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SYSTEMS ANALYSIS OF THE INSTALLATION, MOUNTING, AND ACTIVATION OF EMERGENCY LOCATOR TRANSMITTERS IN GENERAL AVIATION AIRCRAFT

David S. Hall
Crash Research Institute
a division of Robertson Research, Inc.
P.O. Box 968
Tempe, Arizona 85281

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16. Abstract The Emergency Locator Transmitter (ELT), which is required in most general aviation aircraft in the U.S. and Canada, has been both a benefit and a problem to Search & Rescue personnel. The benefit of finding a downed aircraft is obvious and speaks for itself; however, the primary problems of the ELT are an unacceptably high false alarm rate and an unacceptably low rate of successful use in searches.

NASA has begun a program to assist in the search task by using a satellite-mounted receiver to detect and locate the position of ELT signals. As part of the Search & Rescue Satellite (SARSAT) effort, a development program was begun to design and improve ELT transmitter and to improve the installation in the aircraft and its activation subsystem.

This study reviewed 1135 general aviation fixed-wing aircraft accident files and produced a detailed description of the damage to the aircraft, the search aspects of these accidents, and collected as much information as possible about the ELT units in these cases.

The data in this report should assist in establishing installation and mounting criteria, better design standards for activation subsystems, and requirements for the new ELT system design in the area of crashworthiness. The data also can be used in other types of aircraft crashworthiness studies.

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ABSTRACT

The Emergency Locator Transmitter (ELT), which is required in most general aviation aircraft in the United States and Canada, has been both a benefit and a problem to Search and Rescue personnel. The benefit of finding a downed aircraft is obvious and speaks for itself; however, the primary problems of the ELT are an unacceptably high false alarm rate and an unacceptably low rate of successful use in searches.

The National Aeronautics and Space Administration (NASA) has begun a program to assist in the search task by using a satellite-mounted receiver to detect and locate the position of ELT signals. As part of the Search and Rescue Satellite (SARSAT) effort, a development program was begun to design an improved ELT transmitter and to improve the installation in the aircraft and its activation subsystem.

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FORWARD

This study is an attempt to fill one of the major voids in the area of General Aviation safety--the lack of a summary of detailed knowledge of the resulting airframe damage when the aircraft crashes in real-world operational circumstances. Although there are over 4000 aircraft accidents in the U.S. each year, very little has been done to describe the mechanical aspects of damage beyond a single-word description. This study, although limited in scope by various constraints, has provided a more detailed picture of the airframe damage in fixed-wing light aircraft, and a computer program capable of expanding our data base in this area. It is hoped that further use will be made of this data, analysis method, and computer program in future crashworthiness efforts.

Because of the limited nature of the data base, as described herein, the author cautions that this study be used as a guide, and not as a set of hard and fast rules.

In addition, the basic source data, which underlies this report, is of unknown quality, having been gathered by many different investigators under difficult circumstances. As noted, there are large gaps in the source data, especially in the recording of ELT data.

The author wishes to acknowledge the outstanding support and encouragement received from personnel at NASA Goddard Space Flight Center during this study. In addition, Mr. John Carter, Jr., who wrote all the data storage and analysis programs on the Univac computer at Arizona State University, made this study possible. Without automatic data processing and his excellent program, this mass of data would still be unusable. A special thank you is also given to Mary Norfleet for the many hours of typing and retyping and her great patience.

It is hoped that further use can be made of this detailed base--one of the most unique in the field of aviation safety for General Aviation.

SUMMARY OF GENERAL CONCLUSIONS

The following overall conclusions can be made from the data in this study.

1. In order to have the highest probability of operating properly after a general aviation fixed-wing accident, any ELT should:

   a. be capable of operation in any aircraft attitude.
   b. be mounted as far aft as possible.
   c. have some degree of crashworthiness, including fire resistance.
   d. be securely fastened in its mount and connected to an antenna as nearby as possible, preferably integral with the ELT, and external to the airframe.
   e. sense the crash as far forward in the aircraft as possible.

2. Increased enforcement of regulations could reduce the 8% violation rate of ELT installation rules, and the 5% having expired batteries.

3. The NASA 406 MHz ELT should be designed with this data in mind, incorporating as many of the following provisions as possible:

   a. crashworthy and fire resistant.
   b. integral, external antenna.
   c. aft location for ELT.
   d. forward location for sensing crash.
   e. semi-permanent mount, no quick disconnect.
   f. remote cockpit control and testing.

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1.0 INTRODUCTION

1.1 BACKGROUND

The Emergency Locator Transmitter (ELT) is a small, relatively inexpensive radio transmitter, with a self-contained power supply, designed to transmit a characteristic signal on 121.5 and 243.0 MHz in the event of an aircraft crash. These units have been in military use since the mid 1950s, and have been required on most general aviation aircraft since 1974. They are required to have a means of automatic activation in the event of a crash, and are built to meet a Technical Standard Order (TSO) of the Federal Aviation Administration (FAA). This TSO (C91) was issued after Congress mandated the installation of ELTs as part of the Occupational Safety and Health Act (OSHA) of 1970.

The ELT is supposed to provide notification of and homing to an aircraft accident site, whether there are survivors or not. The Search and Rescue (SAR) community has found the ELT to be their greatest help as well as their greatest headache. The problem is that these units have very poor reliability, both as to the problem of false alarms and the failure to transmit a usable signal after the crash.

Ref. 1 is an excellent review of the ELT history and related regulatory activities. Ref. 2 is a current study of the false alarm problem. This report will not attempt to duplicate the summaries contained therein.

The National Aeronautics and Space Administration (NASA), as part of its effort to use space for the benefit of mankind, has established a Search and Rescue Satellite Program (SARSAT), designed to overcome several of the major shortcomings of the existing ELT system. These include providing a relatively continuous listening watch over the widest possible area, position fixing of received signals, and potential improvements in the transmitter units. This program covers both ELTs and maritime Emergency Position Indicating Rescue Beacons (EPIRB) and is discussed in Ref. 3.

The SARSAT program includes the development of new transmitter electronics, operating at 406 MHz and transmitting a digital signal to the satellite, as well as a 121.5 MHz homing signal for ground and air search. This study is part of the effort to improve the aircraft ELT unit, to increase the probability of transmitting a usable signal to the satellite, and reduce the probability of false alarms.

The problem statement for the systems analysis was: Currently available activation subsystems and mounting criteria are inadequate to meet the performance criteria and system constraints of the NASA SARSAT program which utilizes an experimental 406 MHz ELT.

Prime Objectives:

1. Recommend an activation subsystem design approach and performance standards that will meet the performance goals and reliability goals of the NASA 406 MHz ELT.

2. Recommend mounting criteria that will meet the performance goals and reliability goals of the NASA experimental 406 MHz ELT.

3. Identify the state-of-the-art in activation techniques.

Secondary Objectives:

1. Provide data to evaluate candidate activation subsystems and mounting criteria.

2. Identify design characteristics that affect reliability.

1.2 OVERVIEW OF ELT SYSTEMS

1.2.1 Existing Systems

A typical current ELT system block diagram is shown in Figure 1.2.1. The transmitter-power-supply units were produced by a large number of vendors in the early 70s when the ELT was mandated by Congress. A listing of the various ELT units believed to be in the field and their significant characteristics is provided in Appendix B.

Some units were sold with a self-contained antenna, and some had an external antenna designed to mount on the outside of the aircraft--some units had both. Some units came with a factory supplied mount, some with a remote control or provision for one. Various battery configurations and shapes and sizes were available, and market forces, generated by the mandate to install, resulted in a varied mix of units in the field.

All units were required to have a means for automatic activation in accordance with the FAA TSO requirements, which were based on a Radio Technical Commission for Aeronautics (RTCA) specification, DO-147 (Ref. 4). This called for activation by a crash pulse exceeding 5G +2, -0 which exceeds 11 +5, -0 milliseconds in duration, and no activation in a less severe pulse. Several switch manufacturers provided activation devices, and a few ELT manufacturers built their own switches. Section 1.2.2 contains data on various switch designs and, where known, these are indicated in Appendix B for each unit.

