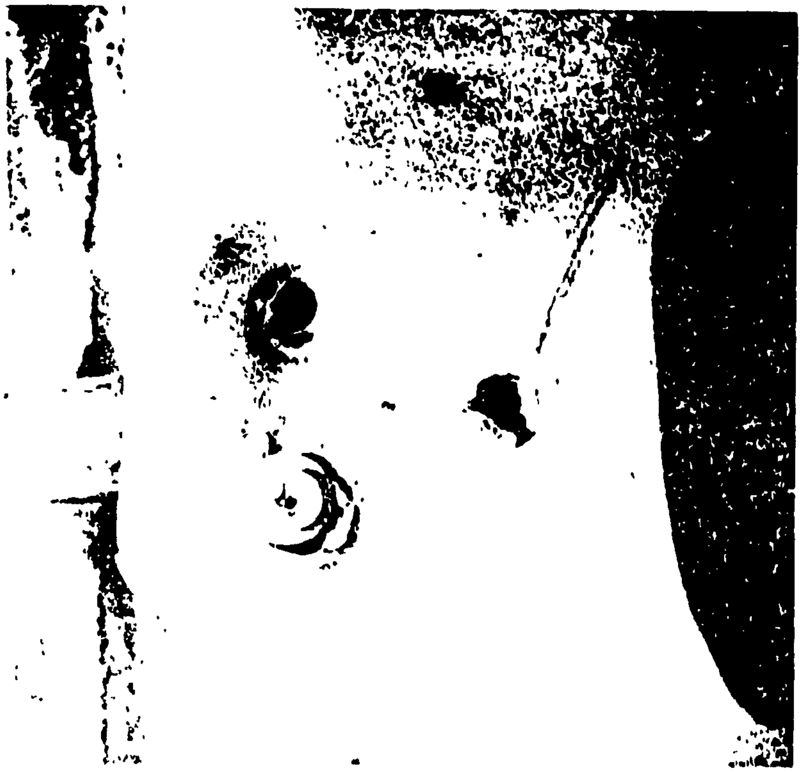


PHOTO 3. Forward door lock arm location. Note missing screws and worn holes

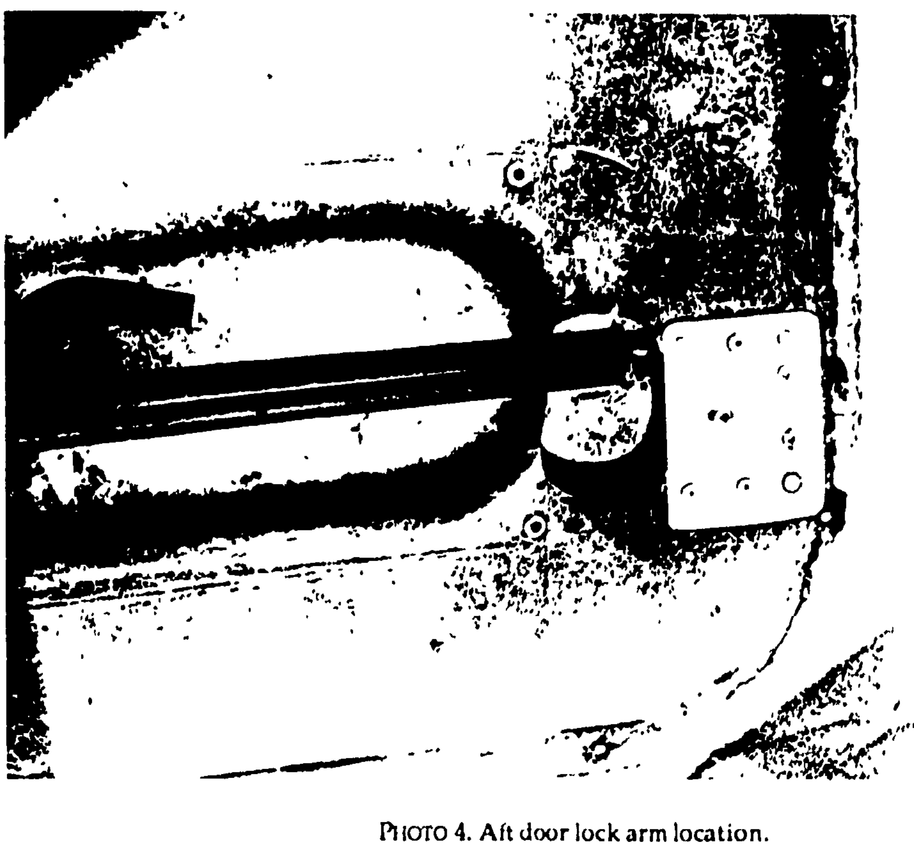


PHOTO 4. Aft door lock arm location.

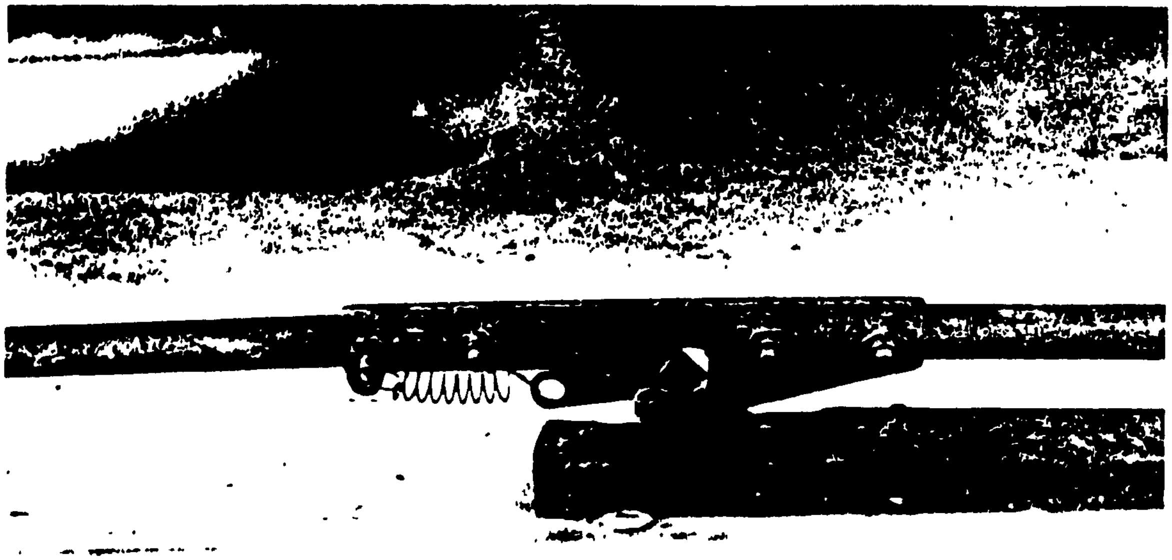


PHOTO 5. Door latch mechanism on inner side at handle location.

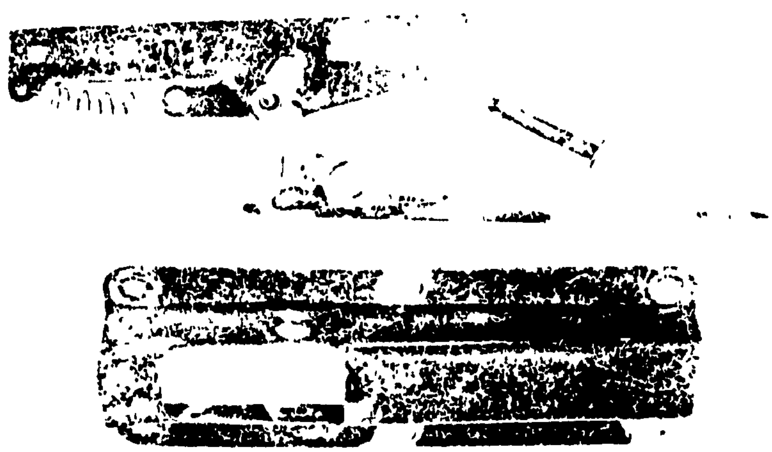


PHOTO 6. Handle mechanism disassembled showing areas of wear.

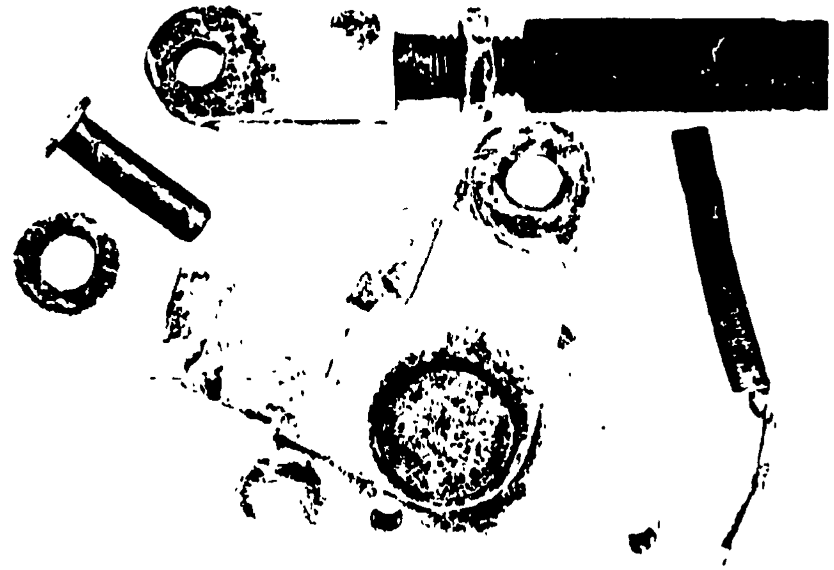


PHOTO 7. Forward door lock arm assembly removed for examination. Note wear at tip of lock arm.

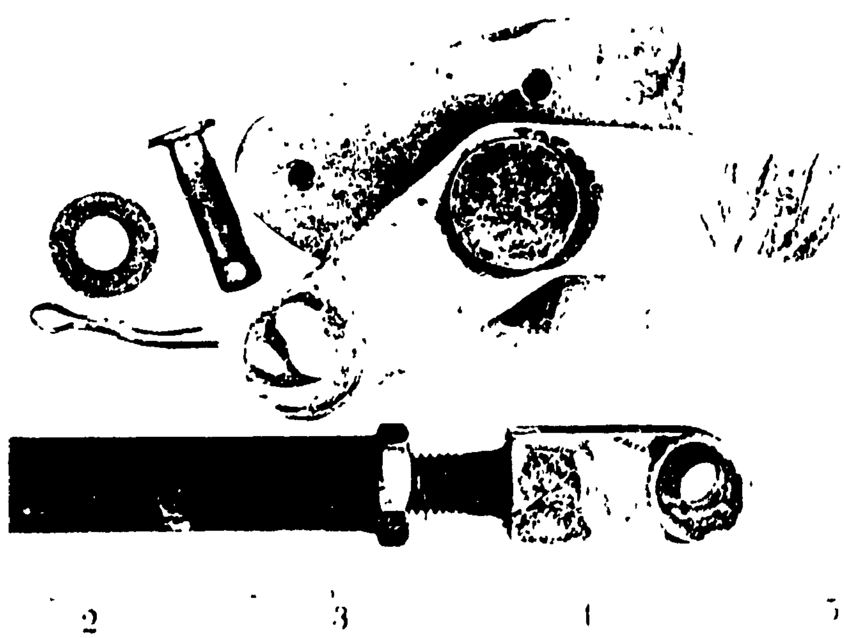


PHOTO 8. Aft door lock arm assembly removed for examination. Note wear in hole of arm and at tip of lock arm.

three screws in the aft lock arm bracket were loose by about one-eighth of a turn.

In addition to the looseness at the lock arm bracket attachments, there was considerable slack throughout the connecting linkages, and the inner door cover for the door latch mechanism was missing. The overall condition of the door indicated a less than acceptable level of maintenance.

During testing, with the two screws missing, the front lock arm could be disengaged by shifting the door lock arms inward towards the unlatch position while the door handle was in the closed position. Because of the missing spring and screws, there was nothing to prevent the lock arm from disengaging the door frame.

It was determined that the most serious defect was the missing screws from the forward door lock assembly. With these screws missing, the arm could either disengage as a result of vibration or, more probably, shift during the door closing operation and not engage the door frame cut-out. With the front lock not engaged, air loads in flight could distort the door slightly, allowing the aft lock to disengage and the door to open.

1.16.3 Aerodynamics

An analysis of the aircraft's flight characteristics with the nose baggage compartment door open was prepared by the TSB Engineering Laboratory.

With the landing gear up and the door closed, a total of about 140 horsepower is required for the aircraft to maintain 100 mph. The open door would increase aerodynamic drag, and about 155 horsepower would be required to maintain 100 mph. If the aircraft was allowed to yaw to the left and present a larger door area to the slipstream, the power requirement could be about 170 horsepower. The aircraft's engines are rated at 250 horsepower each and are capable of producing the power required to maintain an airspeed well above the stalling speed, with the door open and with the landing gear down.

Aircraft directional control would be affected by the aerodynamic forces created by the open baggage door. However, it was determined that the aircraft rudder authority would easily counteract these forces. Flight with the open door would create noise and airframe vibrations, and the feel of the aircraft controls might also be affected. Control feedback and airframe buffet that would normally warn of an approaching aerodynamic stall might be masked by these noises and vibrations.

1.17 Additional Information

1.17.1 Aircraft Controls

The aircraft was fitted with dual controls, and the right seat was occupied by a passenger; there was no evidence to indicate that the passenger had interfered with the pilot or the aircraft's controls. There have been a number of cases in which the baggage door of this or a similar aircraft model has opened in flight; the aircraft were easily controlled. No record was found of an occurrence where an open nose baggage door, on this or similar aircraft model, had caused the pilot to lose control of the aircraft. On two occasions when the baggage door was inadvertently left unlocked before flight, the door opened either just before or at lift-off, and the pilots rejected the take-offs. The aircraft manufacturer does not have any information on the PA-23's flight characteristics with an open nose baggage door.

1.17.2 *Aircraft Yaw*

Without rudder input, a twin-engine aircraft will yaw toward the engine which is producing less power. If the pilot reduces right engine power or if the right engine loses power for any reason, the aircraft will yaw to the right, and the pilot will normally apply sufficient left rudder to eliminate the yaw. Pilots will normally limit the rudder input to that required for coordinated flight.

1.17.3 *Forward Baggage Compartment Contents*

The burned remains of a Thermos bottle and a pair of working boots were all that remained of the articles stowed in the forward baggage compartment. The area under the flight path of the aircraft was searched from the end of the departure runway to the accident site. Nothing that had been in the aircraft was found. One witness was told by an unidentified person that he saw something fall from the aircraft before it crashed. None of the witnesses interviewed reported seeing anything fall from the aircraft. There were no marks on the right propeller, engine, or fuselage to indicate that anything had fallen from the compartment.