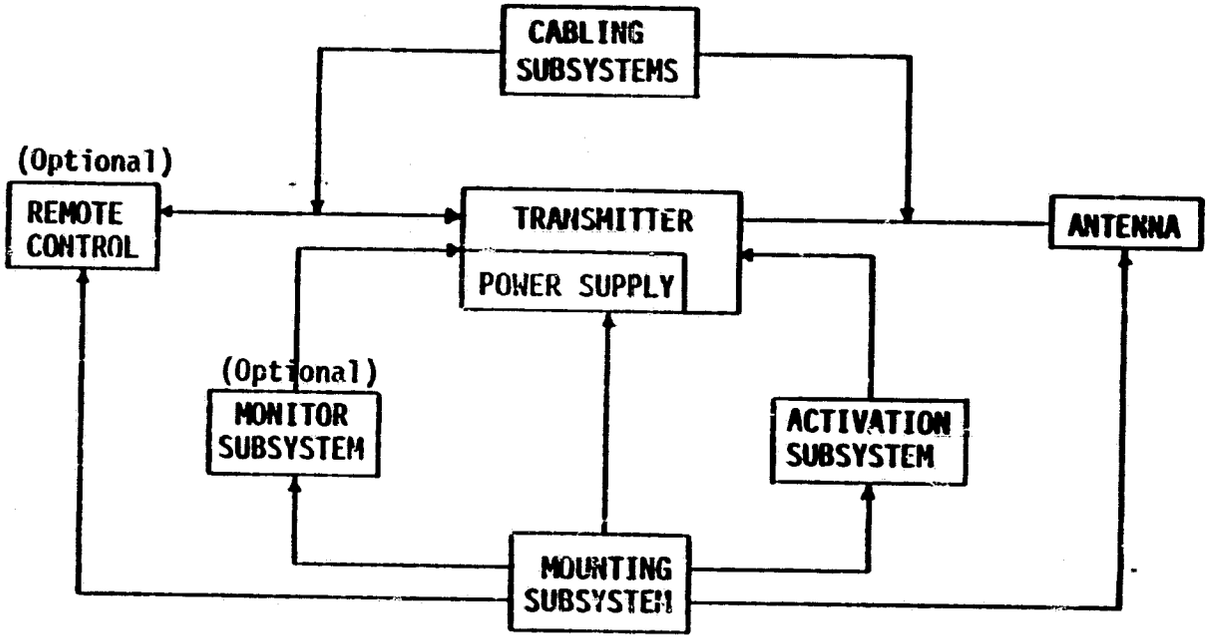


FIGURE 1.2.1
ELT SYSTEM BLOCK DIAGRAM

The Canadian government issued their own specifications, RSS-147 (Ref. 6), which had a more specific definition of the activation pulse, and other changes in the area of cold weather operation. Table 1.2.1 summarizes the U.S. and Canadian specifications in the area of interest. Also included is a later spec, DO-168, which is the work of a recent RTCA committee (Ref. 5).

The directive implementing the ELT program did not provide detailed guide lines for proper mounting, which was left to each manufacturer or installer. A wide variation in mounting location and configuration resulted. Some were designed for cockpit mounting, some could be put in the vertical fin, and some could be put almost anywhere the installer desired. FAA publication AC43.13-2A, as revised in 1977, contains a brief paragraph on ELT installations, which is reproduced in Appendix D.

No provisions were made for anyone to be required to listen for ELTs. Most FAA ground stations monitor 121.5 MHz, but since VHF propagation is line-of-sight, this resulted in only small coverage areas. Many airliners and military aircraft have the capability of listening continuously to these "guard" channels, and so intermittant coverage is provided over the parts of the U.S. under the airways or military operating areas. Non-military coverage is on a voluntary basis only. Within the last year, Nevada has installed mountain top receivers tied into the state police telecommunications network, giving coverage over almost all the state.

No formal plan was instituted to evaluate the ELT program after its implementation. Only minimal data is sought on ELT units after accidents or false alarms, and as this study will show, even that data is often missed.

The ELT System began to be plagued by many problems almost as soon as it was implemented. The most apparent problem was the false alarm problem, with over 6,000 alarms reported each year. Battery corrosion, primarily from the Lithium-Sulfur-Dioxide type batteries, became serious as the units aged and these batteries were finally removed from service due to several cases of fire or explosion.

As accidents occurred, another problem became apparent, the units often failed to transmit a usable signal. The causes varied, and in most cases were not adequately investigated in depth. Some of the causes were:

1. Switch did not sense crash.
2. Antenna broken or disconnected.
3. Unit destroyed in crash.
4. Battery dead.
5. Internal malfunction.
6. Antenna shielded.
7. Unit not armed.

This study is part of an attempt to collect sufficient data to determine the causes of their unreliable operation, as well as make the recommendations required for the 406 MHz system.

TABLE 1.2.1
ELT REQUIREMENTS (TYPE AF)

Function	Per RTCA DO-147	Canadian RSS-147-3	Per RTCA DO-168
Local Controls	On-off switch	On-off	On-off-arm switch
Remote (cockpit) Controls and Indicators	None Required	None Required	On-reset switch, transmitter "on" indicator, no disabling failure modes.
Power Source	Independent	Independent re-charging permitted	Independent, battery gas or leak will not degrade performance
Antenna Mounting	Omnidirectional, external mount-ing	Vertically polarized omnidirectional, ex-ternal	Vertically polarized omnidirectional, aircraft external mounting, locking, noncorrosive rf cable connectors
Operating Frequencies	121.5 MHz, 243.0 MHz, + - 0.005%	121.5 or both	121.5 MHz, 243.0 MHz, + - 0.005 percent; carrier stability over audio sweep cycle + - 150 Hz
Peak Effective Ratio Radiated Power	75 mW on each frequency	75 mW STD, DAY 37.5 mW cold	75 mW on each frequency
Operating Life	48 hours	100 hours	50 hours
Automatic Activation	5 +2, -0g longitudinal for 11 +5, -0ms stay latched during 50g for 11 ms; alternate sensor acceptable	Half sine pulse 7.0, +.2 -0G; 16 +.5 -0 must activate 5 +0 -.2; 11 +0 -.5ms must not activate	Inhibit below 2 + - 0.3g; activate if ΔV exceeds 3.5 + - .5 ft. sec, frang-gible switch sensor acceptable
Crashworthi-ness	--	--	Mounting to withstand 100g
RFI	--	--	Unaffected by 103 to 136 MHz (no acti-vation, no reradiation)
Temperature Low Storage Low Operating High Storage High Operating	 -65°C -20°C +71°C +55°C	 -65°C -40°C +71°C +55°C	 -55°C -20°C +85°C +55°C
Shock	50g for 11 ms	50g for 11 ms	100g for 23 ms
Vibration	10g maximum 5 Hz to 2000 Hz	10g maximum 5 Hz to 2000 Hz	7g maximum 5 Hz to 2000 Hz

1.2.2 ELT Activation Methods on Existing ELT Units

During the study period, contact was made with three switch manufacturers and one ELT manufacturer who makes his own switch. The following switch types have been identified as existing in current ELTs, and the type is listed in the table in Appendix B if known. The electrical configuration of the switch varies, in some cases the switch is a latching type and in some it is momentary. The ELT manufacturer can choose to measure the duration of the pulse electronically and then select a momentary switch at the 5G level, or he can use a damped switch to mechanically integrate the pulse duration and then either latch mechanically or electrically. All options have been used.

ROLAMITE TYPE

The rolamite is a unique mechanical device, invented by Sandia Corporation, and is basically a means of suspending and guiding a movable mass with almost no loss of energy due to friction. As implemented in the switch design by Technar, Inc., a roller is wrapped in a band of spring steel, which is shaped to provide a bias force toward one end of the switch. When the bias force is overcome by a sufficient external force, the roller moves along the band at a rate proportional to the force, until it contacts the opposite end of the device and opens or closes a switch. This is basically a velocity change sensitive device, although in use they are calibrated for a threshold force (G) and a time duration at a peak G. Technar now produces four rolamite switches for ELT use, all similar in construction but set at four different levels. They are uni-directional switches.

SPRING MASS TYPE

In these switches, a mass is restrained at one end of the switch by a spring, and moves toward the other end when sufficient force is applied. The rate of motion is modified by the spring and by gas or fluid damping if the mass and container are properly sized. This is a uni-directional device.

Aerodyne Controls, Inc., has produced three basic varieties of this switch in a gas damped configuration. The earlier switches had a high threshold and low damping and were very sensitive to vibration, leading to high false alarm rates. The current production switch has a lower threshold G force and higher damping, and appears to have a much lower sensitivity to vibration.

PENDULOUS MASS

In one application, a mass on a pivot is restrained against a stop by a spring. When sufficient force is applied to overcome the spring, the mass moves and physically displaces a mechanical toggle switch. This is a uni-directional device.

In another pendulous mass configuration, a small mass is suspended at the end of a fine piece of spring wire, in the center of a cylinder. A force perpendicular to the axis of the wire causes the mass to move to one side and contact the cylinder wall, completing a circuit. This device is fluid damped in the ELT application. It is sensitive to forces in a 360° circle about its axis.

MAGNETIC MASS

A ball is seated on a magnet and held by its magnetic force. When an acceleration force exceeds the holding force, the ball moves to the other end of the container and closes an electrical circuit. This device is uni-directional in the ELT application.

MAGNETIC REED SWITCH

A normally closed reed switch inside the case is held open by an external magnet, held to the case by magnetic force. When the magnet is moved away, by hand or by acceleration force, the switch closes.

FRANGIBLE SWITCH

A mechanical or gas conducting switch in a glass envelope is located in aircraft where impact damage is expected (i.e. nose, wing tips, etc.). Breaking of the switch envelope activates the ELT device. This system was not reported on any aircraft in this study, nor used on any commercially available ELT in U.S. civil aircraft; however, it has had military applications.

1.2.3 ELT Switch Set Points

Table 1.2.1 summarized the key ELT requirements of the existing specifications. For comparison purposes, Table 1.2.2 lists the pulse data for the various combinations of crash sensor specifications and actual switches. Data was not available for other switch types.

The pulse comparison chart is based on calculating the velocity change experienced by the switch when subjected to a pulse shaped as stated and with a maximum G as specified. The time duration is measured at the zero points on the curve. This gives a common measure for comparison, and points out the fairly wide variety of switches permitted and used in ELT units. It does not consider the threshold G level of the switches, below which no activation will take place regardless of time duration or velocity change. This figure is not readily available for any of the switches, but could be interpreted to be 5G under the current specification. In practice, it is usually lower, and may be as low as 2Gs in some models.

1.2.4 Current Improvement Activities

In an attempt to correct some of the deficiencies of the ELT units, the RTCA convened another special committee, and they produced a new ELT Minimum Performance Specification, DO-168 (Ref. 5). This changes many requirements, including the specification for the activation sensor. Under contract to the FAA to support this RTCA committee (SC-127), Crash Research Institute prepared a study report recommending a velocity sensitive switch with a low "G" threshold (Ref. 7). The resultant DO-168 requirement is for a sensor to measure a velocity change of 3.5 feet per second when a threshold of 2G is exceeded. This was based on studies of accidents wherein the aircraft deceleration rate (G) and velocity change were determined. The specified sensor should detect more than 80% of all general aviation survivable crashes, if installed to measure the same forces that are applied to the habitable volume of the aircraft.

TABLE 1.2.2

PULSE COMPARISON

Use	Specified Switch Setting G	Specified Switch Setting ms	Calculated Pulse Shape	Calculated ΔV (fps)
Max DO-147 (Shape unspecified in spec, but square wave implied)	7	16	Square	3.60
			Sine	2.54
Min DO-147 (Shape unspecified in spec, but square wave implied)	5	11	Square	1.77
			Sine	1.25
Max RSS-147 (Sine specified)	7.2	16.5	Sine	2.70
Nominal RSS-147	7.0	16.0	Sine	2.54
No Go RSS-147	5.0	11.0	Sine	1.25
Technar Max	6.6	16	Square	3.39
Technar	6.5	15	Square	3.13
Technar	6.0	13	Square	2.51
Technar for Canadian Use	6.0	11	Square	2.12

However, the committee that wrote DO-168 did not include in their study the installation and mounting criteria, and this is now under consideration by another special committee, SC-136. It is hoped this report will be of value to SC-136.

A summary of the DO-168 requirements is also contained in Table 1.2.1.

1.2.5 NASA Experimental 406 MHz System

As part of the SARSAT program, NASA has defined a new ELT configuration. This ELT system block diagram is shown in Figure 1.2.2. The transmitter is being designed to a Goddard Space Flight Center "Specification for the Electronics for Use in Experimental 406 MHz ELTs and EPIRBs", GSFC-S-480-11, 1 September 78. This battery-powered unit includes a digital message generator, a modulator and transmitter on 406 MHz for satellite use, and a 121.5 MHz beacon for earth based search. It will also have an optional capability to send a user selectable code message. When the user message feature is not used, the message will also contain an elapsed time code showing time since activation.

Performance specifications for this system, in the areas of activation and mounting, have not been defined. Cost benefit studies by The Interagency Committee for Search and Rescue (ICSAR) in the final report of October 1976 (Ref. 8), assumed an ELT "effectiveness" of 60 to 90%, based on projections of knowledgable individuals. This wide range of estimates is an indication of the lack of confidence in the present ELT and the absence of a clear understanding of the potential of this new system.

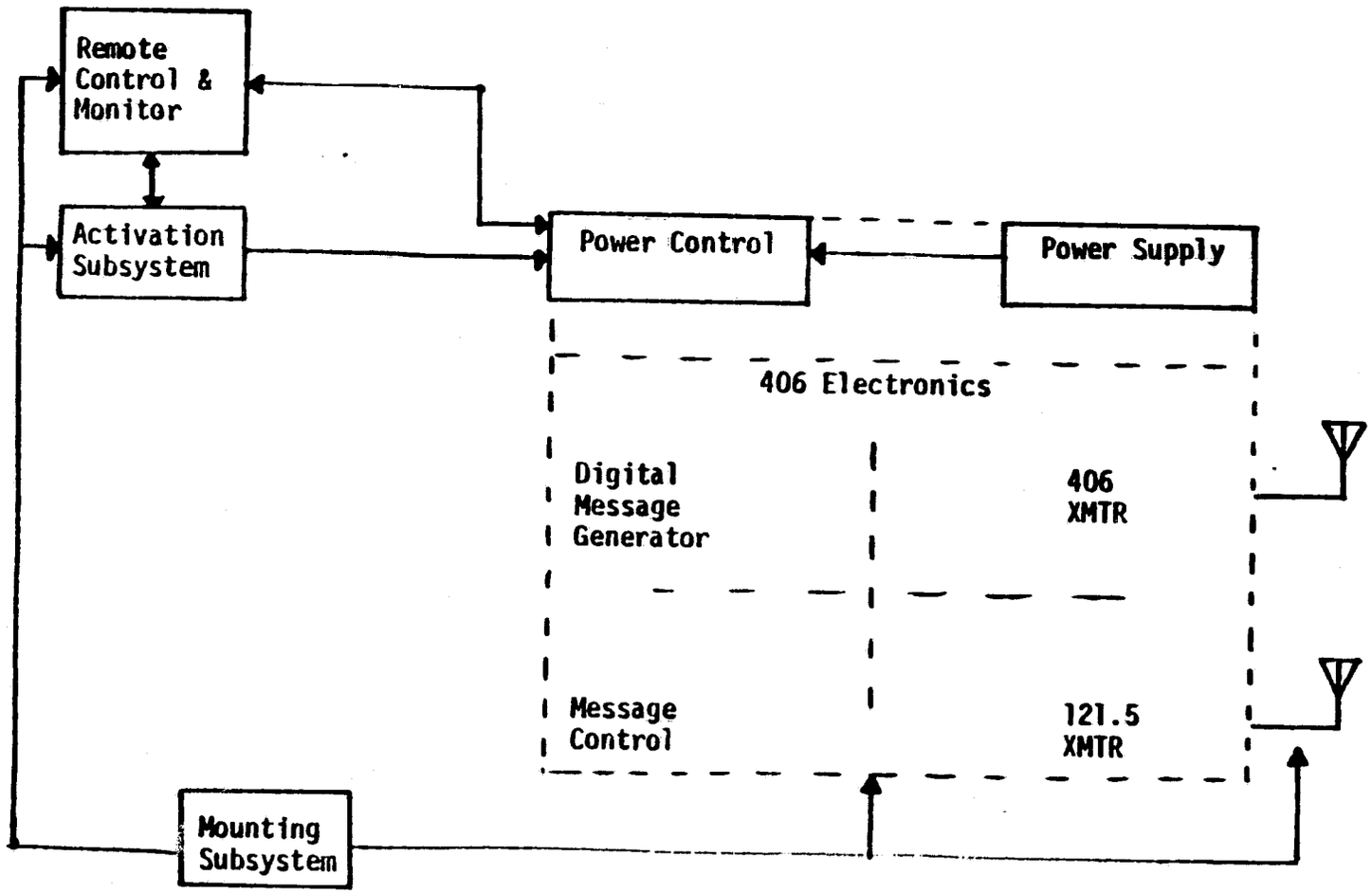


FIGURE 1.2.2
406 MHz ELT BLOCK DIAGRAM

1.3 OUTLINE OF STUDY METHOD

Several avenues of investigation were begun early in the study. Some of these proved fruitful and several were of little value. A review of these efforts is provided here, with detailed results later in the report.

1.3.1 ELT Manufacturer Data

Twenty-three letters were sent to all known addresses of ELT and switch manufacturers requesting information on their ELT units or G switch. Seven were returned "address unknown", four ELT manufacturers responded with information on their switches, and contact with three manufacturers was subsequently established. A list of currently known ELT and switch manufacturers is provided in Appendix B. Only six are believed to be still producing ELT units, but some others are still supporting their product in the field.

1.3.2 ELT Reliability Data

FAA Service Difficulty Reports were obtained for the five-year period 6/1/74 to 6/1/79. A summary of these reports is contained in Table 1.3.1. About one third of the reports relate to false activation, which is covered in the ARINC Study (Ref. 2). Over 40% of the reports relate to battery problems, while only 2% relate to failure to activate. Another 2% relate to broken antennas in service use and not as accident results.

The largest part of the battery complaints fall under units using lithium batteries, and the problem should be largely corrected by the current efforts in this area.

No other useful data on ELT reliability was obtained, and other studies have been started to fill this void.

1.3.3 NASA Langley Crash Testing

This study effort was conducted in parallel with ELT testing being done at NASA Langley Research Center, and their development work on analytical programs for structural crash response prediction.

A discussion with LaRC personnel regarding the applicability of their computer program to ELT performance prediction has indicated that when a particular structure is specified (i.e. a given airplane), it is possible to determine the loads at particular points in the structure for various crashes. However, no generalized prediction can be made from these programs for other aircraft.

LaRC also has tested many ELT units on full-scale crash tests and a special fixture containing the tail section of an aircraft.

TABLE 1.3.1

SUMMARY OF FAA SERVICE DIFFICULTY REPORTS

MANUFACTURER	# OF ENTRIES	# BATTERY PROBLEMS	# CORRODED	# ANTENNA PROBLEMS	# ANTENNAS BROKEN	# FALSE ACTIVATIONS	# NOT ACTIVATED IN CRASH
Undetermined	34	3	3	8	7	18	2
ACR	73	40	16	2	2	11	8
Aircraft Products	27	0	0	0	0	17	0
CCC	767	542	540	1	2	101	14
Dorne Margolin	568	417	272	5	4	38	10
Dynair	4	2	1	0	0	2	0
EBC	235	7	0	0	0	197	7
EDO	16	5	6	0	1	6	2
Garrett	318	56	39	0	34	147	0
Jahco	2	0	0	0	0	2	0
Larago	108	21	9	0	2	57	2
Leigh	1759	452	694	0	0	703	45
Martech	62	24	20	0	0	23	3
Navco	335	189	155	1	6	77	9
Pathfinder	88	8	32	0	8	32	0
Pointer	205	114	111	2	16	27	1
TOTAL	4401	1780	1901	19	85	1458	103

1.3.4 Actual ELT Installation Data

An attempt was to be made to determine how ELT units are actually mounted in the field. No detailed installation data was obtained from the accident studies, but a tabulation of installation information was summarized from vendor data obtained either from FAA certification files or outside sources. This tabulation was provided, in part, to RTCA SC-136, and a more complete list is contained in Appendix C.