1.17.4 *Engine Performance*

On each of the two previous flights on the morning of the accident, a passenger stated that the pilot seemed to have a problem with the aircraft's right engine. One said that the engine appeared difficult to start at Vancouver, and the other said that the propeller stopped after the landing at Nanaimo. There is no record of the right engine being difficult to start, and none of the pilots reported experiencing a similar problem. Although it is not a standard procedure, some pilots will shut down the right engine of the Aztec aircraft after landing; however, it could not be determined whether the pilot followed this practice. The pilot did not report any engine malfunction to the company after the first shuttle flight.

1.17.5 *Aquila Air Audit*

Aquila Air was again audited by a team of TC officials on 06 and 07 March 1989. The inspection team reported that the company's operations "were in accordance with appropriate sections of the regulations with some minor exceptions". The minor exceptions pertained to aircraft manuals and maintenance documentation. The team found no non-conformance deficiencies with any of the company's aircraft. The accident aircraft was examined, and the airworthiness inspector identified a number of minor defects. The baggage door was not mentioned in the report. Documentation on the aircraft file at TC indicates that some of the deficiencies had not been rectified by 14 March 1989, and there is no record that the minor defects were ever rectified.

Shortly after the accident, on 05 and 06 June, Aquila Air was again audited by TC. As a result of this audit, the company's Operating Certificate was suspended. TC cited a loss of operational and maintenance control as grounds for the suspension.

1.17.6 Conditions of Employment

If a commercially operated aircraft is involved in an accident and there is an insurance claim, the insurance company may increase the deductible amount on the hull insurance and/or raise the insurance premiums. Pilots involved in these occurrences are often released from their employment.

If a pilot is involved in a reportable accident or incident, this fact is normally recorded in the pilot's TC licensing file.

2.0 Analysis

2.1 Introduction

The analysis will address the flight, the accident sequence, the airworthiness of the nose baggage door, the aerodynamic effects of the open baggage door, and the appropriateness of the pilot's response to the emergency.

2.2 Preparation and Flight

There is no evidence that pre-flight preparations for the second round-trip flight between Nanaimo and Vancouver were anything other than routine. The pilot loaded the passengers and their baggage following an established pattern as he had already done twice that morning.

The weather was good, the flight was on time, and the pilot appeared to be satisfied with the aircraft's performance. His taxi procedures and radio calls to the Nanaimo FSS were normal, and the take-off roll and lift-off were uneventful. After the aircraft was airborne, and when it was adjacent to the FSS building, both the pilot and the FSS Specialist noticed that the baggage door had opened. On the two similar occurrences, the door had opened on lift-off, and the pilots were able to reject the take-off. Piper C-FJAI was airborne when the door opened, and the pilot was unable to land on the runway that remained.

2.3 Nose Baggage Door

The overall condition of the baggage door indicated a less than acceptable level of maintenance. The loose and missing screws, the broken, missing and stretched springs, a missing panel over the latch mechanism, and the looseness in the linkage joints were deficiencies which should have been detected during routine maintenance. Evidence indicates that company maintenance personnel were aware that the door was difficult to lock, and that they had attempted to correct the problem, however, the details of the maintenance were not recorded in the aircraft maintenance log.

The fact that the baggage door did not open at lift-off indicates that the pilot latched the door and secured the opening handle with the aerodynamic lock, however, given the unreliable nature of the door lock mechanism, it is probable that the front lock arm did not engage in the door frame cut-out. Although the door would appear secure, the front would be unlocked. The door would then shift and twist when subjected to air loads and vibration after take-off, and the rear lock arm would disengage. Because the front of the door was unlocked, the door would then open.

2.4 Accident Sequence

After the door opened, the pilot climbed to about 300 feet agl as he flew away from the airport. It could not be determined why he did not raise the landing gear. It could not be determined why he did not continue climbing to the normal circuit altitude when the aircraft was capable of doing so. The additional ground clearance would have provided a safety margin if the pilot experienced any difficulty as he manoeuvred to land.

The aircraft appeared to be in controlled flight after take-off, and, after some deliberation about the landing runway, the pilot entered a tear-drop pattern to return and land on runway 16 at Nanaimo. During the minute and one-half the aircraft was airborne, the pilot did not express any concern about his ability to control the aircraft; there were no radio transmissions at all after he notified the FSS of his intentions.

The description of the accident provided by witnesses, the condition of the aircraft and engines after the crash, the short wreckage trail, and the shallow impact crater all indicate that the aircraft was in a stall at impact.

Witnesses reported hearing the volume of the engine noise vary. It is possible that the pilot reduced power on one or both of the engines in order to reduce airspeed. A lower airspeed would result in reduced air loads on the open baggage door and possibly prevent the door from tearing off; however, the airspeed loss would probably be rapid because of the aerodynamic drag created by the open door and by the extended landing gear. There is also the possibility that the pilot thought he had forgotten to lock the door, in which case it would reflect adversely on his competency

The FSS Specialist saw the aircraft yaw left just before it crashed to the ground. It is probable that the yaw was associated with the stall sequence, and that it occurred when the pilot attempted a right turn to reverse course; Woodley Mountain was immediately in front of the aircraft, and the aircraft was well below the peak. It is also possible that the pilot attempted a side-slip to the right, either to prevent baggage from falling from the open baggage compartment, or to try to close the compartment door. Although the open baggage door should not have caused any severe aircraft control problems (the aircraft flew in level flight one and one-half miles before it crashed), it was an unusual and distracting occurrence, and it probably diverted the pilot's attention from his primary task of maintaining control of the aircraft. He may also have been preoccupied with preventing any further damage to the door. It is concluded that the pilot allowed the airspeed to decrease to a stall, and that the noise and vibrations associated with the open door probably masked the warning symptoms of the stall. It could not be determined whether the visual stall warning activated or, if so, whether it was noticed by the pilot. The aircraft stalled, and because of the low altitude, the pilot was unable to recover in time to prevent the crash.

3.0 Conclusions

3.1 Findings

1. The nose baggage door locking mechanism was defective because of inadequate maintenance.
2. The baggage door opened on take-off.
3. There was insufficient runway remaining for the pilot to reject the take-off when the baggage door opened.
4. The pilot levelled the aircraft at a low altitude and did not raise the landing gear.
5. The pilot allowed the airspeed to decrease until the aircraft stalled at low altitude.
6. The noise and vibration created by the open door may have distracted the pilot and could have masked the warnings of the approaching aerodynamic stall.
7. Aircraft maintenance records were not kept in accordance with Transport Canada regulations.
8. Other than the inadequate maintenance of the baggage door lock, there was no evidence of a system malfunction prior to the accident.
9. Transport Canada audits of Aquila Air, conducted only three months apart, produced significantly different findings.
10. The pilot was certified and qualified in accordance with existing regulations.
11. The aircraft was certified and equipped in accordance with existing regulations.
12. The aircraft weight and centre of gravity were within the prescribed limits.

3.2 Causes

The nose baggage door locking mechanism was defective because of inadequate maintenance and allowed the door to open in flight. The aircraft stalled, and, because of the low altitude, the pilot was unable to recover in time to prevent the aircraft from crashing to the ground.

4.0 Safety Action

4.1 Action Taken

4.1.1 Surveillance, Audit, and Inspection

On 06 and 07 March 1989, a routine audit of Aquila Air was done by Transport Canada (TC). The inspection team reported that the company's operations were in accordance with the appropriate regulations, with some minor exceptions pertaining to aircraft manuals and maintenance documentation.

The purpose of an audit of this type, as stated in the Air Carrier Inspector Manual (Small Aeroplanes) TP 3783E, would be to ensure that an air carrier is equipped adequately and able to provide the service for which the company is certificated, and that it is operating safely in accordance with the conditions of its Operating Certificate, Air Regulations, Air Navigation Orders, and the company's TC approved/accepted Operations Manual.

After the accident, on 05 and 06 June 1989, the company was again audited by TC; this audit revealed a loss of operational and maintenance control. Aquila Air's Operating Certificate was subsequently suspended.

The vastly different results of the two audits, conducted only three months apart, added to an existing concern held by the Canadian Aviation Safety Board (CASB), the predecessor to the Transportation Safety Board of Canada (TSB). The CASB felt that audits, as they were being conducted by TC in the period leading up to and encompassing this occurrence, were not accomplishing their purpose.

On 28 April 1989, five days prior to this accident, the CASB forwarded Recommendation 88-31 to the Minister of Transport on the requirement to improve its procedures for the follow-up to any outstanding items from its audits of a company's operations. This recommendation resulted from an occurrence on 24 June 1987 (87H0002). TC replied on 28 July 1989, stating that the establishment of four audit management positions, combined with the future implementation of a National Aviation Company Information System (NACIS) would ensure a more effective follow-up to Air Carrier audit activities

Two subsequent recommendations were issued by the CASB and the TSB relating to the conduct of audits, inspections, and surveillance of Canadian air carriers and operators. On 21 July 1989, the CASB forwarded Recommendation 89-05 to address concerns stemming from an accident on 10 November 1987 (87W0073) which had revealed problems with the audit and inspection of air carriers engaged in remote operations. In its response, TC indicated that a private consulting firm had been engaged to determine TC's "Capability to Monitor the Industry to Ensure Compliance and a High Level of Flight Safety". They further indicated that the study, which had begun in May 1989, would be examining TC's capability to monitor air carriers engaged in remote operations. The study was completed in September 1990, and TC is currently reassessing its audit policies and procedures in light of the study's recommendations.

In its Recommendation 90-49, forwarded on 31 May 1990, the TSB identified a deficiency with the frequency of TC audits on operators of aircraft with restricted Aircraft Type Approvals. This recommendation resulted from an accident on 02 August 1988 (88H0009). In its June 1990 reply to Recommendation 90-49, TC indicated that recent changes in policy, as outlined in the Manual of Regulatory Audits, TP 8606E, which supersedes the requirements of TP 3783E, would address the Board's concerns regarding the Department's conduct of surveillance, audit, and inspection of air carrier operations. TC indicated that its audit and inspection program would allow managers to target effectively audits to the areas of greatest need, in accordance with the principles of risk management. Under the new policy, no aviation company would operate without an inspection for a period greater than 12 months, nor without an audit for a period longer than 36 months. Depending on the results of inspections and other indicators, managers would schedule audits to the frequency, depth, and scope required to ensure compliance with safety regulations. In addition to this application of risk management principles, TC believes that the implementation of the NACIS will effectively increase audit resources by relieving inspectors of routine audit administrative tasks.

In light of the TC initiatives, the TSB feels that its concern about the adequacy of TC audits raised by this occurrence is being addressed. The TSB will continue to follow the full implementation of the new policy and procedures with interest.

4.1.2 *Human Factors Training*

Although the open baggage door in this accident should not have caused unsurmountable aircraft control difficulties, the distraction that it created may have diverted the pilot's attention from his aircraft's flight parameters to a point where he failed to recognize the onset of an unsafe condition.

Since 1977, there have been 26 other Canadian-registered aircraft accidents which involved doors opening in flight. In over half of these accidents, it appears that the pilot's attention may have been overly focused on the open door, and proper aircraft control was inadvertently sacrificed. This channelizing of attention, a process by which the individual directs all his/her attention and resources towards the achievement of a goal or action, is a common reaction to what is perceived to be a stressful situation. In these stressful situations, the workload demands can be high, and the ability to respond can be limited. However, it is now generally agreed that proper training and awareness programs dealing with the effects of stress and other human factors on performance has the potential to minimize their consequences and to prevent other similar accidents from occurring.

Moreover, it is through knowledge and understanding of the role of human factors in aviation that various agencies hope to address the underlying "human" aspects cited as contributory factors in approximately 85 per cent of all aircraft accidents. For instance, the TSB has placed an increased emphasis on the identification and analysis of safety deficiencies involving human factors in transportation occurrences. The International Civil Aviation Organization (ICAO) has undertaken several initiatives, including the production of a series of digests on various aspects of human factors in aviation, and the implementation of training in human factors as a requirement for all aircrew licences in ICAO member states. TC, as part of its undertakings with respect to human factors in aviation, is advancing pilot knowledge through promotional activities (such as newsletters), by upgrading study and reference materials (such as the Pilot Decision-Making: Manual for Private Pilot Training, TP 8940E), and by increasing knowledge requirements for the issue of pilot licences.

Even though the understanding of human factors in aviation safety has only recently begun in earnest on a wide front, the TSB feels that the initiatives taken to date have the long-term potential for preventing accidents such as this one.

This report represents the completion of the investigation into this occurrence and is made public by the Transportation Safety Board of Canada. The Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, Wilfred R. DuPont and Hugh MacNeil, must reconsider any of its findings when, in its opinion, new material facts appear.

Appendix A – List of Laboratory Reports

The following laboratory reports were completed.

LP 78/89 – Forward Bagg ge Door (General Condition), and

LP 171/89 – Baggage Door Aerodynamics Analysis.

These reports are available upon request from the Transportation Safety Board of Canada.