Additional studies are underway to obtain field data to determine if ELT units are actually mounted as recommended.

1.3.5 Candidate Activation Systems

The following list of generalized activation concepts was used as the basis for the data collection phase of the study. Each concept was expanded with specific examples as shown, with no attempt made to evaluate their desirability or adequacy, but only to aid in selection of parameters to record in the data collection phase.

I. Internal (to ELT) Sensor

G Switch
G/ΔV Switch
Attitude at Rest
Pitot ΔP

II. External Sensor - Single Point

G Switch
G/ΔV Switch
Attitude at Rest
Structural Continuity/Deformation/Frangible Switch
Pitot ΔP
Oil Pressure
RPM
Electrical Power
Control Inputs
Vibration

III. Logic Based Sensing

Simple Logic - Dual Input, both required (see list above)
Complex Logic - Microprocessor based
What can be sensed
Flight status: Pitot ΔP, angle of attack, stall vane, vibration
Engine Operation: RPM, oil pressure, fuel pressure, electrical power, rate of change of these values
Structural Conditions: Engine mounts, gear loads, wing attachments, nose crushing, attitude
Loss of Sensor Input
Time Between States of Flight and Rest

The current data file is now available to evaluate these potential Sensor systems. About mid-study, Task II was added to this contract to evaluate Sensor Technology and this work will be reported separately.

1.3.6 Literature Study

A review of the technical literature on crash sensing was conducted during this systems analysis. The latest literature in various data banks was retrieved, and most of this will be reported in the Task II Sensor Study.

The revised Aircraft Crash Survival Design Guide, USARTL-TR-79-22B, which is now in preparation for the U.S. Army, was obtained for review in a preprint copy. All current NASA Langley test reports and ELT test data was reviewed.

The FAA conducted a Directed Safety Investigation (DSI) during 1975, and a copy was obtained for review.

All of the above data sources are integrated into the study report.

1.3.7 Aircraft Accident Data Base

The primary analysis effort was to obtain detailed information on aircraft accidents in order to provide a data base against which to measure existing and proposed activation and mounting criteria.

The result has been the Crash Research Institute SARSAT Information System (CRISIS) data base. The computer data bases now in existence for civil accident data (U.S., Canadian, and ICAO, for example) do not contain any significant damage data--for the most part limited to a single entry (i.e. Destroyed, Substantial, Minor, None).

In order to select a data base with the highest potential for having good data available, the study was narrowed to the following type accidents:

a. Fixed-wing, general aviation aircraft under 12,500 pounds gross weight.
b. U.S. fatal accidents occurring during 1977.
c. Canadian fatal and serious accidents occurring during 1976, 1977, and 1978.

This group is the source of the "BASIC" study group. It is a random sample with respect to cause, ELT data, location in North America, and quality of investigation. It is not random as to severity, but represents the most severe accidents only. The definition of fatal in this context is that someone dies in the event. The CRISIS data base contains about 90% of the U.S. accidents and almost 100% of the Canadian accidents that were reported and investigated for this time and accident injury group. The balance of the files were unavailable for study.

Some accident files were studied which were recorded as fatal due to injuries to personnel outside the aircraft, a part of the formal definition of an aircraft accident. These cases were eliminated from the BASIC group, since only injuries to persons inside the aircraft were considered in establishing the "injury index".

The term "injury index", as applied to this data base means an assigned code for sorting based on the following definitions:

FATAL = ALL OCCUPANTS OF THE AIRCRAFT DIED

FATAL WITH SURVIVORS = AT LEAST ONE OCCUPANT DIED AND AT LEAST ONE OCCUPANT SURVIVED

SERIOUS = NO OCCUPANT DIED, BUT AT LEAST ONE HAD SERIOUS INJURIES

Injuries and deaths to persons outside the aircraft were not considered in assigning these codes.

In addition, two other subcategories of cases were obtained:

1. SAR Group, U.S. accidents for 1976, 1977, and 1978 where the U.S. Air Force Rescue Coordination Center (RCC) reported the ELT aided in the search.
2. Canadian cases for 1976 through 1978 where ELT data was available regardless of injury.

The total data base consists of 1135 files, of which 916 are in the BASIC group. Table 1.3.2 shows the distribution of files by injury index, country and year.

TABLE 1.3.2

TOTAL DATA BASE CONTENTS BY INJURY, COUNTRY, AND YEAR

Injury Index	Country	C.Y. 76	C.Y. 77	C.Y. 78
Fatal	U.S.	23	469	27
Fatal	Canada	52	53	55
Fatal w/surv.	U.S.	4	108	9
Fatal w/surv.	Canada	18	12	8
Serious	U.S.	3	3	2
Serious	Canada	55	48	38
Minor/None	U.S.	8	9	8
Minor/None	Canada	51	59	13

BASIC Group in Boxes

1.4 ORGANIZATION OF THE REPORT

Chapter two covers the accident data collection effort, data base computer program, and analysis routines. The codes necessary to interpret the data are contained in chapter two, and the data collection form is contained in Appendix E. All computer output data tables referred to in this report are contained in chapter seven.

Chapter three attempts to describe the general aviation fixed-wing accident, based on the data collected. It is described overall, and by general types of aircraft.

Chapter four discusses the ELT data in the file from several viewpoints. Five manufacturers of ELTs were represented by more than 10 entries in the file, and these types were reviewed individually. ELT data was also examined by aircraft category to see if any distinct differences are apparent. Separate studies of ELT units destroyed in the crash and ELT units that activated are also contained in this section.

Chapter five reviews several areas of special concern. It contains a comparison of several subsets of data in the file and special studies.

Chapter six contains the general conclusions and specific recommendations developed as a result of this study.

2.0 DATA COLLECTION AND DATA BASE

2.1 DATA COLLECTION PROCEDURES

2.1.1 Encoding of Accident Data

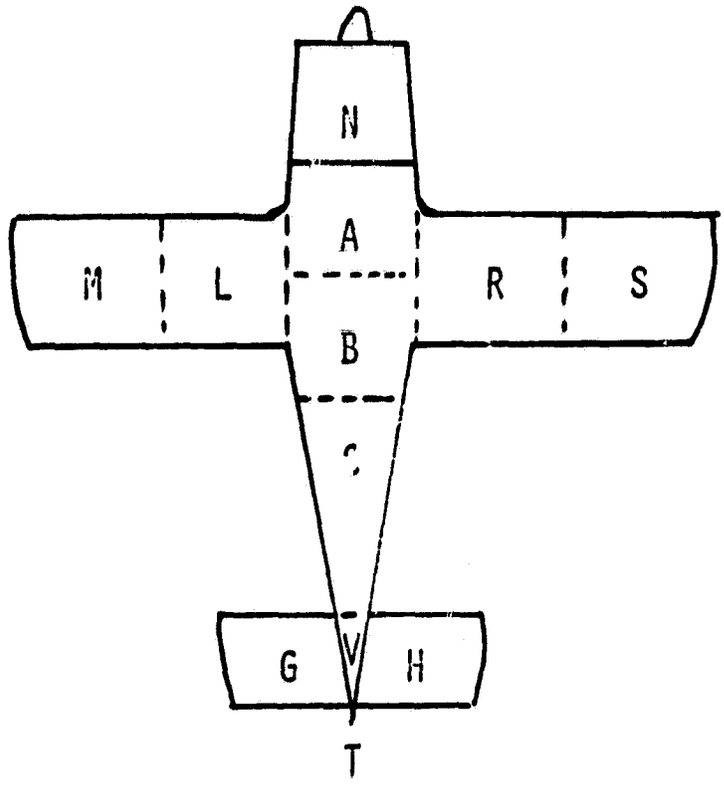
Accident data was placed in the CRI SARSAT Information System (CRISIS) data base in machine readable form through the following process:

1. A data encoding form was developed (See Appendix E)
2. A researcher analyzed the original government files including:
   a. Original data collection forms
   b. The narrative report
   c. The photographs
3. The researcher quantified and transcribed this data onto the encoding forms
4. The data on these forms was encoded in machine readable format and placed in the CRISIS data base

For the Canadian files, almost all of the data to be transcribed onto pages 1-4 of the encoding form was already available in machine readable form; and thus, were automatically transferred to the study accident data base. In order to minimize differences in data analysis and interpretation, a minimum number of researchers were used for this task--one researcher encoded all of the data from the Canadian files, and two researchers encoded all of the U.S. (NTSB) files.

The bulk of the data collection effort was the interpretation of the photographic and narrative record to describe the aircraft damage in much greater detail. The aircraft was divided into twelve zones as shown in Figure 2.1.1, plus main gear, nose or tail gear, and each engine and propeller. Each zone or component was described by the Location, Deformation, and Attitude codes shown in Table 2.1.1.