Appendix B – Glossary

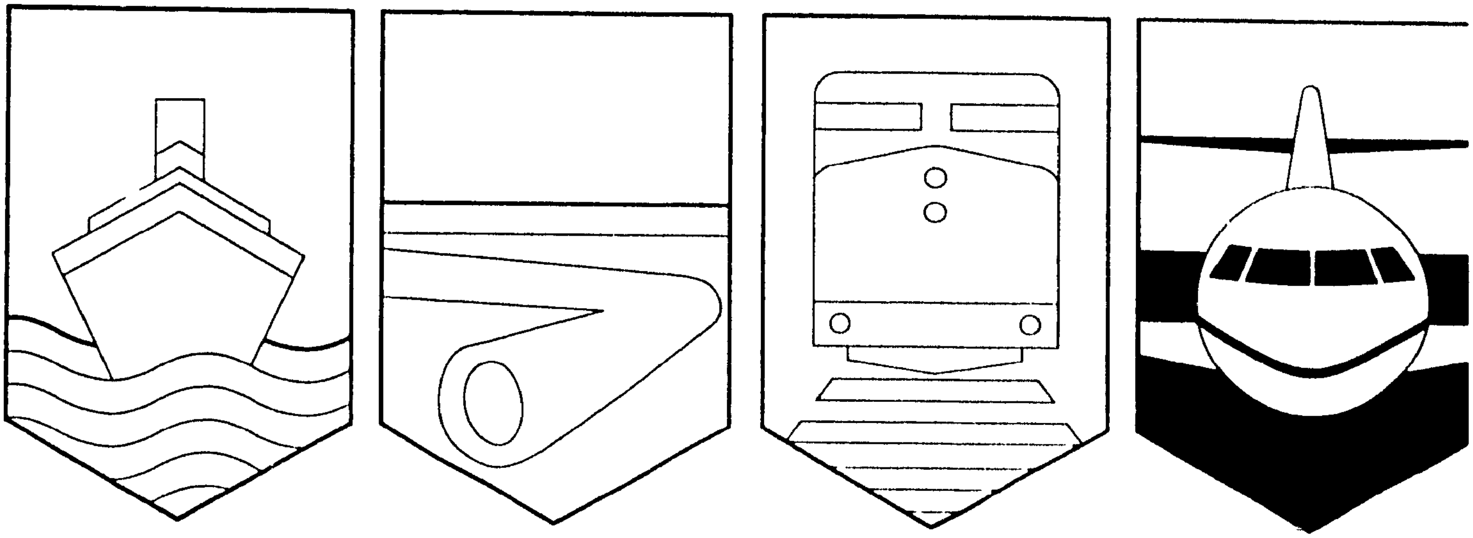
agl	above ground level
asl	above sea level
ATC	air traffic control
C of A	Certificate of Airworthiness
CAIL	Canadian Airlines International Ltd.
CASB	Canadian Aviation Safety Board
CVR	cockpit voice recorder
FDR	flight data recorder
FSS	Flight Service Station
hr	hour(s)
ICAO	International Civil Aviation Organization
kHz	kilohertz
lb	pound(s)
MHz	megahertz
mph	miles per hour
N	north
NACIS	National Aviation Company Information System
NDB	non-directional beacon
PDT	Pacific daylight time
TC	Transport Canada
TP	Transport Canada Publication
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VHF	very high frequency
W	west
°	degree(s)
′	minute(s)

IV-C

Transportation Safety Board of Canada: Report of a Safety Study on VFR Flight Into Adverse Weather

Transportation Safety Board
of Canada

Bureau de la sécurité des transports
du Canada



REPORT OF A SAFETY STUDY
ON
VFR FLIGHT INTO ADVERSE WEATHER

REPORT NO. 90-SP002

Canada

REPORT OF A
SAFETY STUDY
ON
VFR FLIGHT INTO
ADVERSE WEATHER

REPORT NO. 90-SP002

Adopted 13 November 1990

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

Accidents in which the aircraft was operated under Visual Flight Rules (VFR) into adverse weather conditions occur regularly, claiming a disproportionately high number of fatalities each year. They involve professional pilots, private pilots and business pilots who fly general aviation aircraft and chartered commercial aircraft, including fixed-wing aircraft and helicopters.

The regularity with which these accidents have occurred, and the seriousness of the continuing loss of life, prompted the Canadian Aviation Safety Board (CASB) to initiate a comprehensive and systematic examination of the issue. In March 1990, when this report was nearing completion, the CASB was replaced by the Transportation Safety Board of Canada (TSB), under whose auspices this report is now published.

During the last two decades, a number of foreign government agencies have undertaken measures to more fully understand these types of accidents. Recent studies emphasize both the complex decisional nature of continued VFR flight into adverse-weather and the often fatal consequences. This Safety Study is the first comprehensive review of the topic in Canada in recent years, and builds upon these earlier works.

1.2 Aim

The objective of this study is to examine the contributing factors to accidents which involved the initiation or continuation of flight under VFR despite adverse weather conditions.

Particular attention is made to:

— the requirements for obtaining and retaining an Instrument Flight Rules (IFR) rating; and

— the capability of and the requirement for Air Traffic Services (ATS) to assist VFR pilots in distress due to deteriorating weather.

1.3 The Conduct of The Safety Study

The scope of the safety study was confined to accidents which involved Canadian-registered aircraft in Canadian territory, over the ten year period between 1976 and 1985. There were 352 weather-related accidents occurring to Canadian registered aircraft; of these, nineteen occurred outside of the country and were excluded. Information from the remaining 333 accident investigations was extracted from the CASB data base and analyzed in relation to all Canadian occurrences during this period. Consequently, the seriousness of the issue was assessed, and the trends specific to the accidents in the study population were identified and examined.

The accident data were analyzed in two ways. First, accidents were clustered to simplify the identification of patterns. Accidents with similar characteristics were assigned to the same cluster. Clusters were examined individually and comparatively to identify distinct trends. Second, the accidents were examined in the context of particular safety issues identified in the findings of individual investigations, other safety studies, and secondary source material. The accident experience was examined in the context of the classic "man/machine/environment" model of safety analysis.

By this process, the trends identified by numerical tabulation were examined in the light of any apparent deficiencies which existed in the regulations, the industry practices, and/or the general operating practices in the aviation environment. The analysis accounted for revisions to the regulations which have occurred during the years 1986 to 1990.

The detailed staff report of the safety study on which this final TSB report is based is available under separate cover.

1.4 Report Format

The material from the staff report has been organized in this TSB final report into seven sections to facilitate analysis. Section 2 pertains to the regulations which generally govern VFR flight. Section 3 addresses safety deficiencies particular to VFR flight at night, while Section 4 focuses on issues pertaining to pilot licences and licence endorsements. Section 5 deals with the commercial operating environment in Canada, Section 6 with aircraft equipment, and Section 7 with such Transport Canada (TC) responsibilities as safety promotion and the dissemination of aeronautical weather information. The report contains recommendations which pertain to the operation of all VFR flights in Canada, some which relate to only commercial operations, and some which are specific to only fixed-wing or helicopter operations. To assist in locating recommendations which pertain to specific aircraft categories or types of operations, the reader is directed to Appendix B of this report, where a cross-reference is located.

1.5 General Observations

A comparison of this category of accident to all other accidents to Canadian-registered aircraft verified the need to more fully examine accidents occurring to VFR flights in adverse weather conditions. Although they involved only 352 of the 5,994 accidents recorded between 1976 and 1985 (6% of the total), they accounted for 23% of all fatal accidents and took the lives of 418 persons, or 26% of all fatalities during the ten year period. Even though the annual number of accidents involving aircraft governed by VFR which initiated or continued flight into instrument meteorological conditions (referred in this report as "VFR-into-IMC" accidents) has declined over the period (as have all aviation accidents), the annual number of fatalities in VFR-into-IMC accidents has remained generally constant. In other words, VFR-into-IMC accidents have claimed an annual proportion of aviation fatalities that has increased with time.*

* Although not all of the investigations for the period 1985-1988 have been finalized and the cause factors assigned, the data which is available suggests that the seriousness of VFR-into-IMC accidents continues. During the years 1985 to 1988, VFR-into-IMC involved 23% of the fatal accidents occurring to Canadian-registered aircraft, and accounted for 22% of the fatalities.

Canadian Registered Aircraft Accidents 1976 – 1985

	Number of Accidents	Number of Fatal Accidents	Number of Fatalities	Number of Serious Injuries
Continued VFR Flight into Adverse Weather	352	177	418	105
All Accidents	5,994	761	1,618	1,031

The Canadian accident experience exhibits similarities to the accident record of other nations. Approximately 12.7% of all the Canadian accidents during this period involved fatalities, but fully 50.2% of Canadian VFR-into-IMC accidents resulted in fatalities. A recently-released National Transportation Safety Board (NTSB) study came to similar conclusions regarding the American accident record: 17.3% of U.S. General Aviation accidents between 1975 and 1986 resulted in fatalities, but 72.2% of VFR-into-IMC accidents were fatal.* Clearly, accidents that result from pilots initiating or continuing VFR flight into adverse weather constitute a significant portion of the annual aviation fatalities in North America.

A comparison between Canadian pilots involved in VFR-into-IMC accidents and all other Canadian accident pilots yielded few differences; indeed, the pilot age, experience, and licence-type were generally similar. Although VFR-into-IMC accident pilots were slightly younger and had flown fewer hours, almost one fifth of the VFR-into-IMC accidents involved pilots with more than 3000 hours total flying time.

The most common types of operations involved in VFR-into-IMC accidents were recreational flying, charter operations, business flying and specialty operations (primarily flying training). In comparison with the averages for all accidents, the most notable feature was the higher incidence of accidents involving charter operations in VFR flight into IMC. Whereas charter operations account for less than 19% of all accidents, they comprised almost 27% of the VFR-into-IMC accidents.

This is cause for concern: charter aircraft, most of which regularly carry fare-paying passengers, are subject to stringent regulatory controls, and are piloted by experienced pilots. Consequently, the analysis of these accidents focused on the underlying causes which could be identified in the circumstances surrounding the accident flights.

VFR-into-IMC accidents tended to occur in the more remote areas of Canada. Four out of ten took place in the "sparsely settled region" as defined in the Air Navigation Orders (ANOs). Lacking the facilities to operate conventionally-configured aircraft in these areas, over one quarter of the aircraft were float- or ski-equipped. Half of the VFR-into-IMC

* U.S., National Transportation Safety Board, *General Aviation Accidents Involving Visual Flight Rules Into Instrument Meteorological Conditions*, Report No. NTSB SR-89/01, February, 1989, pages 3-4.

accidents took place where the terrain was mountainous or hilly.* Typically, accidents involving general aviation aircraft occur over flat areas (i.e. 22% occur in mountainous/hilly terrain).

Specific conclusions derived from the safety study along with appropriate recommendations are categorized and discussed in the following sections: VFR flight, night VFR flight, pilot licensing; industry practices; aircraft equipment, and the role of the TC safety infrastructure.

* A further 13% occurred over rolling terrain.

2.0 VFR FLIGHT

Reduced to its most simple terms, this study examines the ramifications of Air Regulation 542 which states.

> "When operating in accordance with VFR, aircraft shall be flown with visual reference to the ground or water unless otherwise authorized by the appropriate air traffic control unit. .."

This regulation is intended to permit safe flight by pilots who possess the most basic skills of navigation and piloting. The section which follows summarizes observations regarding VFR weather minima, Special Visual Flight Rules (SVFR), VFR flight in mountainous terrain, and the practice of 'scud-running'.

2.1 VFR Weather Minima

VFR visibility minima of three miles and one mile have been prescribed for flight by fixed-wing aircraft within controlled and uncontrolled airspace, respectively; i.e these VFR weather minima, particularly in uncontrolled airspace, permit pilots to fly in conditions whereby visual reference to the earth's surface is limited. Consequently, these regulations implicitly assume that orientation by other than reference to a natural horizon may be required to maintain control during VFR flight.

Seventy-four accidents occurred to pilots who lost control of the aircraft in reduced forward visibility; 80% of these (59) occurred in uncontrolled airspace, where the visibility minimum is one mile. It is extremely difficult to judge one mile forward visibility from a moving aircraft. In some cases, the accidents occurred in weather conditions which met or exceeded the legal minima. In other cases, it is likely that the pilots had difficulty in accurately determining one mile flight visibility from the moving aircraft, and flew into conditions less than those prescribed by regulation. A visibility of one mile leaves no margin for error, and permits pilots to fly in weather conditions in which there is inadequate outside reference to ensure consistent aircraft control. Therefore, the Board recommends that:

> The Department of Transport establish VFR visibility minima which will permit pilots to retain control of their aircraft by outside reference.

TSB-A90-65

Canadian regulations are, in many ways, more stringent for commercial operations than for private operations. However, the criteria for weather minima during day VFR operations for commercially-operated aircraft are the same as those governing any other VFR flight, placing a large number of fare-paying passengers at risk. American weather minima reduce this risk by being more restrictive for commercial VFR operations; Part 135 operators in the U.S. may not conduct flight under VFR in uncontrolled airspace when the ceiling is less than 1000 feet unless the flight visibility is at least 2 miles.

Although these limitations exceed the Canadian provisions, the NTSB in the United States has recently proposed even higher visibility limitations for commercial operations. NTSB recommendation A-89-91 proposes that the Federal Aviation Administration (FAA):

> "Restrict 14 CFR Part 135 air carrier (fixed-wing) passenger flights from operating in uncontrolled airspace under visual flight rules (VFR) in less than the basic VFR weather minimums of a 1000-foot ceiling and 3 miles flight visibility".

The NTSB supported this recommendation by information from three accidents in which 14 persons had died. The TSB believes that the circumstances of the 111 accidents between 1976 and 1985 which occurred to Canadian operators warrants similar regulatory revisions. The Board believes that commercial passenger-carrying operations conducted in Canadian uncontrolled airspace in flight visibilities of one mile will continue to experience a high accident and fatality rate. Accordingly, the Board recommends that

> The Department of Transport increase the VFR weather minima for fixed-wing commercial operations in uncontrolled airspace.

TSB-A90-66

2.2 VFR Minima – Mountainous Terrain

The accident data, both in Canada and in the United States, clearly indicate that mountainous terrain is most unforgiving to VFR pilots when weather conditions are poor. 51% of the Canadian VFR-into-IMC accidents occurred in mountainous or hilly terrain. VFR aircraft often transit the mountains through narrow valleys, where they may be subjected to strong winds and severe turbulence. Weather conditions which are highly changeable due to local effects, and variations in topography combine to create areas where VFR flights operate at high risk. Furthermore, the turning radius of many aircraft is increased at the higher altitudes at which they often operate through mountainous terrain.

Transport Canada has designated certain areas of Canada as "Mountainous Regions", and introduced more stringent rules to safeguard IFR flight in mountainous terrain. The need for higher VFR weather criteria has also been recognized, but only for the coastal regions of British Columbia; there, the minimum flight visibility for VFR flight in uncontrolled airspace is two miles. In most of the Designated Mountainous Regions of Canada, the one mile VFR flight visibility minimum is applicable. The Board believes that this minimum is inadequate Accordingly, the Board recommends that:

> The Department of Transport increase the minimum flight visibility for VFR flight in all designated Mountainous Regions to two miles.

TSB-A90-67

2.3 Special VFR (SVFR)

Canadian regulations can permit VFR flight in controlled airspace in weather conditions below the VFR weather minima. SVFR can be authorized during the day or night. During the years 1976 to 1985 in which the studied accidents occurred, SVFR could be authorized in weather conditions ranging from ceilings of 500 feet and three miles visibility, to ceilings of 700 feet and one mile visibility. ANO Series V, No. 1 was amended in June 1990, and now SVFR is permitted when the visibility is one mile, making the Canadian criteria similar to those of the U.S. and the U.K. However, SVFR flight at night, when inclement weather can not be readily discerned prior to entry, is restricted in the U.S. and the U.K. to pilots and aircraft certified for IFR flight. Such additional restrictions to night SVFR flight have not been included in the amendment to the Canadian regulations.

This study found only six accidents involving SVFR operations. Four of the six occurred during daylight, four occurred when forward flight visibilities were reduced (as opposed to two in which the pilots flew into cloud) and four of them occurred after the pilots lost control of the aircraft. While acknowledging that the accident data are scarce in this regard, the Board believes that in view of Canada's topography, low population density (which affects ground lighting and other visual references), and variable weather, the recent reduction in SVFR weather minima could increase the incidence of VFR-into-IMC accidents in Canada. The new weather minima for SVFR flight will permit greater use of SVFR in weather conditions worse than those which permitted the studied accident flights to occur. Accordingly, the Board recommends that:

> The Department of Transport reconsider the decision to reduce SVFR weather minima to visibilities of one mile.

TSB-A90-68

Canad'an regulations make no distinction between day and night SVFR. The American and British regulations, restricting night SVFR to specially qualified pilots flying aircraft equipped for IFR flight, take account of the additional risk of operating in poor weather in low-light or no-light conditions. To obviate conditions in which non-qualified pilots are at risk of encountering adverse weather conditions which require instrument flying skills, the Board recommends that:

> The Department of Transport restrict the authorization of night SVFR to pilots who are instrument-endorsed and who operate aircraft certified for instrument flight.

TSB-A90-69

2.4 VFR-Over-The-Top

Two hundred sixty-six of the accidents (80%) occurred in the enroute phase of flight. The options available to the pilots who encountered the first indications of impending inclement weather included: continuing flight in the adverse conditions in the belief that conditions would improve; conducting a 180 degree turn; or "ducking under" and proceeding around obstacles and inclement weather with the intention of reversing course if conditions deteriorated further. The latter practice, commonly termed 'scud-running', has resulted in pilots regularly operating in weather conditions which jeopardize safe flight.

Regulations in the United States provide American pilots with the options of flying 'VFR-On-Top' and 'VFR-Over-The-Top' (eg: remaining above and clear of cloud). By flying 'VFR-On-Top', U.S. pilots on an IFR flight plan may fly above a cloud deck and in Visual Meterological Conditions (VMC), navigating their IFR-equipped aircraft by means of navigation aids. VFR-Over-The-Top permits the VMC operation of a VFR-equipped aircraft above a cloud deck when it is not being operated on an IFR flight plan. It is not clear to what extent 'VFR-On-Top' or 'VFR-Over-The-Top' provisions have prevented certain types of VFR-into-IMC accidents in the U.S. However, the Canadian operating conditions and the Canadian accident data suggest that Canadian VFR pilots need additional options with which to make decisions when encountering adverse weather enroute.

One such option would be a form of 'VFR-Over-The-Top' which has been adapted from the American practice and which has received the support of members of the Canadian aviation community for some time. VFR-Over-The-Top would permit pilots to climb in visual meterological conditions (VMC), proceed enroute above inclement weather, and descend in VMC at a destination which had been forecast for conditions surpassing VMC for a period extending before and after the intended time of arrival. VFR-Over-The-Top (in other than high density areas) could provide a safe alternative to 'scud-running' and permit pilots to operate in weather conditions for which they are presently trained. To reduce the number of Canadian accidents occurring enroute, the Board recommends that:

> The Department of Transport prescribe conditions and procedures for the conduct of VFR-Over-The-Top in Canada.

TSB-A90-70

3.0 NIGHT VISUAL FLIGHT

Accidents occurring in other than daylight conditions comprised a disproportionately large number of VFR-into-IMC accidents. Approximately 10% of all Canadian accidents occur during the hours of darkness, which parallels estimates of the general level of night flying activity (also 10%). However, VFR-into-IMC accidents occurring during the hours of darkness accounted for almost 30% of the total study accidents. Analysis pointed to three issues: night VFR weather minima; the conditions for obtaining and maintaining a night endorsement; and weather briefings.

3.1 VFR Weather Minima

The consequences of flying in reduced visibilities are exacerbated when operating at night, in light conditions which do not permit sufficient warning for the pilot to see and avoid worsening weather conditions. Inadvertent entry into IMC when the actual conditions can not be seen can be minimized by reducing the possibility of occurrence.

Other countries employ weather minima to reduce the probability of aircraft encountering adverse weather, even during daylight conditions. For instance, in the United States VFR weather minima were recently introduced which prohibit daytime recreational pilots from flight in visibility of less than three statute miles. This measure reduces the risk of bad-weather encounters, and is even more effective for flights at night when bad weather is not so easily detected.

The high proportion of fatal night accidents attributable to adverse weather is in part the consequence of pilots initiating flight in weather conditions which are legally acceptable, but which deteriorate. The first indication to the night-flying pilot can be the inadvertent entry into IMC. The Board believes that, to reduce this risk, VFR flight at night should be restricted to more favourable weather conditions. Accordingly, the Board recommends that:

> The Department of Transport increase VFR weather minima for night flight so as to reduce the risk of inadvertent flight into poor enroute weather conditions

TSB-A90-71

3.2 Night Endorsement

The night endorsement qualifies the private pilot to fly during the hours of official darkness. To obtain this endorsement, the pilot undergoes a minimum of ten hours training in basic instrument flight manoeuvres. The intent is to prepare the pilot for inadvertent entry into IMC and to familiarize the pilot with aircraft control in conditions in which there is no apparent horizon. Five of the instrument training hours can be acquired in a simulator. No evaluation of competency is required prior to endorsement, nor are there re-certification requirements for the continued exercise of privileges of the endorsement.

Twenty-four studied accidents which occurred at night resulted from a loss of aircraft control, often after the apparent onset of vertigo. To understand the circumstances of such occurrences, the training, experience and skills of the accident pilots were examined. The accident pilots had seldom obtained additional instrument training after acquiring the minimum experience for night endorsement. Since instrument flying skills are perishable and require regular practice to maintain even a modicum of proficiency, the criteria for obtaining and maintaining a night endorsement apparently do not adequately reflect the skills required to cope with inadvertent entry into adverse weather. There is a higher probability of these circumstances occurring at night.

At present there is no method of ensuring that a minimum level of skill in flying on instruments has been achieved prior to receiving a night endorsement, an evaluation of a pilot's skills under the type of vertigo-inducing conditions encountered in adverse weather at night appears to be warranted. Furthermore, at present there is no method of ensuring that a minimum level of proficiency has been retained after the issue of a night endorsement, therefore, some form of recurrency training and/or testing also appears to be warranted. Such training and testing should focus on the instrument flying skills required for the safe conduct of night visual flight, skills which are considerably less complex than those required, for instance, to conduct a complete instrument approach.

In view of the disproportionate frequency of VFR-into-IMC accidents which occurred at night, the Board recommends that:

> The Department of Transport revise conditions for the issue and maintenance of a night endorsement by.
>
> a) including a practical evaluation of the pilot's skill prior to issue of the endorsement; and
>
> b) verifying continued proficiency on a recurrent basis

TSB-A90-72

3.3 Night Weather Briefing

In light conditions in which hazardous weather conditions can not be detected until they have been encountered, it is essential that pilots have appropriate information before initiating flight. Seventeen accidents that occurred in other-than-daylight conditions involved pilots who did not use available weather briefing facilities.

Weather information can be obtained by phone, by remotely-located computer terminals, or in-person at a weather office. There are no regulations specifically requiring a weather briefing before VFR flight, yet the probability of inadvertent entry into IMC at night could be reduced if pilots had appropriate information upon which to base their decision to initiate or defer a flight. This applies to all night flights, both private and commercial, but the Board is particularly concerned about the safety of the air transportation system used by fare-paying travellers. The Board believes that the Department of Transport should encourage private pilots to obtain a weather briefing prior to conducting a flight at night, but that the requirement for operations conducted by commercial pilots should be more stringent. Therefore, the Board recommends that:

The Department of Transport require that, prior to initiating night flight under VFR from locations for which weather briefing facilities exist, pilots engaged in commercial passenger-carrying operations obtain a weather briefing.

TSB-A90-73

4.0 PILOT LICENSING

4.1 Private Pilot Licence

Examination of the VFR-into-IMC accident data identified a number of deficiencies in the criteria for acquisition of a Private Pilot Licence. However, a number of initiatives presently underway in TC are likely to redress many of these deficiencies. Specifically, the introduction of five hours instruction in basic instrument flying skills and the addition of pilot decision-making training to the syllabus for the Private Pilot Licence will supplement the knowledge and skills required for flying under VFR in Canada. Aviation physiology will also be introduced to the curriculum for the Private Pilot Licence. Furthermore, plans by Transport Canada to divide the written examinations for the Private and Commercial Pilot Licence into components, each of which shall require a passing grade, should ensure that every pilot has obtained a minimum level of meteorological knowledge at the time of licence issue.

TC has introduced these modifications in response to licensing discrepancies identified by Justice Dubin,* industry representatives, TC's own officials, and CASB investigations. The Board is encouraged by this progress, and finds no reason to make further recommendations at this time.

Examination of the accident data identified a large number which occurred enroute to relatively inexperienced pilots, and a disproportionately high number which occurred to flying/school aircraft in B.C. The minimum experience of 45 flight hours required for a Canadian Private Pilot Licence includes eight hours of cross-country flight, during which the candidate must have completed at least one solo cross-country flight. This is considerably less experience than that required for the U.S. private pilot licence, in which 13 hours of the total 40 hours must be amassed in cross-country flight.**

The large number of weather-related accidents in the enroute phase suggests that a re-examination of this licence requirement is warranted. However, the simple introduction of additional cross-country flying hours would not necessarily provide a solution, as total flying hours could be accumulated several years prior to licence issue. Furthermore, pilots seldom acquire substantially more than 8 hours cross-country flying hours, even when significantly more than the 45 hour minimum total has been amassed. Accordingly, to improve cross-country piloting skills, the training curriculum, flight training practices, and standards of evaluation require examination.

In light of the large number of enroute accidents occurring to inexperienced private licensed pilots, and particularly in consideration of the high proportion of VFR into IMC accidents occurring to flying club/school aircraft in B.C., the Board recommends that

* *Inquiry Into Aviation Safety in Canada* (1981-1982) 3 volumes

** U.S. requirements include a minimum of three hours dual and 10 hours solo (FAR 61.109). Canadian requirements include two hours dual and three hours solo. Personnel Licensing Handbook, Volume 1, Chapter 4, 1.28

> The Department of Transport modify the training curriculum, flight training practices and standards of evaluation for cross-country flight training for the Private Pilot Licence.

TSB-A90-74

4.2 Licence Validity

Pilots who had acquired less than 1000 hours total flying time accounted for 56% of the accidents studied. Many of these pilots had acquired very low annual accumulations of flying time over an extended period. Presently, private pilots in Canada are required to satisfactorily complete a written examination only once, prior to licence issue. Without a means of regularly verifying pilots' comprehension of meterological phenomena, their knowledge may diminish to the extent that they can no longer reasonably assess the forecast conditions or the actual weather encountered enroute. Such pilots would undoubtedly have difficulty in making appropriate decisions when they are about to encounter IMC conditions. While this is particularly true of pilots who fly infrequently, a general erosion of the practical aspects of meteorology can be expected amongst most recreational pilots. Accordingly, the Board recommends that:

> The Department of Transport periodically verify minimum levels of knowledge in meteorology as a requirement for the continuing validity of the Private Pilot Licence.

TSB-A90-75

Many accident pilots, particularly private pilots, had flown little in the period leading up to the accident. Thirty-nine percent of the private-licensed pilots had flown 20 or less hours in the previous 90 days.

Accident pilots characteristically encountered conditions which required appropriate and timely decisions while they operated their aircraft in deteriorating visibilities through hazardous terrain. Effective decision-making can be impaired if pilots lack confidence in their skills. Furthermore, a disproportionate amount of time and effort may be spent by non-current pilots in the operation of the aircraft, detracting from their assimilation of important cues which would aid in a timely decision. It is impossible to measure the degree to which currency might have influenced the circumstances underlying many of these accidents, nonetheless, the circumstances surrounding many of the accidents examined in this study, in conjunction with the findings of independent studies on factors which induce stress in the aviation environment,* strongly suggest that a lack of currency and/or proficiency consistently jeopardizes rational decision-making.

In the U.S., after the introduction of a mandatory biennial review of proficiency in November 1974, there was a "one-time 10 percent decrease in fatal accident rates beyond the existing long-term declining trend in accident rates".** U.S. authorities have been sufficiently

* See for instance, Dr. Michael Thomas *Managing Pilot Stress* (New York, Macmillan Publishing Company, 1989)

** The United States Government *Federal Register*, volume 54, number 59, Wednesday March 29, 1989, p. 13035 satisfied with the safety dividends accrued by such regulatory requirements that they recently have broadened the provisions to make them more comprehensive.

The Inquiry into Aviation Safety in Canada, conducted by Justice Dubin, recommended similar regulations for Canada. Officials from Transport Canada have spent considerable time examining this issue, and plan to introduce measures shortly that will require proof of currency for the full exercise of licence privileges. Essentially, all pilots wishing to carry passengers will be required to conduct five take-offs and landings in the previous six months, and pilots who have not operated an aircraft in five years will be required to successfully complete a written examination to revalidate their licence. These measures are a step in the right direction. However, they will not fully meet the intent of Justice Dubin's recommendation. Furthermore, they are unlikely to reap the benefits to safety that the American provisions have achieved, nor to significantly influence the circumstances surrounding accidents such as these examined in the study, particularly those which occurred during cross-country or night flight. Consequently, to enhance proficiency through the regular practice of flying and navigational skills, thereby reducing the recurrence of weather-related accidents to pilots with minimal recent experience, the Board recommends that:

> The Department of Transport introduce more stringent requirements for currency of all Canadian licensed pilots which will enhance proficiency in flying and decision-making skills.

TSB-A90-76

In summary, analysis of the accident data concluded that the proficiency of private pilots would be enhanced by regular attendance (perhaps every five years) at a refresher ground school for a comprehensive review of such important topics as pilot decision-making, navigation and meteorology.

4.3 Licence Privileges

As noted earlier in this report, eighty percent of the VFR-into-IMC accidents (and 89% of the fatalities) occurred during the enroute phase of flight. Consequently, the study considered the training and skills in cross-country flying required for licence acquisition, the privileges extended to the licence holder, and the conditions encountered while exercising the privileges of the licence.

Much of the flying training for the Private Pilot Licence focuses on aircraft handling, with relatively few hours dedicated to cross-country flying skills. However, the privileges attached to a licence permit a person, immediately upon licence issue, to fly in conditions which can surpass the knowledge and skill in cross-country flying achieved in initial training. Although inexperienced pilots account for the majority of all accidents in all phases of flight, the adverse-weather-related cross-country accidents are of particular concern because they claim so many fatalities. The accident record indicates a discrepancy between the training requirements and the experience necessary to conduct cross-country flights. In addition to supplementing knowledge and skill during initial licence training, as proposed earlier, further measures are considered necessary to reduce the frequency of accidents during cross-country flights.

The concept of a restricted-privilege Private Pilot Licence is being explored in the United States, where a pilot with a 'recreational' licence with reduced privileges is permitted to fly in restricted locations in more conservative weather minima. To reduce the number of fatalities involving inexperienced pilots engaged in cross-country flying, the Board recommends that:

> The Department of Transport assess the feasibility of amending the privileges of the Private Pilot Licence to require additional licence endorsements for the conduct of cross-country flights with passengers.