Every attempt was made to standardize the data collection, and each of the research assistants were personally supervised by the principal investigator during their first few case studies, and some of their work was later checked against independent sources for accuracy.



N. Nose--comp or engine/fwd of cabin bulkhead
A. Cockpit--instrument panel to back of first seat
B. Cabin--back of first seat to rear cabin bulkhead
C. Aft fuselage--tail cone from bulkhead to L.E. of horizontal
T. Tail cone aft of horizontal
R. Right wing from fuselage to mid-wing
S. Right wing mid to tip
L. Left wing from fuselage to mid-wing
M. Left wing mid to tip
H. Right horizontal
G. Left horizontal
V. Vertical tail and tail cone below it

FIGURE 2.1.1
AIRCRAFT ZONES

While a large number of data elements were obtained, only the search data and damage data called for analytical judgement by the researcher--all the rest of the data that was obtained was taken directly from the narrative or accident report form.

TABLE 2.1.1

CODES FOR DATA COLLECTION FORM

LOCATION CODES

0 Unknown
1 Continuity of structure back to section A
2 Attached to next inboard section, but not back to A
3 Almost separated, most structural continuity gone
4 Separated completely

DEFORMATION CODES

0 Unknown
1 Basically undamaged, minor dents and tears
2 Major dents, tears but still in near normal shape
3 Crushed/distorted/crumpled
4 Destroyed, pieces separated
5 Buried in wreckage/dirt/debris

ATTITUDE AT REST (PITCH AND ROLL)

1 $\pm$ 30 degrees of upright/normal attitude in both pitch and roll
2 30 degrees - 90 degrees from normal in pitch or roll
3 90 degrees from normal (inverted)

CONFIDENCE LEVEL IN DATA

1 Estimated/guessed from photo or text
2 Clearly shown in photo
3 Detailed data in report
4 Personally observed at scene

The Canadian file normally contains specific search information (Appendix E, page 4) and specific ELT data (Figure 2.1.2). The NTSB form, however has only two questions on ELT and search. Figure 2.1.3 is extracted from NTSB form 6120.4, page 4 (9-72). In addition, the NTSB computer data file has one entry for ELT data with 10 possible answers, shown in Table 2.1.2. All additional data in the CRISIS data base was determined from narrative reports and appended police or other reports.

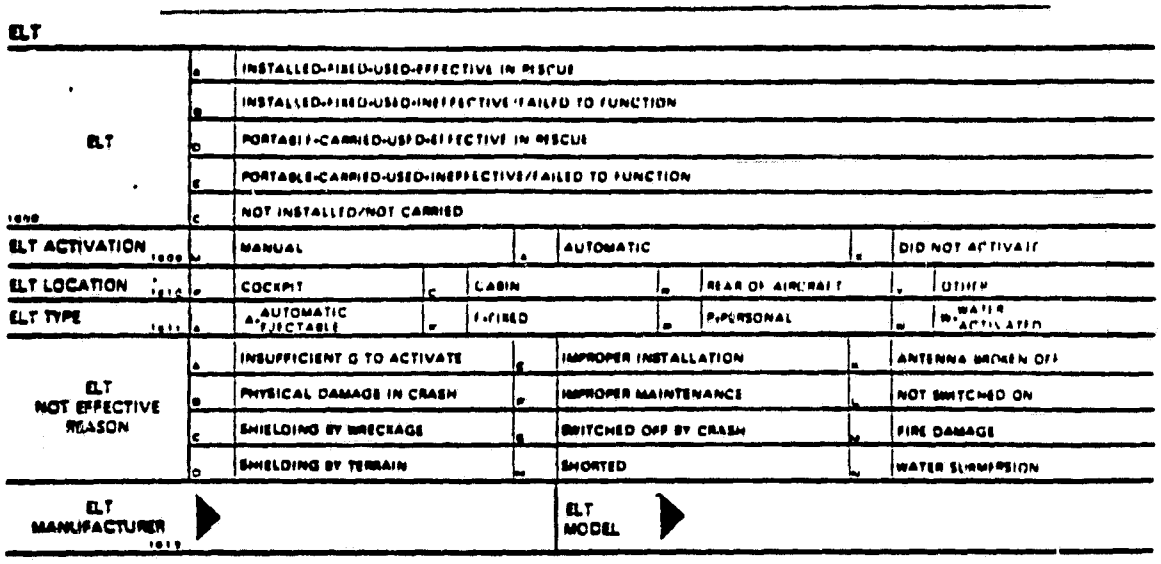


FIGURE 2.1.2

CANADIAN INVESTIGATION FORM
QUESTION ON ELT

EMERGENCY LOCATOR TRANSMITTER	ON BOARD ☐No ☐Yes	AIDED SEARCH/LOCATION ☐ No ☐ Yes	REMARKS

FIGURE 2.1.3

NTSB INVESTIGATION FORM
QUESTIONS ON ELT AND SEARCH

TABLE 2.1.2

CODED ANSWERS AVAILABLE FOR THE SINGLE ELT ENTRY IN NTSB COMPUTER FILE

Operated - Used in locating A/C
Operated - Not used
Not Used - Not armed
Not Used - Separated from antenna
Not Used - Battery malfunction
Not Used - Other malfunction/failure
Not Used - Impact/fire damage
Not Used - Operation unknown
Not Installed
Not Applicable/Insufficient Impact
Unknown/Not Reported

Subsequent to the basic data collection in Washington and Ottawa, additional data was obtained on some California accidents on a visit to the Civil Air Patrol (CAP) California Wing Headquarters.

2.1.2 Development of the Statistics

The reader should bear in mind that the statistics presented in this report have been generated by a complex sampling process, much of which was not under the control of the CRISIS research team. The overall process may be seen as follows:

1. General aviation aircraft are operated in the U.S. and Canada each year, this is the "population".
2. The subset "Fixed-Wing", and specific years were selected, a sub-population.
3. A certain subset of 2. is involved in accidents.
4. A certain subset of 3. are investigated, depending on severity, location, injury, availability of investigators, and other politcal and practical considerations. In the U.S., only fatal accidents are investigated in depth. In Canada, serious accidents are included.
5. A certain subset of 4. was available for study for CRISIS. Some cases were out for study by other people, or being reproduced for lawyers, etc. This effect is not random, but is biased against the more interesting and more severe accidents. This is the sample of the sub-population 2.

Therefore, a particular statistic (e.g. the number of brand X ELTs installed) is reliably only to the extent that the above factors are random with respect to brand X ELT. The user of this report is cautioned to consider these constraints when applying the statistics in this report to the population 1. above.

However, CRISIS is still the best data available to answer the questions raised by the systems analysis task. Valid conclusions can be obtained when normal precautions are taken.

Within the data base, certain questions are subsets of other questions, based on the real world situation and the question form. Figure 2.1.4 is a representation of the relationship of ELT questions on page 6 of Appendix E.

2.1.3 Confidence in the Data

Although the CRISIS data base contains 1135 files, and the BASIC set is 916 files, some questions may exist as to how representative these data elements really are. The quality of investigation by the original field investigators is unknown, therefore, some error is possible due to carelessness or poor investigation. The damage data was taken from photos wherever possible, and from narrative descriptions when necessary. Canadian files generally have many photos as specific requirements have been established. No similar photographic requirement exists in the U.S., and over 180 cases, not counting those where wreckage was not recovered, have 3 or less photos of the wreckage.

As will be described, and specifically to minimize the effect of missing data. calculations of percentages in the damage tables were made as percent of cases with data in the given field, unless otherwise stated. This is based on the assumption that the absense of photos or data was random with respect to damage, and that the sample obtained was representative of all similar accidents.

While the case selection for the BASIC file is random as far as ELT data is concerned, this is not true of the ALL file. Even within the BASIC set, however, it is possible that some elements are recorded with a bias. For example, a major search is more likely to be reported than a short one, and an ELT that aids is more likely to be documented than one that is destroyed in the wreckage of an accident with no search needed. An ELT in a readily accessible part of the aircraft is more likely to be documented, compared to one that requires tools for access. It is therefore necessary to approach this data with caution, drawing useful conclusions where the data seems strong, and proceeding with due caution where samples are small or bias is likely.

> CAUTION
>
> Caution should be used in extrapolating detailed conclusions where the sample size is small, which is the case for any specific ELT or any specific aircraft make and model.

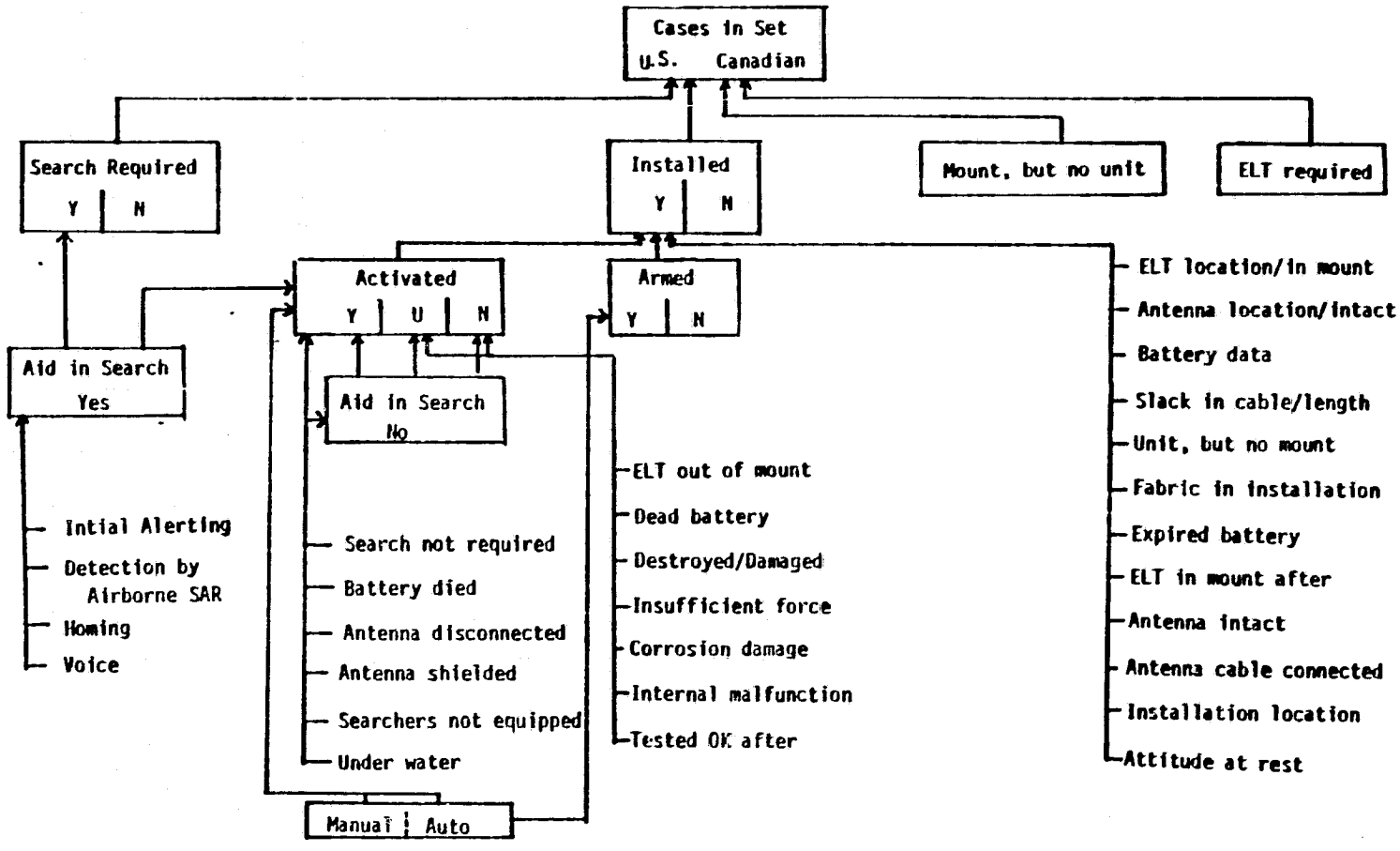


FIGURE 2.1.4
RELATIONSHIP BETWEEN QUESTIONS AND ANSWERS ON DATA COLLECTION FORM PAGE 6 AS SUBSETS OF OTHER ITEMS

In the specific case of the aircraft section coded T, for tail cone, the overall data base is very small owing to the fact that many aircraft did not have an identifiable tail cone. As a result, sample size for this area is small, even in the ALL file (see Table 7.7C). No detailed conclusions should be drawn for any data in the T section of any data table.

Sample size was fairly large in the BASIC set; but in the case of some categories of aircraft (see Table 2.1.3), sample sizes are fairly small. No attempt has been made to establish statistical measure of significance for any data or comparison in this report. Regardless of their absolute accuracy or statistical confidence limits, this data represents a description of the real world with enough accuracy to draw careful conclusions and make recommendations in light of the problem statement upon which the study is based.

TABLE 2.1.3

MOST COMMON AIRCRAFT MAKE AND MODEL IN THE CRISIS DATA BASE

Make and Model	No. of Cases in ALL File
PA-28	116
C-150	101
C-172	92
C-182	66
Bellanca (7ACA, 7ECA, 8ECAB)	44
Bonanza, Debonair	40
PA-18	30
C-185	29
PA-30	24

2.2 COMPUTER ANALYSIS

A computer data storage program was developed, along with specialized data analysis routines for this study. Other correlations and data comparisons are possible beyond the ones prepared for this report. The data base is organized in files, each file represents an accident and is identified by a four-digit file number, which is the primary access number for any file. If a particular file is needed, and the file number is not readily known, the brief print can be reviewed by aircraft type, registration number, or government file number.

The data base is organized into four major subsets:

ALL = All files
BASIC = The random group of severe accidents previously defined
SAR = Those identified by RCC as having ELT help in finding the aircraft
ELT = Those in which the ELT was recorded as aiding in the search in the accident file itself

These subsets are overlapping.

Each file is individually coded as to whether it is in the BASIC or SAR group, and an injury index is appended as described in section 1.3.7. An NTSB or Canadian source code is also provided.

During the early phase of the study planning, a review of the general aviation fixed-wing fleet was prepared to facilitate analysis of groups of aircraft having similar characteristics that would relate to crash dynamics. Many features were reviewed, and the following were determined to have a high probability of influencing ELT activation and mounting factors.

Weight/Power
Structural Design
Passenger Load

Specific "type codes" were assigned, and the number of aircraft in each category are shown in Table 2.2.1.

2.3 CRISIS DATA OUTPUTS

The following printout formats are available for outputs of the data base. The first three are maintenance routines.

a. Runstream: Prints full file on a single page, some items coded and some in plain language.
b. Brief Print: Lists the files by our file number, with government file number, aircraft make and model and type and several other items. Can be printed in a number of different ways (i.e. by file number, by aircraft type, etc.).
c. Table 1: File size tabulations and some general ELT tabulations, plus a few general tabulations relating to weather, terrain, and location.
d. Table 2: ELT data by make and model, search data, photo data, and several miscellaneous items.
e. Table 3: Data on obstacles, fire, specific ELT information by make and model, and damage data by combination of Location and Deformation code vs. aircraft type code.
f. Table 4: This table summarizes ground contact and final rest attitude from the impact conditions on page 3 of the data collection form.
g. Table 5: This table summarizes final rest attitude data by aircraft category, and engine and propeller damage by combined location and damage code.

Tables 2 through 5 are designed to be run for the ALL, BASIC, SAR, and ELT subsets, not for any other random selected set.

TABLE 2.2.1

NUMBER OF CASES BY TYPE CODES

TYPE CODE	CHARACTERISTIC	EXAMPLE	NUMBER OF CASES ALL	BASIC
A	Very light/home built GW ≤1200#	Pitts	37	33
B	Light utility/trainer Metal structure, 2-4 place	Piper Cub C-150	282	225
C	Cabin class, single eng. unpressurized	C-172	607	482
D	Cabin class, single eng. pressurized	TP-210	0	0
E	Cabin class, twin unpressurized	C-310	102	83
F	Cabin class, twin pressurized	C-421	21	19
G	Commuter 10+ pass. unpressurized	DHC-6	10	7
H	Commuter 10+ pass. pressurized	Metro	1	0
J	Unusual configurations, agricultural, wooden structure, biplane rear engine, etc.	Ag Cat C-337	70 (7 twin engine)	64

h. Tally: This printout presents the damage data, fire data, attitude data and ELT data as both number of entries and percent. It is designed to be run for any set of IF/AND/OR statements for any subset of the data base. Most of the data in this report is presented in the TALLY format.
i. Match: Prints out the file number of all files that match a set of IF/AND/OR statements.

The data tables in this report which are based on the tally output are normally presented in two ways. The first is the damage table (see Table 7.1A) which contains the summation of all Fire, Location, Deformation, and Attitude codes of the set of data described in the title of the table. This type table is always postscripted as A. Each group of codes is listed as a percent of data entries in that field, with blanks or unknowns not counted. For example:

	Location 1	2	3	4	
Nose	38	0	30	32	TOTAL = 100%

The actual counts of data in this set were as shown on Table 7.1C. Code 0 is defined as unknown.

	Location 0	1	2	3	4	No Report
Nose	27	340	0	262	285	221

All tables showing total counts are postscripted as C. Code 0 and No Report are combined.

Tables with the postscript B contain specific ELT data (see Table 7.1B) for the stated subset.

All tables for a given subset carry the same basic identifier number. For example, the total file, or ALL set, has three tables presented.

Table 7.1A	Percent tables of damage
Table 7.1B	ELT summation
Table 7.1C	Total count summation

In most cases, the type C table is not presented, as comparisons from this raw data are very difficult.

The primary analysis emphasis is to describe the damage to the aircraft in enough detail to determine if an ELT located at a given point would:

1. Activate
2. Survive
3. Transmit a usable signal

In addition, other possible crash sensing approaches should be able to be evaluated using this data. An overall estimate of ELT effectiveness should be obtainable from the data, given a specific ELT configuration.

3.0 DESCRIPTION OF THE GENERAL AVIATION ACCIDENT

3.1 OVERALL SUMMARY OF THE BASIC FILE

3.1.1 The General Aviation Fixed-Wing Accident

Since the BASIC file constitutes a random set of accident cases from the viewpoint of ELT data, location in the U.S. and Canada, and quality of investigation, it should give a valid representation of the major general aviation fixed-wing aircraft accident. They are considered major accidents in this report due to the recorded level of occupant injury, since at least one serious or fatal injury occurred in each accident to an occupant of the aircraft. This term should not be confused with official government definitions.