TSB-A90-77

The night endorsement to the Canadian Private Pilot Licence permits unrestricted VFR night flight. British regulations are not so permissive: night-endorsed pilots there are not permitted to conduct cross-country night flight unless they also are instrument-rated and are operating an IFR-certified aircraft. This restriction ensures that pilots operating under VFR at night (who have a greater likelihood of unexpectedly encountering IMC) are capable of maintaining controlled flight by sole reference to flight instruments.

Nearly a quarter of the other-than-daylight accidents occurred after the pilots lost control of the aircraft. In consideration of the high proportion of night VFR-into-IMC accidents (see Section 3), most of which occur enroute and many of which result from the pilot having inadvertently encountered IMC, only suitably qualified pilots, flying aircraft certified for IFR flight, should be permitted to conduct cross-country flights at night under VFR. Therefore, the Board recommends that:

> The Department of Transport develop a licence endorsement which permits VFR cross-country flight at night only in aircraft equipped to maintain control of the aircraft by reference to flight instruments.

TSB-A90-78

4.4 Instrument Endorsements

In undertaking this study, there was concern about the role which possession of an instrument rating might play in reducing the number of adverse-weather-related VFR accidents. It had been suggested that American provisions are more amenable to obtaining and maintaining an instrument rating than Canadian provisions. It was hypothesized that if a pilot could obtain an instrument rating more easily, and if it could be renewed with minimal inconvenience, more pilots might file IFR flight plans when confronted with poor weather.

Many difficulties were encountered in examining this issue. Meaningful comparisons of each nation's accident experience are hampered by the inability to measure the impact of differences in regulations, the operating environment, the aviation infrastructure, weather conditions, etc. Furthermore, there was insufficient data from Canada and the United States to compare the rates of accidents amongst instrument-rated and non-instrument-rated accident pilots; this rendered much of the discussion hypothetical. Nonetheless, the analysis which was possible proved instructive.

In Canada in 1985, 1.2% and 15.5% of the Private and Commercial Pilot Licence holders, respectively, possessed instrument ratings; whereas 14.1% and 83.3% of Private and

Commercial Licence holders in the U.S. were instrument-endorsed. Comparison with the findings of the study conducted by the NTSB indicated that American commercially-employed pilots were proportionately less involved in VFR-into-IMC accidents than Canadian commercial pilots. Consequently, there was at least a general indication that instrument ratings had played some role in reducing American adverse-weather-related accidents in VFR operations. However, it was not possible to determine the degree to which the lesser incidence for commercial-licensed pilots in the American data was associated with differences in the operating environments of the two nations, as compared with the knowledge and flying skills associated with the training and experience of an instrument-rated pilot.

Both Canadian and American pilots with instrument flying experience were less likely to be involved in VFR-into-IMC accidents; and U.S. commercially-licensed pilots (who generally possessed instrument ratings) were less apt to be involved in VFR-in-IMC accidents compared to their Canadian counterparts (who generally did not possess an instrument rating). The Board does not wish to degrade the traditionally high safety standards for IFR-endorsed pilots flying IFR; however, any procedures which facilitate obtaining and maintaining instrument flying skills and which could lead to a reduction of VFR-into-IMC accidents should be explored. In light of the high involvement of non-instrument qualified pilots in VFR-into-IMC accidents, the Board recommends that:

> The Department of Transport develop means by which instrument endorsements could be more readily obtained and maintained by Canadian-licensed pilots.

TSB-A90-79

Approximately half of the VFR-into-IMC accidents in Canada occurred to aircraft being operated for private-recreational purposes; the remaining half occurred to aircraft being operated for commercial or private-business purposes.* The aviation and insurance industries generally use flying experience (often measured by total flying hours or experience acquired on aircraft types) to assess risk in the hiring or insuring of pilots. Generally, possession of an instrument rating is only considered when IFR flying will be required. Yet, the limited involvement of instrument-qualified pilots in VFR-into-IMC accidents suggests that an important indication of a low-risk pilot is being overlooked. A pilot with superior qualifications can be expected to be less at risk at incurring the financial and property loss associated with an accident. Acknowledging the reduced risk, incentives such as a reduction in insurance premiums for companies and the introduction of salary bonuses for VFR pilots with instrument endorsements could be expected to positively influence the safety of many types of commercial VFR operations. Therefore, as a means of increasing the competence of commercial pilots employed in such VFR operations, the Board recommends that:

> The Department of Transport promote the adoption of incentive programs in the aviation and insurance industries to encourage increased use of IFR-qualified pilots in VFR commercial operations.

TSB-A90-80

* Approximately 35% were engaged in commercial operations, and 15% were private-business aircraft.

4.5 Helicopter Commercial Pilot Licence

Of the 33 helicopter accidents in the study, 27 occurred when pilots encountered whiteout conditions in which they were not able to visually maintain adequate reference to the ground to avert the accident. When pilots encounter whiteout, they must transition from visual flight and fly away from the hazard by sole reference to the aircrafts' instruments. Only one of the helicopter pilots had an instrument rating. Of the remainder, two had acquired some actual instrument flying time, but neither of these pilots had accumulated more than 20 instrument hours.

Since July 1987, a candidate for a Commercial Pilot Licence for helicopters has had to obtain 20 hours of instrument flight time (combined actual and simulated). Before this, no instrument training was required. Therefore, all the accidents studied involved pilots who had not been required to have instrument training to obtain a licence. Their lack of instrument flying experience is believed to be representative of the experience of most helicopter pilots presently employed in commercial operations. These experienced pilots fly in remote locations year-round – often over featureless, flat terrain. Their inexperience in basic instrument flying can be expected to lead to a continuation of weather-related accidents in whiteout conditions.

The safety study suggests that more recently licensed helicopter pilots, who have acquired basic instrument flying experience to obtain their licence, will find that their instrument flying skills will deteriorate if not practised. Therefore, the benefit of one-time exposure to advanced flying skills acquired during licence training and necessary for a safe recovery from whiteout conditions, may be lost. There is no requirement to undergo refresher training in basic instrument flying as a condition of licence-revalidation. However, a commercially-employed pilot is required to submit to an annual Pilot Proficiency Check (PPC). An evaluation of a pilot's basic instrument flying skills during the PPC would ensure that commercially-employed helicopter pilots, regardless of when they had obtained their licence, would regularly demonstrate proficiency in skills necessary for coping with the major cause of VFR helicopter accidents in adverse weather. Therefore, the Board recommends that:

> The Department of Transport require verification of proficiency in basic instrument flying skills for commercially-employed helicopter pilots during annual pilot proficiency flight checks.

TSB-A90-81

5.0 INDUSTRY PRACTICES

5.1 Risk Management – Commercial Operations

Approximately 35% of the accidents occurred to aircraft engaged in commercial operations. This proportion was considerably larger than that of commercial operators involved in American adverse-weather-related accidents (23%), even after the commercial flying hours of each country had been considered. This suggested that specific influences in the Canadian operating environment might have played an important role. When the Canadian accident data were examined on their own, it was found that the involvement of commercial operators in VFR-into-IMC accidents was disproportionately high when compared to all Canadian accidents, when compared to other categories of Canadian commercial accidents, and when compared to all adverse weather-related accidents.

Detailed analysis of these accidents found that the accident pilots were generally experienced in aircraft handling, even in adverse weather conditions. Consequently, the analysis focused on the circumstances which led to the flights being initiated or conducted in conditions which jeopardized the safety of the flight.

Many remote commercial operations are conducted in an environment of high physical and economic risk by aviation safety standards. Northern transportation is seasonal, and intensely active during the long summer hours of daylight. There are many pressures on the company, the client, and the pilot to get the job done, and failure to complete assignments can be measured in harsh economic terms. This industry is conducted in a most unforgiving physical environment, which often is intolerant of such short-term operating expedients as continuing flight into adverse weather. The annual record of commercial accidents occurring in adverse weather is testimony of an industry's inability to manage the risk of providing a safe air transportation service to the remotely-located communities and resource camps in Canada's hinterland.

Furthermore, the constituent parts of the industry's environment which affect the national safety record are not likely to change of their own accord in the future. commercial pilots are generally experienced and skilled; extremes of climate and geographic conditions will always prevail; even the economic determinants of low-capital investment and high economic risk will likely continue to exist.

The provision of air transportation services in this environment leads to pressures from management, the client, and the pilots themselves. To control or minimize the influences of these pressures requires excellent risk management practices. Indeed, a number of U.S. studies which examined the air charter industry in Alaska in the early eighties verified that sound operating practices and effective management of risk led to an improved company safety record. Transport Canada has undertaken a number of initiatives in the last decade to improve risk management procedures in the aviation sector. Some programs have aimed at influencing pilot decision-making before and during the flight, while other safety management programs, such as the Company Safety Officer Program and the Executive Safety Seminar aim at instilling the tenets of effective risk management amongst those responsible for the operation of a safe air transportation industry. Regrettably, many commercial weather-related accidents continue to be characterized by inappropriate operational decisions.

As a result of individual accident investigations, the CASB issued a number of Recommendations which sought change in particular aspects of the industry operations, changes which were intended to alter the management of risk industry-wide. Although most of the recommendations were accepted by TC, the findings of this study suggest that they have not had the cumulative effect of altering industry practices. Until there is a major evaluation of the conduct of high risk operations in a demanding and unforgiving physical environment – an evaluation involving such principal participants as government departments (in their roles as clients and as regulatory agents), the insurance industry, financial institutions, commercial operators and their employees – the Board believes that the factors which affect impaired decision-making will remain unattended and that the management of risk in this demanding environment will be less than optimal. Without a reassessment of the methods by which many small, commercial operations are conducted, the Board fears the continuation of a high fatality rate associated with VFR-into-IMC commercial accidents.

Rather than issue recommendations at this time to address this concern, the TSB will continue to monitor the safety of remote commercial operations.

5.2 Regulatory Standards for Commercial Operations

The air regulations are designed to ensure that the safety of the air transportation system does not fall below a minimum level. The regulatory standard for commercial operations is generally more stringent than those governing the private operation of aircraft, and is intended to provide a high standard of safety for the fare-paying passenger. Moreover, Canadian international air carriers and the larger domestic air carriers have traditionally adopted practices and procedures which further reduce the probability of an aviation occurrence. This 'margin of safety' which characterizes many of the larger commercial operations is not usually found in many of the smaller commercial operations, a segment of the industry which made up a large proportion of the VFR-into-IMC accidents.

This report has already commented on measures which would enhance the safety of many remotely-located commercial operations. The employment of instrument-qualified pilots; the operation of aircraft with enhanced communication equipment, certified for instrument flight rules; effective company safety programs; improved facilities and procedures for flight planning; and better use of pre-flight weather information are a few measures which the Board believes could reduce the incidence of VFR-into-IMC accidents involving commercial operations.

However, the Board believes that in light of the accident record of small commercial operations, and considering that there is, in general, a lower voluntary 'margin of safety' built into these operations, the regulations may require revision to safeguard the interests of the fare-paying public. The Board's concern is heightened in view of recent studies which have concluded that the accident rate for small companies operating fixed-wing aircraft in Canada has increased significantly in the past five years*.

* See for instance. "Evaluation of the Contribution of Aviation Safety Regulation and Aviation Safety Programs to Aviation Safety in Canada". Prepared by Sypher: Mueller International, 1990. page 3-19.

While examining commercial VFR-into-IMC accidents, it became clear that a number of major users of Canadian aviation charter services stipulate additional safety criteria when they contract air charter services. Major clients of Canadian charter services are demanding a higher standard of safety than the existing regulations and industry practices can provide. Oil companies, many air ambulance services, and a number of agencies and departments from various levels of government have adopted such practices.

The following are several examples of the higher standards demanded.

- Mandatory passenger briefings are recorded and signed by a designated passenger,

- extra survival equipment or overwater life-support equipment is often carried,

- many aircraft are equipped with additional navigation and radio communications equipment, with the stipulation that unserviceabilities in this equipment render the aircraft unserviceable;

- additional aircraft maintenance facilities are sometimes stipulated;

- the experience and training levels required for pilots under contract far exceed the legal minima,

- pilots are independently tested for pilot proficiency, and

- company facilities are audited by agents of the client.

The many examples of higher safety standards found in the course of the study suggest that TC's standards and audit procedures no longer meet the expectations of major clients of charter services. In light of the accident data, the Board believes that serious consideration must be given to instituting additional safety criteria into the regulatory standard, thereby ensuring that a high standard of safety is provided for all passengers who use the air transportation system. TC officials may wish to evaluate the existing practices of major clients of air charter systems to ascertain the most effective means by which the incidence and seriousness of VFR-into-IMC accidents could be reduced. Accordingly, the Board recommends that:

> The Department of Transport revise the safety standards for commercial operations to include requirements designed to reduce the probability and seriousness of VFR-into-IMC accidents.

TSB-A90-82

6.0 AIRCRAFT EQUIPMENT

6.1 Radar Altimeters

Analysis of the accidents revealed few equipment deficiencies for either fixed-wing aircraft or helicopters. However as noted earlier, 27 of the 33 helicopter accidents occurred in whiteout conditions, and many of these occurred while in controlled flight. Many VFR-into-IMC helicopter accidents occurred as a result of inadvertent descent while flying over featureless terrain in conditions that often made it impossible for the pilot to accurately determine the altitude of the aircraft above the ground. Such descents would have been detected by the pilot if the aircraft had been equipped with an automated warning device, such as a radar altimeter, to signal the pilot of the ground's proximity. Only two accident helicopters were equipped with radar altimeters. In light of the conditions encountered in many of the helicopter accidents, where inadvertent descents were undetected by the pilot, the Board recommends that:

> The Department of Transport require all helicopters engaged in commercial passenger-carrying operations be equipped with radar altimeters.

TSB-A90-83

6.2 Helicopter Instrumentation

The frequency with which helicopters crashed in whiteout conditions led the Board to recommend that commercial helicopter pilots regularly demonstrate sufficient proficiency in basic instrument flying skills (see section 4.5). However, it is well known that many commercial helicopters are not equipped with an artificial horizon, an important instrument for aircraft control when flying by sole reference to instruments. To ensure that commercial helicopter pilots operate aircraft adequately instrumented to escape from whiteout conditions, the Board recommends that:

> The Department of Transport require all commercially-operated helicopters to be equipped with appropriate instrumentation for the conduct of basic instrument flying.

TSB-A90-84

7.0 OTHER TC SAFETY MEASURES

7.1 Safety Promotion

A large proportion of VFR-into-IMC accidents were attributable to inappropriate or faulty decision-making by pilots. TC safety promotional programs endeavour to illustrate that sound decision-making requires analysis of relevant information in the context of appropriate knowledge and consideration of the consequences of risk-taking. Through the production and distribution of newsletters, flyers, posters and audio-visual presentations, and by the development of safety programs aimed at influencing the safety of commercial operations, TC officials "market" the safety message.