The data is summarized in Table 7.2C which gives the total numbers of each entry, and Table 7.2A which is in percent of entries in a given field. The percent table is used throughout the body of this report to facilitate comparison.

The composite picture that emerges from this BASIC summary has a number of interesting features.

1. Ground fire occurs in 22% of the cases, but does not usually involve the whole aircraft. The empennage is least often involved, being burned in only 9% of these BASIC accidents. Almost all the fires are associated with fatal accidents.
2. Inflight breakup occurs in 6% of the accidents, all of which involved fatalities.
3. Inflight fire occurred in 10 cases (1%), 9 of which were fatal.
4. Nearly one third of all the aircraft came to rest inverted. About one half were upright within 30° of normal.
5. Six percent of the aircraft were not recovered, most often because they were underwater.

6. The cockpit was severely damaged (Deformation codes 3-5) in 82% of the cases, the cabin in 76%, and the nose section in 91%. The nose was undamaged in only 2% of the cases.

3.1.2 Fatal Accident Comparison in the BASIC File

Tables 7.15 and 7.16 show the damage data for the BASIC subsets, U.S. Fatal injury index, and Canadian Fatal injury index. The Fatal injury index shows that all occupants of the aircraft received fatal injuries. This data can be compared with Table 7.2 which is the full BASIC set and 7.14, which is BASIC fatal.

The injury index "Fatal With Survivors" includes all accidents where at least one occupant was killed and at least one occupant survived the accident. This data is in Table 7.17 for BASIC, 7.18 for U.S. BASIC and 7.19 for Canadian BASIC. The injury index "Serious" means that the most severe occupant injury was serious and there were no occupant fatalities.

A comparison of the Fatal and Fatal With Survivors groups (Tables 7.14 and 7.17) clearly shows the more severe nature of the accidents with no survivors. For a summary of this data, see Figures 3.1.1 and 3.1.2. However, it also shows that it is possible to survive an accident that does severe damage to an aircraft. About 20% of the habitable areas were "destroyed, pieces separated" and yet someone lived through it. Fire also occurred about 17% of the time, compared to 27% in fatal cases, but the sections damaged are similar. Final attitude at rest is also similar.

In comparing the two national groups of fatal accidents, fire occurred in 30% of the U.S. fatals and 23% of the Canadian fatals, but the Canadian data indicates the fire affected more of the aircraft. Only empennage involvement is similar in both groups. Damage levels overall are more severe in the Canadian case, engines and propellers separate more often, and twice as many aircraft end up inverted. However, 11% of the U.S. accidents involve inflight breakup of the aircraft, and only 4% of the Canadian cases have this finding. There were a number of inflight fires in the U.S. data, none in the Canadian.

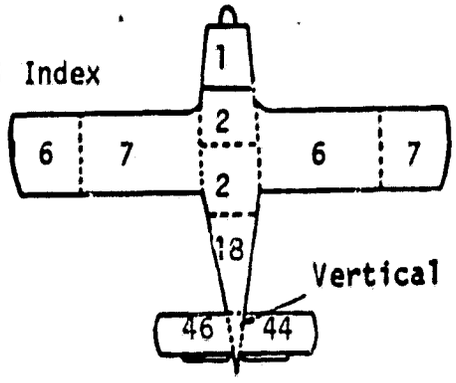
Comparing the "Fatal With Survivors" on a national basis again shows the Canadian accidents are more severe--fire occurs twice as often, and more aircraft are inverted.

3.1.3 Fire Data in the BASIC File

Table 7.38 is for the BASIC accidents with ground fire, which includes 22% of the BASIC set. The destruction of the aircraft is very severe, with only 2% of the cockpits and cabins and 4% of the nose sections remaining in near normal shape. Only 23% of the aft fuselage sections were still near normal, and half of the vertical and horizontal tail surfaces were in near normal shape. (see Figure 3.1.3) All but 13 of these accidents involved fatalities, and 4% were preceeded by inflight fire. The wings separated and were heavily damaged in about 85% of these accidents. The overall damage level is more severe than the set of fatal accidents, but the aircraft was upright a little more often.

SECTION DAMAGE

DATA SET:
BASIC, Fatal Index
Ref:
Table 7.14

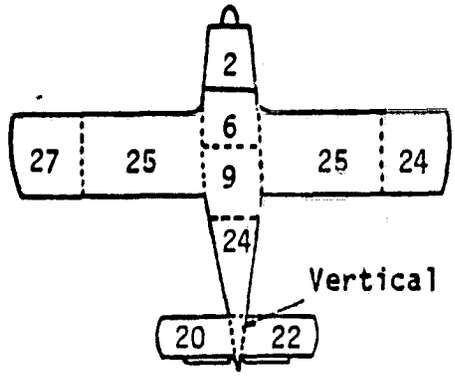


Main Gear 19

Nose or Tail Gear 26

Vertical Tail 44

% of aircraft where section indicated was basically undamaged (Code 1)

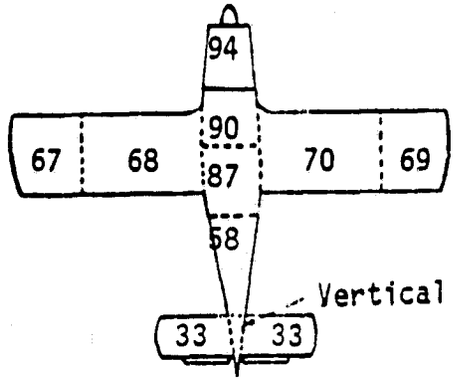


Main Gear 13

Nose or Tail Gear 11

Vertical Tail 23

% of aircraft where section was dented or torn (Code 2)



Main Gear 61

Nose or Tail Gear 59

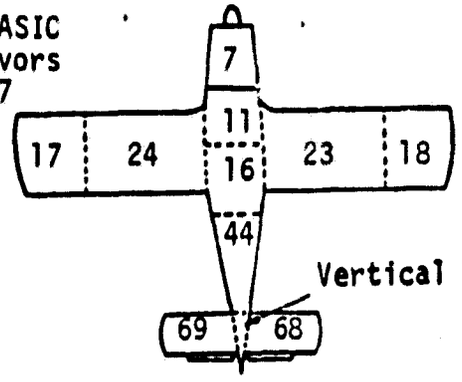
Vertical Tail 32

% of aircraft where section was at least crushed (includes destroyed)(Codes 3 & 4)

FIGURE 3.1.1

SECTION DAMAGE

DATA SET: BASIC
Fatal with Survivors
Ref: Table 7.17

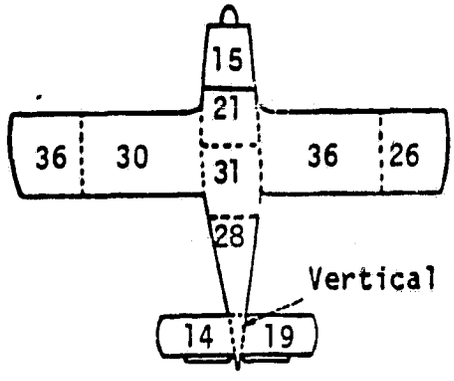


Main Gear 32

Nose or Tail Gear 42

Vertical Tail 68

% of aircraft where section indicated was basically undamaged (Code 1)

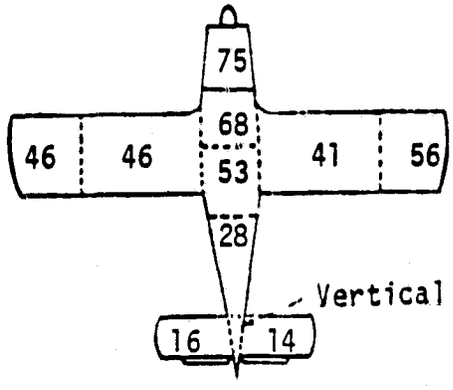


Main Gear 17

Nose or Tail Gear 13

Vertical Tail 19

% of aircraft where section was dented or torn (Code 2)



Main Gear 46

Nose or Tail Gear 42

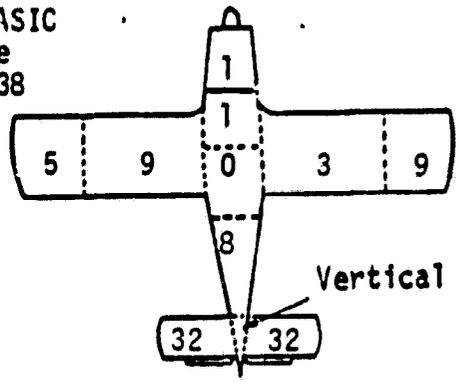
Vertical Tail 13

% of aircraft where section was at least crushed (includes destroyed)(Codes 3 & 4)

FIGURE 3.1.2

SECTION DAMAGE

DATA SET: BASIC
With Ground Fire
Ref: Table 7.38

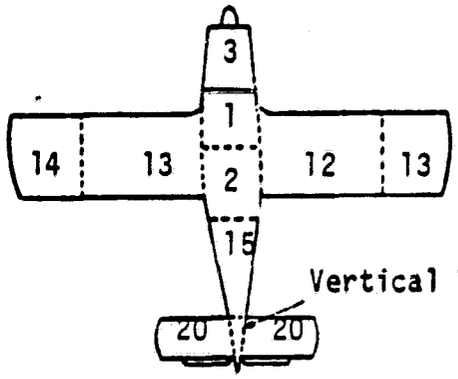


Main Gear 6

Nose or Tail Gear 14

Vertical Tail 32

% of aircraft where section indicated was basically undamaged (Code 1)