In each TC region, a Regional Aviation Safety Officer (RASO) with a small staff supervises the company safety programs in the region, conducts confidential aviation safety surveys when requested by commercial operators, and liaises directly with the aviation public. The Headquarters staff in Ottawa produce the highly acclaimed safety newsletters and the instructional material for the various safety programs and the national safety campaigns. Approximately 28 full-time persons in the TC regions and Headquarters are dedicated to these responsibilities.

In light of the preference of the aviation industry to be informed rather than regulated, it is likely that additional resources expended on safety programs would positively influence industry practices and enhance aviation safety. Such an enhancement of decision-making skills by improved safety promotion would address the root cause of many accidents in Canada, not just VFR-in-IMC accidents.

This study did not attempt to evaluate TC's allocation of resources or the efficiency of its safety promotion activities; consequently, the Board will not make Recommendations regarding the allocation of resources to safety promotional programs in TC at this time. It does, however, heartily endorse the programs in-place, and encourages officials to continue to influence aviation safety through the development in the aviation industry of sound decision-making skills.

The study identified 44 private-business category accidents, which accounted for 55 fatalities in 29 fatal accidents. The pilots were generally experienced and Private-licensed, and were often operating in sparsely-settled areas. Circumstances of the flight often suggested the presence of personal or economic pressures to initiate or complete the flight. Commercial operations characterized by similar pressures are targeted by TC officials for regular auditing, and for specially-designed safety programs; however, no such measures specifically address private-business category operations. The Board, while respecting the limited resources presently allocated for safety promotional activities, believes that valuable safety dividends could be achieved by targeting private-business pilots with safety material relevant to their particular operating circumstances. To reduce the high number of fatalities in this category of accident, the Board recommends that:

> The Department of Transport develop and implement specially-designed safety promotional programs to reduce the incidence of private-business category VFR-into-IMC accidents.

TSB-A90-85

7.2 TC Regulatory Audit and Certification

At least one-third of the studied accidents involved operations which were subject to TC audits. These audits seek to ensure that companies and pilots are adhering to minimum safety standards. Section Five of this report dealt with the Board's concerns about industry practices, many of which are not influenced by regulatory criteria; this section addresses the effectiveness of regulatory procedures to evaluate an important aspect of a company's safety, the pilot's inflight skills. At present, the skill of commercially-employed pilots operating small, multi-engined fixed-wing aircraft in VFR operations is evaluated by an annual PPC. The PPC focuses on aircraft handling skills and essentia' technical knowledge required for the safe operation of the aircraft.

Technical piloting skills were seldom found wanting in the accidents examined in this study, suggesting that the present method of evaluating pilots' skills do not address the root causes of most commercial VFR-into-IMC accidents. The study indicates that without some means of evaluating pilots' decision-making skills, professional inadequacies will go undetected until after an accident has occurred. This principle has led to a number of recent initiatives in the aviation industry. Line Oriented Flight Training (LOFT) and Cockpit Resource Management (CRM) have improved pilot decision-making skills throughout the world in larger commercial operations. TC is presently undertaking measures to incorporate an evaluation of Pilot decision-making skills into the Private Pilot Licence flight test. The Board supports this, and it believes that similar initiatives to train and evaluate pilots employed in smaller commercial operations in decision-making skills would reduce the incidence of VFR-into-IMC accidents. Accordingly, the Board recommends that:

> The Department of Transport devise and implement a means of regularly evaluating the practical decision-making skills of commercially-employed pilots engaged in small air carrier operations.

TSB-A90-86

7.3 Weather Recording and Briefing Facilities

The adequacy of weather recording, forecasting and briefing as it pertained to VFR-into-IMC accidents was examined. Limitations in the accident data sometimes hampered the analysis of this issue; however, weather forecasting was found to be generally accurate, and inaccuracies seldom played a significant role in the occurrences.

Weather observation sites logically tend to be located at or near airports, where the regular measurement of weather phenomena is required for aircraft movements. Conversely, few observation sites are located in sparsely inhabited areas. In mountainous terrain, local conditions may vary widely from valley to valley, and differ significantly from the general area forecast. Such variations, particularly if they occur enroute, are apt to go undetected.

Advances in technology are leading towards automated measurement of weather phenomena. Transport Canada plans to have an Automated Weather Observation System (AWOS) partially in place by 1993. However, it will be well into the new century before fully functioning AWOS are installed at the locations initially designated for AWOS across Canada. TC will initially locate AWOS only in support of IFR operations; once these IFR sites are in-place, a limited number of observation sites may be positioned in locations such as selected mountain passes to support VFR operations. The Board is concerned that TC's introduction of AWOS to support IFR operations only may not take adequate account of the Canadian accident experience, and may not be the most effective utilization of this technology. In light of the frequency of fatal VFR-into-IMC accidents involving aircraft operating enroute through mountains and sparsely-inhabited regions, where deteriorating local weather conditions go unobserved with often fatal consequences, the Board believes that enroute VFR flights warrant a higher priority in being served by AWOS. Accordingly, the Board recommends that:

> The Department of Transport locate automated weather measuring devices in support of VFR operations in the areas of highest risk in mountainous terrain.

TSB-A90-87

The Board recognizes that AWOS sites will not be in-place for many years. Presently, TC maintains a limited number of contract weather observation sites, particularly in British Columbia. Local inhabitants under contract are trained to operate basic weather observation equipment. Thus, at relatively little expense, TC disseminates information about adverse weather conditions at remote, enroute locations which otherwise would go unreported.

The Board believes that while AWOS is being introduced in the next decade, additional manned observation sites would be an inexpensive means of enhancing the reporting of adverse enroute weather in the sparsely-settled regions, particularly in mountainous terrain. Accordingly, the Board recommends that:

> The Department of Transport examine the policy for the contracting of manned weather observation services with a view to expanding the service in remote locations of highest risk.

TSB-A90-88

Weather briefing facilities were not available to pilots in over one-third of the accidents occurring in the sparsely-settled area. Fifty percent and 33% of the pilots in the helicopter and mountain-commercial accident groups, respectively, had no access to weather briefings prior to the accident flight. The Board is concerned that this situation persists; facilities exist which can provide remotely-located pilots with timely weather information. High Frequency (HF) communications equipment permits long-distance communications between an aircraft and a ground-based weather briefer, even when the aircraft is on the ground, several hundred miles distance from the briefer. Furthermore, technological advances, including satellite relays, are effectively reducing the remoteness of many locations in Canada. In light of the large proportion of pilots engaged in remote commercial operations who did not have ready access to weather briefing facilities prior to the accident, the Board recommends that:

> The Department of Transport promote the upgrading of weather briefing facilities where required, for remotely-located commercial operations, and encourage commercial operators to provide crews with the means of obtaining a weather briefing for all flights.

TSB-A90-89

Transport Canada has recently introduced a transcribed weather service aimed at improving the provision of weather information to pilots. With prior coordination, taped weather information can be transmitted at a predetermined time on an Non-Direction Beacon (NDB) frequency. In this manner, commercial operators or private recreational pilots can obtain weather information prior to or just after departure from remote sites at which no briefing facilities exist. Regrettably, TC officials report that this service is seldom requested. Earlier sections of this report have emphasized the need for pilots to have timely and accurate weather information for sound decision-making. In light of the large number of VFR-into-IMC accidents which occurred in remote locations where no weather briefing could be obtained through traditional methods, the Board recommends that:

> The Department of Transport publicize the availability of Transcribed Weather Services at remote locations.

TSB-A90-90

8.0 CONCLUSION

Accidents involving continued VFR-into-IMC account for a disproportionate number of fatalities each year. The causes and contributing factors to these accidents have recurring themes. These include inappropriate pilot qualifications or proficiency for the conditions encountered, and serious shortcomings in the permissable weather minima for VFR flight, in pilot training, and in pilot licence privileges. In some cases, current industry practices and limitations in aircraft equipment and weather briefing facilities exacerbated the circumstances leading up to the accidents. Since the phenomenon is not limited to any particular sector of the aviation community, diverse action is required. The Board believes that full implementation of the recommendations made in the report will go a long way towards redressing the pervasive conditions leading to this type of accident which annually claims so many fatalities.

ANNEX A

SELECTED DEFINITIONS

Ceiling:	The lowest height at which a broken or overcast condition exists, or the vertical visibility when an obscured condition such as snow, smoke or fog exists, whichever is the lower.
Commercial Aircraft:	An aircraft operated or available for operation for hire or reward.
Commercial Air Service:	Any use of aircraft for hire or reward.
Controlled Airspace:	An airspace of defined dimensions within which air traffic control service is provided.
Daylight.	In respect of any place in Canada, the period of time in any day when the centre of the sun's disc is less than 6" below the horizon, and in any place where the sun rises and sets daily, may be considered to be the period of time commencing 1/2 hour before sunrise and ending 1/2 hour after sunset.
Day VFR:	In respect of the flight of any aircraft in Canada, a flight conducted in accordance with VFR during the hours of daylight.
Flight Visibility:	The average range of visibility at any given time forward from the cockpit of any aircraft in flight.
Instrument Flight Rules:	The rules set forth in the Air Regulations and in the orders and directions made by the Minister thereunder.
IFR:	The instrument flight rules.
IFR Aircraft:	An aircraft in IFR flight.
IFR Flight:	A flight conducted in accordance with the instrument flight rules.
IFR Weather Conditions:	Weather conditions below the minima prescribed for VFR flight.
Night:	In respect of any place in Canada, the period of time when the centre of the sun's disc is more than 6" below the horizon and, in any place where the sun rises and sets daily, may be considered to be the period of time commencing 1/2 hour after sunset and ending 1/2 hour before sunrise.
Night VFR:	In respect of a flight of any aircraft in Canada, a flight conducted in accordance with VFR during the hours of night.
Serviceable:	In respect of an aircraft or aircraft part, in a fit and safe state for flight.

ANNEX B

CROSS-REFERENCE OF SAFETY RECOMMENDATIONS

	TITLE	PAGE NUMBER
All Operations		
TSB-A90-65	VFR visibility minima	5
TSB-A90-67	VFR minima, mountainous regions	6
TSB-A90-68	SVFR weather minima	7
TSB-A90-69	Night SVFR	7
TSB-A90-70	VFR-Over-The-Top	8
TSB-A90-71	Night VFR weather minima	9
TSB-A90-76	Licence Currency	15
TSB-A90-79	Instrument Endorsements	17
TSB-A90-87	AWOS, mountainous regions	27
TSB-A90-88	Manned weather observation sites	27
TSB-A90-90	Transcribed weather services	28
Private Operations		
TSB-A90-72	Night endorsement	10
TSB-A90-74	Licensing requirements	14
TSB-A90-75	Licence recurrency	14
TSB-A90-77	Licence privileges, cross-country	16
TSB-A90-78	Night cross-country endorsement	16
TSB-A90-85	Safety Promotion, private-business	25
Commercial Operations (All)		
TSB-A90-73	Weather briefings	11
TSB-A90-80	IFR-qualified pilots	17
TSB-A90-82	Regulatory standard	21
TSB-A90-86	Pilot evaluation	26
TSB-A90-89	Weather briefing	27
Commercial Operations (Fixed-wing)		
TSB-A90-66	VFR weather minima	6
Commercial Operations (Rotary-wing)		
TSB-A90-81	Basic instrument flying skills	18
TSB-A90-83	Radar altimeters	23
TSB-A90-84	Flight instruments	23

ANNEX C

GLOSSARY

ADF	automatic direction finder
agl	above ground level
asl	above sea level
ATC Unit	Air Traffic Control Unit
ATS	Air Traffic Services
AWOS	Automated Weather Observation System
CASB	Canadian Aviation Safety Board
CRM	Cockpit Resource Management
DOT	Department of Transport
FAA	Federal Aviation Administration
HF	high frequency
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
LOFT	Line Oriented Flight Training
NDB	non-directional beacon
NTSB	National Transportation Safety Board
PPC	Pilot Proficiency Check
RASO	Regional Aviation Safety Officer
SVFR	Special Visual Flight Rules
TC	Transport Canada
TSB	Transportation Safety Board of Canada
VFR	Visual Flight Rules
VMC	Visual Meterological Conditions

IV-D

Response to Petition for Reconsideration

National Transportation Safety Boar

Washington, D.C. 20594

June 15, 1990

Mr. Robert Byrom, Petitioner
Attorney at Law
609 East High Street, Suite 2
Charlottesville, Virginia 22901
File No. 1828, - -
Accident No. NYC-84-MA102

RESPONSE TO PETITION FOR RECONSIDERATION

In accordance with the National Transportation Safety Board's rule (Title 49 Code of Federal Regulations Part 845), the Safety Board ha reviewed the petition for reconsideration of probable cause of the aircraf accident involving Cumberland Airlines flight 302, a Piper PA-31, N6629L that crashed near Cumberland, Maryland, on March 5, 1984. Based on it review of the petition received on August 10, 1988, the Nationa Transportation Safety Board hereby grants the petition.

The Safety Board's original investigation of the accident determine that the airplane had crashed about 10 miles northeast of the Cumberlar airport along the localizer course for runway 23. The airplane had bee cleared by air traffic control for the approach to the airport. The pilc and two passengers aboard the flight were killed in the accident.

As a result of its investigation, the Safety Board had determined tha the probable cause of the accident was:

IFR Procedure--Not Followed--Pilot in Command
Proper Altitude--Not Maintained--Pilot in Command

The Safety Board also cited factors related to the accident as:

Weather Condition--Clouds
Weather Condition--Fog

The petitioner challenged the "pilot error" findings and stated tha certain information had not been addressed in the Safety Board's report ar findings. That is, that the pilot's blood carboxyhemoglobin level of 2C found at autopsy was sufficient to impair the pilot's flying abilities. H also stated that the autopsy results indicated that the pilot had nc survived the impact and thus could not have inhaled the carbon monoxide afte the crash. Lastly, the petitioner cited the findings of products o combustion (soot) in the fresh air passage between the cabin heater burne can and the heater shroud as evidence that there had been a source of carbo monoxide while the airplane was in flight. The petitioner delivered th cabin heater to the Safety Board's laboratory for examination along with th petition.

As part of its review of the record of this case, the Safety Board re-evaluated the autopsy findings that showed multiple extreme impact injuries. Although not totally conclusive, the autopsy findings suggest strongly that the pilot had died instantly from multiple extreme impact type injuries. If this were the case it would have been virtually impossible for the carbon monoxide to have been inhaled after the accident.

The Safety Board's re-evaluation also included an examination of the cabin heater, which had been thrown clear of the main wreckage, away from the ground fire area, and not exposed to external ground fire. The Safety Board's examination of the cabin heater revealed evidence of sooting in the fresh air passage where no combustion should occur during heater operation. There were no other areas of external sooting. Samples of the soot material were examined with the Safety Board's x-ray energy dispersive analysis equipment and the presence of lead (Pb) was found. The lead is evidence of the by-products of combustion of aviation fuel.

Neither the petitioner nor the Safety Board were able to determine the source of the soot material; however, it was determined that the source was not a hole or leak through the heat exchanger from the combustion chamber. This was determined by pressure/leak tests that showed no leaks. The one possibility considered, but not proven, was that there had been a small leak of fuel from the fuel supply line fittings that ignited in the hot heater chamber and caused the carbon monoxide to enter the cabin. The leak would have to have been very small to not indicate a severe fire or to generate large amounts of smoke in the cabin. However, even slight amounts of carbon monoxide, which is colorless and odorless, can be absorbed by the blood of a person inhaling it.

Consequently, based on the information presented in the petition, and based on the Safety Board's review of the evidence, it has revised its original report findings to include:

Physical Impairment(Carbon Monoxide)--Pilot in Command
Aircond/heating/pressurization--Leak

Research data show that a carboxyhemoglobin saturation of 10-20% can cause tightness across the forehead, slight headache, and dilation of cutaneous blood vessels. The elevated carboxyhemoglobin in the pilot could have, in combination with other stress factors, affected the pilot's ability to concentrate on the instrument approach. However, the research data show that the level of carboxyhemoglobin would not have been incapacitating, and the pilot's performance prior to the initiation of the approach and his communication with air traffic control do not suggest incapacitation. Consequently, the Safety Board does not believe that there is sufficient evidence to cite the carbon monoxide as a primary cause of the accident. However, because of the uncertainty regarding the level of discomfort and the extent to which it may have been a distracting factor, the Safety Board is citing carbon monoxide as a contributing factor.

The narrative portion of the Safety Board's Brief of Accident has also been revised and the appropriate factual documentation has been added to the factual report of this investigation.

Accordingly, the petition for reconsideration of the probable cause of the aviation accident involving Cumberland Airlines flight 302, a Piper PA-31, N6629L, near Cumberland, Maryland, on March 5, 1984, has been granted. Revised portions of the factual report and Brief of Accident are attached.

KOLSTAD, Chairman, COUGHLIN, Acting Vice Chairman, and LAUBER, Member, concurred in the disposition of this petition for reconsideration. BURNETT, Member, filed the following dissenting statement.

I believe that if our investigation has determined that the carbon monoxide was impairing to the pilot, then this finding should be listed as a cause of the accident.

The carbon monoxide does not have to be physically incapacitating in order to cause the accident, especially in light of no other convincing evidence as to the cause of the accident.

National Transportation Safety Board

FACTUAL REPORT
AVIATION

NTSB Accident/Incident Number

N | Y | C | 8 | 4 | M | A | 1

16 Narrative Statement of Facts, Conditions and Circumstances Pertinent to the Accident/Incident *(continued)*

ADDENDUM TO 6120.4

An examination of the cabin heater assembly in the Safety Board's laboratory in December, 1989, revealed the presence of soot material on fresh air side of the cabin heater shroud. An examination of the soot material using an x-ray energy dispersive analysis revealed the presence of lead (Pb) in the soot. The Pb is a by-product of the combustion of aviation fuel.

The cabin heater had not been exposed to ground fire.

The cabin heater was checked for leaks from the combustion chamber to the fresh air side and no leaks were found. A source for the fuel to cause the soot was not determined.

[signature]
NTSB, 12-18-89

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. 1878   5/05/81   CUMBERLAND,MD   A/C Reg. No. N6629L   Time (Lcl) - 1107 EST

-Basic Information---

Type Operating Certificate-COMMUTER
Name of Carrier -CUMBERLAND AIRLINES
Type of Operation -SCHEDULED,DOMESTIC,PASSENGER
Flight Conducted Under -14 CFR 135
Accident Occurred During -APPROACH

Aircraft Damage: DESTROYED
Fire: ON GROUND

	Injuries			
	Fatal	Serious	Minor	None
Crew	1	0	0	0
Pass	2	0	0	0

Aircraft Information---

Make/Model - PIPER PA-31
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 6500
No. of Seats - 8

Eng Make/Model - LYCOMING TIO540-A2B
Number Engines - 2
Engine Type - RECIP-FUEL INJECTED
Rated Power - 310 HP

ELT Installed/Activated - YES/YES
Stall Warning System - YES

Environment/Operations Information---

Weather Data
W Briefing - FSS
Method - IN PERSON
Completeness - PARTIAL,LMTD BY PILOT
Basic Weather - IMC
Wind Dir/Speed- CALM
Visibility - 2.000 SM
Lowest Sky/Clouds - 500 FT PART OBS
Lowest Ceiling - 2000 FT OVERCAST
Obstructions to Vision- FOG
Precipitation - DRIZZLE
Condition of Light - DAYLIGHT

Itinerary
Last Departure Point
BALTIMORE,MD
Destination
CUMBERLAND,MD

ATC/Airspace
Type of Flight Plan - IFR
Type of Clearance - IFR
Type Apch/Lndg - ILS-LOCALIZER

Airport Proximity
OFF AIRPORT/STRIP

Airport Data
CUMBERLAND
Runway Ident - 23
Runway Lth/Wid - 5050/ 150
Runway Surface - N/A
Runway Status - N/A

Personnel Information---

Pilot-In Command
Certificate(s)/Rating(s)
COMMERCIAL,ATP,CFI
SE LAND,ME LAND

Age - 24
Biennial Flight Review
Current - YES
Months Since - 12
Aircraft Type - BE-76

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT

Flight Time (Hours)
Total - 2143
Make/Model- 547
Instrument- 200
Multi-Eng - 585
Last 24 Hrs - UNK/NR
Last 30 Days- 61
Last 90 Days- 218

Instrument Rating(s) - AIRPLANE

Narrative---

ABOUT 14 MIN PRIOR TO THE ACCIDENT THE FLT WAS CLEARED FOR THE LOCALIZER DME APPROACH. THE ACFT COLLIDED WITH THE MOUNTAINOUS TERRAIN ON A HDG OF ABOUT 220 DEGREES AT APPROX 8.5 DME ON A BEARING OF 051 DEGREES FROM THE ARPT. AS INDICATED ON THE LOC/DME RWY 23 APPROACH PLATE, THE MINIMUM ALTITUDE BETWEEN THE OUTER MARKER, 6.6 DME, AND 10 DME WAS 3303 FEET. ELEVATION AT THE ACCIDENT SITE WAS 2960 FT; ARPT ELEVATION WAS 776 FT. POST CRASH FIRE CONSUMED MOST OF THE WRECKAGE BUT THE CABIN HEATER WAS NOT IN THE FIRE AREA. THE PILOT'S REPORTED CARBOXY HEMOGLOBIN (CO) WAS 20%. HEATER REVEALED MULTIPLE EXTREME IMPACT DAMAGE. PRODUCTS OF COMBUSTION WERE FOUND ON FRESH AIR SIDE OF CABIN HEATER HEAT EXCHANGER. SOURCE OF COMBUSTION PRODUCTS WERE NOT DETERMINED.

Brief of Accident (Continued)

File No. - 1828 3/05/84 CUMBERLAND,MD A/C Reg. No. N6629L Time (Lcl) - 1107 EST

---

urrence #1 IN FLIGHT COLLISION WITH TERRAIN
ise of Operation APPROACH - IAF TO FAF/OUTER MARKER (IFR)

dings(s)
. TERRAIN CONDITION - HIGH TERRAIN
. WEATHER CONDITION - CLOUDS
. WEATHER CONDITION - FOG
. AIR COND/HEATING/PRESSURIZATION - LEAK
. IFR PROCEDURE - NOT FOLLOWED - PILOT IN COMMAND
. PROPER ALTITUDE - NOT MAINTAINED - PILOT IN COMMAND
. PHYSICAL IMPAIRMENT(CARBON MONOXIDE) - PILOT IN COMMAND

---

urrence #2 FIRE
ise of Operation OTHER

-Probable Cause----

National Transportation Safety Board determines that the Probable Cause(s) of this accident are finding(s) 5,6

tor(s) relating to this accident is/are finding(s) 2,3,4,7

IV-E

"Statistical Analysis Suggests Rise in Airliner Accident Rate"

Statistical analysis suggests rise in airliner accident rate

A SAFETY ANALYSIS prepared by Boeing Commercial Airplane Group predicts that jetliner accidents will increase to 20 annually by 2005, compared to a world-wide average of 15 a year during the 1980s.

The forecast increase in the number of major accidents is based on the projected growth of the world's jetliner fleet compared to the trend in the accident rate: while the rate of accidents is on the decline, the number of flights is increasing at a faster pace.

In releasing its figures, Boeing pointed out that improved pilot training and greater utilization of safety-enhancing equipment could have a positive impact on the safety record.

According to Boeing's calculations, over 72 per cent of the major accidents during a recent 10-year period were caused by human error, and over 75 per cent of accidents between 1959 and 1979 could be attributed to flight crew.

During the 1980s, a disproportionately large number of accidents occurred during the landing and final approach phases, which together represented 4 per cent of total flight time. In many instances, the provision of airport aids for glide slope guidance could have prevented the accident, according to the company's findings.

As a result of its study, Boeing has urged the world's air carriers to use flight data recorders to review the performance of aircraft and their crews in order to uncover potentially dangerous developments or practices. Except for a small number of airlines that have already implemented minor monitoring programmes, the data recorders are normally only checked after there has been an incident or accident.

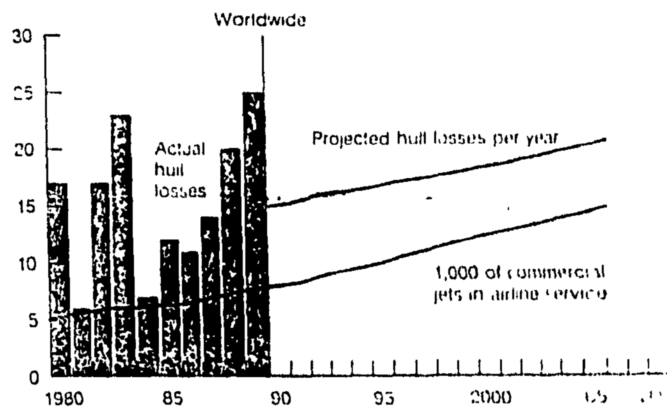
The company also called for the complete world-wide installation of ground proximity warning systems (GPWS). According to the Boeing study, 44 aircraft that collided with terrain during the 1975-88 period were not equipped with GPWS or were fitted with an inoperative GPWS.

Boeing is also concerned about the safeness of non stabilized approaches — the result of high, fast and close-in positioning by air traffic controllers. Another concern cited by the company is the go no-go take-off decision; Boeing felt there is room for improvement in decision-making capability, and noted that pilots could be better trained in the simulator for various take-off emergency scenarios.

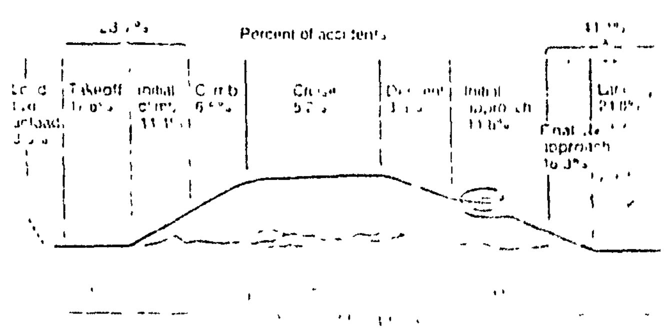
Results of an earlier safety study, based primarily on a survey of 12 operators, were released by Boeing in 1987. It, too, concluded that flight crew were the primary factor in the majority of major accidents, and indicated that an improvement in this statistic depended largely on the aircraft operators and training community.

Following are some of the statistical data released by Boeing in the autumn of 1990.

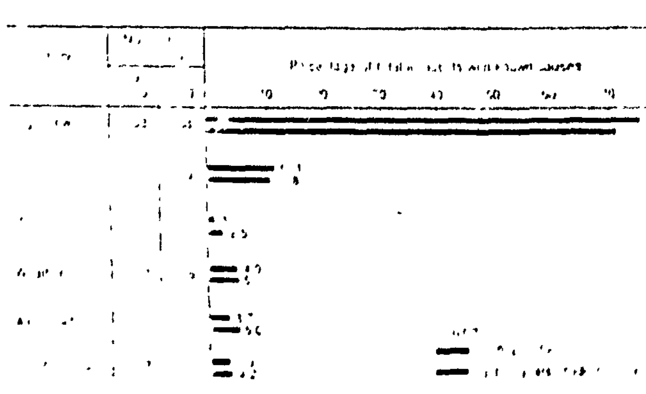
Hull loss accident statistical projection to the year 2005.
(Forecast based on continuation of accident rate over past 10 years and expected fleet growth)



Hull loss accidents by flight phase
(Exposure percentages are based on an average flight duration of 1.6 hours world-wide commercial jet fleet, 1980-89)



Hull loss accidents by primary cause factors.
(World wide commercial jet fleet)



IV-F

ICAO Technical Publications Currently Available

ICAO technical publications

Current editions as of 1 January 1991

This is a report on the status of Technical Publications.
For ordering purposes please refer to the Catalogue of ICAO Publications.

ANNEXES TO THE CONVENTION

Annex	Title	Current edition No.	Current edition Amendments incorporated	Current edition Date applicable	Subsequent amendments No.	Subsequent amendments Date applicable
1	Personnel Licensing	8	1-159	16/11/89		-
2	Rules of the Air	9	1-29	14/11/91		
3	Meteorological Service for International Air Navigation	10	1-66	20/11/86	67 68	19/11/[illegible] 16/11/[illegible]
4	Aeronautical Charts	8	1-47	21/11/85	48	16/11/[illegible]
5	Units of Measurement to be Used in Air and Ground Operations	4	1-13	26/11/81	14 15	22/11/[illegible] 19/11/[illegible]
6	Operation of Aircraft					
	Part I — International Commercial Air Transport — Aeroplanes	5	1-19	15/11/90		
	Part II — International General Aviation — Aeroplanes	4	1-11	15/11/90		
	Part III — International Operations — Helicopters	2	1	15/11/90		
7	Aircraft Nationality and Registration Marks	4	1-4	26/11/81		
8	Airworthiness of Aircraft	8	1-95	22/3/91		
9	Facilitation	9	1-14	15/11/90		
10	Aeronautical Telecommunications					
	Volume I (Part I — Equipment and Systems; Part II — Radio Frequencies)	4	1-65	21/11/85	66[1] 67[2] 68	20/11/[illegible] 22/11/[illegible] 15/11/[illegible]
	Volume II (Communication Procedures including those with PANS status)	4	1-65	21/11/85	67 68	22/10/[illegible] 15/11/[illegible]
11	Air Traffic Services	9	1-33	14/11/91		
12	Search and Rescue	6	1-11	9/10/75	[illegible] [illegible] 14	[illegible] 26/11/[illegible] 15/[illegible]
13	Aircraft Accident Investigation	7	1-8	17/11/88		
14	Aerodromes[3]					
	Volume I — Aerodrome Design and Operations	1	-	15/11/90		
	Volume II — Heliports	1	-	15/11/90		
15	Aeronautical Information Services	7	1-26	22/10/87		
16	Environmental Protection					
	Volume I — Aircraft Noise[4]	2	1-3	17/11/88		
	Volume II — Aircraft Engine Emissions[4]	1	-	18/2/82	1	17/[illegible]
17	Security — Safeguarding International Civil Aviation against Acts of Unlawful Interference	4	1-7	16/11/89		
18	The Safe Transport of Dangerous Goods by Air	2	1-4	16/11/89		

1. Amendment No. 66 affects Volume I only
2. Corrigendum No. 1 issued 2/12/87
3. The first editions of Volumes I and II were adopted by the Council on 9 March 1990 superseding all previous editions of Annex 14. [illegible] incorporates all 39 prior amendments to Annex 14.
4. By Amendments Nos. 5 and 6 Annex 16 was retitled and issued in two volumes

PROCEDURES FOR AIR NAVIGATION SERVICES (PANS)

Document Number	Title	Current edition No.	Current edition Amendments incorporated	Current edition Date applicable	Subsequent amendments No.	Subsequent amendments Date applicable
4444	RAC — Rules of the Air and Air Traffic Services	12		[illegible]	[illegible]	[illegible]
8168	OPS — Aircraft Operations					
	Volume I — Flight Procedures	3	1-5	20/11/86	[illegible]	[illegible]
	Volume II — Construction of Visual and Instrument Flight Procedures	3[1]	1-4	20/11/86	5	[illegible]
8400	ABC — ICAO Abbreviations and Codes	4	1-20	16/11/89	-	
7030	Regional Supplementary Procedures	4	1-168	24/10/85	[illegible]	[illegible]

1. Corrigendum No. 3 issued [illegible] 3 88

TECHNICAL MANUALS

Document Number	Title	Current edition No	Current edition Date	Subsequent amendments No	Subsequent amendments Date
	AGA — Aerodromes, Air Routes and Ground Aids				
9137	Airport Services Manual				
	Part 1 — Rescue and Fire Fighting	2[1]	1984	1	[illegible]
	Part 2 — Pavement Surface Conditions	2[2]	1984	-	-
	Part 3 — Bird Control and Reduction	2	1978	1	[illegible]
	Part 5 — Removal of Disabled Aircraft	2[3]	1986	-	-
	Part 6 — Control of Obstacles	2	1983	-	-
	Part 7 — Airport Emergency Planning	1[4]	1980	-	-
	Part 8 — Airport Operational Services	1	1983	-	-
	Part 9 — Airport Maintenance Practices	1	1984	-	-
9150	Stolport Manual	1	1976	1	[illegible]
9157	Aerodrome Design Manual				
	Part 1 — Runways	2[5]	1984	-	-
	Part 2 — Taxiways Aprons and Holding Bays	2[6]	1983	-	
	Part 3 — Pavements	2	1983	1	[illegible]
				2	[illegible]
	Part 4 — Visual Aids	2[7]	1983	1	[illegible]
				2	[illegible]
				3	[illegible]
	Part 5 — Electrical Systems	1	1983	-	-
9184	Airport Planning Manual				
	Part 1 — Master Planning	2[8]	1987	-	-
	Part 2 — Land Use and Environmental Control	2[9]	1985	-	-
	Part 3 — Guidelines for Consultant/Construction Services	1	1983	-	-
9261	Heliport Manual	2	1985	1	[illegible]
9332	Manual on the ICAO Bird Strike Information System (IBIS)	3	1989	-	-
9476	Manual of Surface Movement Guidance and Control Systems (SMGCS)	1	1986	1	[illegible]
				2	[illegible]
	AIG — Accident Investigation and Prevention				
6920	Manual of Aircraft Accident Investigation	4	1970	1	[illegible]
				2	[illegible]
				3	[illegible]
				4	[illegible]
				5	[illegible]
				6	[illegible]
				7	[illegible]
				8	[illegible]
				9	[illegible]
				10	[illegible]
9156	Accident/Incident Reporting Manual (ADREP Manual)	2	1987	-	-
9422	Accident Prevention Manual	1	1984	-	-
	AIS — Aeronautical Information and Charts				
7101	Aeronautical Chart Catalogue	26	1/90	1	[illegible]
7383	Aeronautical Information Services Provided by States	75	8/90	-	-
8126	Aeronautical Information Services Manual	3[10]	1981	1	[illegible]
				2	[illegible]
				3[11]	[illegible]
8697	Aeronautical Chart Manual	2	1987	-	-
	COM — Communications				
7910	Location Indicators	62	6/90	-	-
7946	Manual of Teletypewriter Operating Practices	4	1967	1	[illegible]
				2	[illegible]
				3	[illegible]
				4	[illegible]
				5	[illegible]
				6	[illegible]
				7	[illegible]
8071	Manual on Testing of Radio Navigation Aids				
	Volume	3	1972	-	-
	Volume — ILS (Instrument Landing System)	3	1972	1	[illegible]
				2	[illegible]
				3	[illegible]
				4	[illegible]
8585	Designators for Aircraft Operating Agencies Aeronautical Authorities and Services	78	7/90	-	-
9399	Manual of Teletypewriter Operating Practices (Teletypewriters based on microprocessor technology)	1	1983	-	-

1 Corrigendum No 1 issued 30/9/85
2 Corrigendum No 1 issued 13/3/85
3 Corrigendum No 1 issued 6 6/86 Corrigendum No 2 issued 24 [illegible] 89 Corrigendum No 3 issued 29/5 90
4 Corrigendum No 1 issued 6/5/81
5 Corrigendum No 1 issued 21/10/88 Corrigendum No 2 issued 31/7 90
6 Corrigendum No 1 issued 9/[illegible]/84
7 Corrigendum No 1 issued 25/3/87
8 Corrigendum No 1 issued in Spanish only Corrigendum No 2 issued 3 [illegible] 90
9 Corrigendum No 1 issued 14/5 85
10 Corrigendum issued [illegible] 0/82
11 Corrigendum issued 1/12/89

Document Number	Title	Current edition No	Current edition Date	Subsequent amendments No	Subsequent amendments Date
	MED — Aviation Medicine				
8984	Manual of Civil Aviation Medicine	2	1985	-	-
	MET — Meteorology				
7488	Manual of the ICAO Standard Atmosphere	2	1964	-	-
8896	Manual of Aeronautical Meteorological Practice	3	1985	1	1/10/86
9328	Manual of Runway Visual Range Observing and Reporting Practices	1[1]	1981	1	13/2/84
9377	Manual on Co-ordination between Air Traffic Services and Aeronautical Meteorological Services	1[2]	1983	-	-
	OPS/AIR — Operations/Airworthiness				
7488	Manual of the ICAO Standard Atmosphere	2	1964	-	
8335	Manual of Procedures for Operations Certification and Inspection	3	1983	-	
9051	Airworthiness Technical Manual	2[3]	1987	10	[illegible]
9274	Manual on the Use of the Collision Risk Model (CRM) for ILS Operations	1	1980	1 2	[illegible] 21/7/83
9284	Technical Instructions for the Safe Transport of Dangerous Goods by Air		1991-1992	-	-
9284SU	Supplement to the Technical Instructions for the Safe Transport of Dangerous Goods by Air		1991-1992		-
9365	Manual of All Weather Operations	1	1982	-	-
9368	Instrument Flight Procedures Construction Manual	1	1983	1	11/12/83
9371	Template Manual for Holding, Reversal and Racetrack Procedures	2	1986	-	
9375	Dangerous Goods Training Programme Book 1 — Shippers and Packers Book 2 — Cargo Agents Book 3 — Operator's Cargo Acceptance Staff Book 4 — Load Planners and Flight Crew Book 5 — Passenger Handling Staff and Flight Attendants Book 6 — Loading and Warehouse Personnel	 2 2 2 2 2 2	 1985 1985 1985 1986 1986 1986	 - - - - -	 - - - -
9388	Manual of Model Regulations for National Control of Flight Operations and Continuing Airworthiness of Aircraft	2	1987	-	
9389	Manual of Procedures for an Airworthiness Organization	1	1983	-	
9408	Manual on Aerial Work	1	1984	-	
9481	Emergency Response Guidance for Aircraft Incidents involving Dangerous Goods		1991-1992	-	
9501	Environmental Technical Manual on the use of Procedures in the Noise Certification of Aircraft	1	1988	-	
	PEL/TRG — Personnel Licensing and Training Practices				
7192	Training Manual Part A-1 — General Considerations Part A-3 — Composite Ground Subject Curriculum Part B-2 — Pilots — Helicopter Licences, CVFR-Rating and Instrument Flight Rating Part B-5 — Volume I Integrated Commercial Pilot Course — Course details Volume II Integrated Commercial Pilot Course — Instructor Briefing Sheets Part D-1 — Aircraft Maintenance Technician, Type II and Type I Part E-1 — Cabin Personnel Part E-3 — Aeronautical Information Services Personnel	 1 1 1 1 1 1 1 1	 1975 1975 1977 1985 1985 1976 1976 1980	 1 1 - - - -	 15/2/[illegible] 1/10/[illegible] - - - - - -
9379	Manual of Procedures for Establishment and Management of a State's Personnel Licensing System	1	1983	-	
9401	Manual on Establishment and Operation of Aviation Training Centres	1	1983	-	
	RAC/SAR — Rules of the Air, Air Traffic Services and Search and Rescue				
7333	Search and Rescue Manual Part 1 — The Search and Rescue Organization Part 2 — Search and Rescue Procedures	 3 3	 1970 1970	 - -	 -
8643	Aircraft Type Designators	19	11/88	-	
9426	Air Traffic Services Planning Manual	1	1984	1 2 3	15/7/85 [illegible]/9/[illegible] 3/1[illegible]/88

1 Corrigendum No 1 issued 8/2/82
2 Corrigendum No 1 issued 8/[illegible]/84
3 Corrigendum No [illegible] issued 1/6/87

Document Number	Title	Current edition No	Current edition Date	Subsequent amendments No	Subsequent amendments Date
9432	Manual of Radiotelephony	2	1990	-	-
9433	Manual Concerning Interception of Civil Aircraft	2	1990	-	-
9554	Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations	1	1990	-	-

FACILITY AND SERVICE DOCUMENTS

Document Number	Title	Current edition
7100	Manual of Airport and Air Navigation Facility Tariffs	1989

AIR NAVIGATION PLANS

Document Number	Title	Current edition No	Current edition Date	Subsequent amendments No	Subsequent amendments Date
7474	Africa-Indian Ocean Region	26	1989	1	30/4/90
7754*	European Region[1]	23	1985	1	27/9/85
				2	24/1/86
				3	30/4/86
				4	23/7/86
				5	26/11/86
				6	13/2/87
				7	6/5/87
				8	29/7/87
				9	21/10/87
				10	17/2/88
				11	15/6/88
				12	14/9/88
				13[2]	7/12/88
				14	31/3/89
				15	21/6/89
				16	6/12/89
				17	21/3/90
				18	29/6/90
8700	Middle East and Asia Regions	15	1989	-	-
8733	Caribbean and South American Regions	13	1985	1[3]	21/3/86
				2	15/10/86
				3	15/5/87
				4	1/3/88
				5	12/12/88
8755	North Atlantic, North American and Pacific Regions	12	5/84	1[4]	9/5/85
				2	28/8/86
				3	20/3/87
				4	30/9/87
				5	4/7/88
				6	4/4/89
				7	15/1/90

**Note — MET Supplements (1 MET, 2 MET and 3 MET) to Part VIII and COM Supplement (Tables) to Part X may be obtained from the following: Représentant de l'OACI, Bureau Europe, 3 bis villa Émile Bergerat, 92522 Neuilly-sur-Seine, Cedex, France*

1 Corrigendum to Part X issued 21/3/86
2 Replacement charts to Amendment No. 13 issued 7/12/88
3 Corrigendum to Amendment No. 1 issued 15/8/86
4 Addendum to Amendment No. 1 issued 28/8/86

— END —

IV-G

Performance Chart Examples for Cessna 337

CONVERSION FORMULAE TO BE USED FOR THE FOLLOWING APPENDICES[1]

- To find METERS: divide feet by 3, then multiply by 0.9.
- To find KILOMETERS: multiply miles by 1.6.
- To find KILOGRAMS: multiply pounds by 0.45.

[1] Random House Dictionary of the English Language, 2d Edition, 1560 (1987).

TAKEOFF DISTANCE

MAXIMUM WEIGHT 4630 LBS

SHORT FIELD

CONDITIONS:
1/3 Flaps
2800 RPM, Full Throttle and
Mixtures Set Prior to Brake Release
Cowl Flaps Open
Paved, Level, Dry Runway
Zero Wind

MIXTURE SETTING	
PRESS ALT	PPH
S.L.	102
2000	96
4000	90
6000	84
8000	78

NOTES:
1. Short field technique as specified in Section 4.
2. Landing gear extended until takeoff obstacle is cleared.
3. Decrease distances 10% for each 11 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2.5 knots.
4. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
4630	69	74	S.L.	895	1500	965	1615	1035	1740	1115	1870	1200	2015
			1000	975	1645	1055	1770	1135	1910	1220	2060	1310	2225
			2000	1070	1805	1150	1950	1240	2105	1335	2275	1435	2460
			3000	1170	1990	1260	2150	1360	2330	1465	2525	1575	2740
			4000	1280	2200	1385	2385	1495	2590	1610	2815	1735	3070
			5000	1410	2445	1520	2660	1640	2895	1770	3165	1910	3465
			6000	1550	2730	1675	2980	1810	3265	1950	3585	2105	3965
			7000	1705	3070	1845	3375	1995	3720	2155	4125	2330	4615
			8000	1885	3490	2040	3865	2210	4305	2385	4845	2580	5545

Figure 5-4. Takeoff Distance (Sheet 1 of 2)

RATE OF CLIMB - TAKEOFF FLAP SETTING

1/3 FLAPS AND GEAR UP

CONDITIONS:
2800 RPM
Full Throttle
Mixtures Set at Placard Fuel Flow
Cowl Flaps Open

MIXTURE SETTING	
PRESS ALT	PPH
S.L.	102
4000	90
8000	78

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
4630	S.L.	87	1205	1085	970	855
	2000	86	1060	950	840	730
	4000	84	920	815	715	605
	6000	83	785	685	585	480
	8000	82	650	555	460	360
4300	S.L.	85	1355	1235	1115	995
	2000	84	1205	1090	975	865
	4000	83	1060	950	845	740
	6000	81	915	815	715	610
	8000	80	775	680	585	485
4000	S.L.	84	1510	1385	1260	1140
	2000	83	1355	1235	1120	1005
	4000	81	1195	1085	975	865
	6000	80	1050	945	845	740
	8000	78	905	805	710	610

Figure 5-6. Rate of Climb - Takeoff Flap Setting