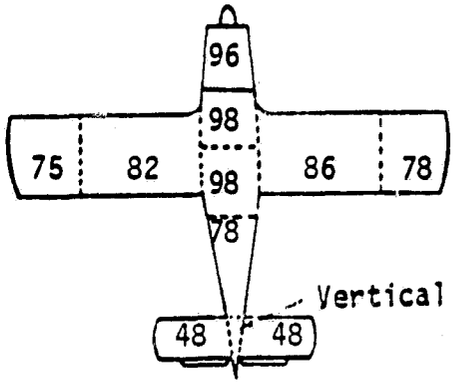


Main Gear 9

Nose or Tail Gear 6

Vertical Tail 18

% of aircraft where section was dented or torn (Code 2)



Main Gear 79

Nose or Tail Gear 78

Vertical Tail 49

% of aircraft where section was at least crushed (includes destroyed)(Codes 3 & 4)

FIGURE 3.1.3

Only one of the commuter-type aircraft (Codes G and H) was involved in fire on the ground, and this was a very localized fire. The percentage of ground fire for the remaining type code groups is shown in Table 3.1.1. Fire seems to be a major problem in the pressurized twins. Table 3.1.2 shows ground fire involvement by aircraft type code and aircraft section.

The ELT data, Table 7.38B, indicates that the ratio of ELT installed and not installed is similar to the whole BASIC group. However, the ELT is destroyed 59% of the time.

TABLE 3.1.1

FIRE DATA BY AIRCRAFT TYPE CODE

AIRCRAFT TYPE CODE	GROUND FIRE %	INFLIGHT FIRE %
A Very light/home built	21	0
B Light utility/trainer	16	0
C Cabin class, single engine, unpressurized	21	0
E Cabin class, twin, unpressurized	29	5
F Cabin class, twin, pressurized	53	21
J Unusual configurations	39	0

TABLE 3.1.2

GROUND FIRE INVOLVEMENT
BASIC SET BY AIRCRAFT TYPE CODE
DATA AS % OF CASES WITH FIRE

	Aircraft Type Code					
Aircraft Zone	A	B	C	E	F	J
Cockpit	100	97	84	68	64	72
Cabin	86	97	84	68	91	72
Nose	86	95	71	68	55	72
Aft Fuselage	86	78	60	52	55	52
Rt. Inbd. Wing	100	89	65	76	45	60
Rt. Otbd. Wing	86	54	38	60	27	52
Lt. Inbd. Wing	86	78	63	76	73	64
Lt. Otbd. Wing	86	57	38	76	45	52
Rt. Horizontal	71	59	29	28	45	40
Lt. Horizontal	86	57	31	28	36	40
Vertical	86	54	30	28	36	44

3.1.4 Temperature Data in the BASIC File

Table 3.1.3 provides temperature comparisons of various subsets in the BASIC file. It can be seen that in 13% of the cases where temperature at the accident was reported, that temperature was below zero. However, that changes to 9% for U.S. fatal accidents, and 24% for Canadian fatal accidents.

At the high end, 7% of the U.S. fatal accidents and zero Canadian fatal accidents occurred over 31°C.

Comparing ELT performance, the subset [ELT installed, armed, activated] and [ELT installed, armed, not activated] shows a shift toward the extremes, with more cold and hot temperatures in the non-activated cases. Additional analysis on the few cases involved would be required to determine if temperature played a part in the non-activation.

3.2 VERY LIGHT/HOME BUILT AIRCRAFT (TYPE CODE A)

Data for this aircraft category is in Tables 7.3. Although the sample size (33) is small, some differences can be seen in the data, which is consistent with expectation. The nose, cockpit, and cabin damage is slightly more severe than the BASIC set, the aft fuselage damage is slightly less severe. Fire occurs in almost the same percent of accidents, and seems to involve more of the aircraft. Inflight fire did not occur. Final attitude data is similar. Engine separation occurs in nearly the same ratio, but engine and prop damage is more severe if the prop is damaged. However, more props are undamaged.

3.3 LIGHT UTILITY/TRAINER AIRCRAFT (TYPE CODE B)

Data for this aircraft category is in Tables 7.4. Ground fire occurs less often in this group, but is more severe and nearly always involves the cockpit and cabin. Inflight breakup occurs less often and no inflight fires occurred. Cabin, cockpit, and nose damage is about the same--aft fuselage damage is slightly less severe. Tail damage is also reduced somewhat, as is engine and propeller damage.

This group makes up 25% of the BASIC file, and in general is quite similar to it. A slight reduction in the number of aircraft within 30° of normal attitude is noted, shifting into the Code 2 group. The same percentage are inverted.

3.4 CABIN CLASS, SINGLE ENGINE (TYPE CODE C)

This set makes up 53% of the BASIC file and is described in Tables 7.5. The percentage of U.S. cases is the same as for the BASIC group. Inflight breakup and ground fire occurs nearly as often--fire damage is about the same except for a slight reduction in tail fires. Final attitude data is also similar. Overall, no significant difference is noted.

TABLE 3.1.3

TEMPERATURE COMPARISONS

Data Set	Temperature Reported at Time of Accident in °C								
	-30 or less	-29 to -20	-19 to -10	-9 to 0	1 to 10	11 to 20	21 to 30	31 or more	No Data
BASIC	3	7	20	67	143	234	207	32	203
BASIC Fatal	3	4	11	41	86	159	140	24	161
BASIC U.S. Fatal	2	0	3	22	55	120	119	24	124
BASIC Can. Fatal	1	4	8	19	31	39	21	0	37
BASIC ELT Installed, Armed, Activated	0	3	6	29	41	54	34	5	51
BASIC, Fatal With Survivors	0	1	2	13	26	31	31	8	24
IN % OF REPORTED CASES									
BASIC	0	1	3	9	20	33	29	4	
BASIC Fatal	1	1	2	9	18	34	30	5	
BASIC U.S. Fatal	1	0	1	6	16	35	34	7	
BASIC Can. Fatal	1	3	7	15	25	32	17	0	
BASIC ELT Installed, Armed, Activated	0	2	3	17	24	31	20	3	
BASIC, Fatal With Survivors	0	1	2	11	21	25	34	7	

3.5 UNPRESSURIZED TWINS (TYPE CODE E)

Tables 7.6 cover these 83 cases. Inflight breakup and ground fire are up, as are the percentage of inflight fires. Fire damage increases in the wings and reduces in the cockpit/cabin area, as would be expected. Fire in the tail is also reduced.

Cockpit, cabin, and nose damage is slightly more severe, and aft fuselage and tail damage is considerably more severe. Wing damage increases markedly, with 80% being crushed or separated into pieces.

3.6 PRESSURIZED TWINS (TYPE CODE F)

Table 7.7A indicates that the 19 cases of this type experienced a 16% inflight breakup and 53% ground fire involvement. Inflight fire occurred in 4 cases (21%). This type aircraft is characterized by a much stronger fuselage to accept pressurization loads. However, accident damage was much more severe in all parts of the aircraft. The aft fuselage survived in basically the original shape in only 23% of the cases, and the vertical tail in only 39%. Engine and propeller damage is also more severe.

Final rest attitude is not significantly different, with somewhat less in the intermediate position, and a wider range of percentage between parts in the inverted condition.

3.7 COMMUTER-TYPE AIRCRAFT (TYPE CODE G AND H)

Sample size was very small here, with only seven cases shown in Table 7.8A. In general, these were severe accidents, but the numbers are too small to draw any meaningful conclusions.

3.8 UNUSUAL AIRCRAFT (TYPE CODE J)

The 64 cases in this group are summarized in Tables 7.9. These aircraft include agricultural types, centerline thrust twins, and any other aircraft that did not fit the other groups.

Ground fire occurred more often than average, but no inflight fires occurred. Inflight breakup was the same as BASIC. Fire damage is somewhat less severe, as is breakup of the aircraft. Deformation is generally less severe, and attitude is less likely to be Code 2, but nearly the same percentage inverted.

Prop #2 damage is less, but 6 of the 7 twins are Cessna 337 with front and rear engines.

3.9 LANDING GEAR

Tables 7.39 and 7.40 compare single-engine, fixed-gear aircraft by tricycle and tail wheel configuration. The tail wheel aircraft burn more often and turn inverted less often, but other damage data is very similar.

3.10 WING LOCATION

Tables 7.41 and 7.42 compare high-wing and low-wing aircraft in type Code C (single-engine cabin class) aircraft. High-wing type end up inverted more often, have considerably fewer inflight breakups, and slightly more fires than the low-wing types. The wings come off the high-wing aircraft a little more often, but basically the damage is similar.

4.0 ELT DATA

4.1 GENERAL ELT DATA IN THE BASIC FILE

4.1.1 Installation and Arming

Table 7.2B contains the ELT data for the BASIC data set. In these 916 accidents, an ELT was recorded as installed in 65%, and as not installed in 14%. ELT data was not available in 21% of the files examined. When ELT installation data was reported, the ELT was installed in 82% of the cases.

Of the 593 installed ELT units, 53% were recorded as armed, and 8% as not armed. This gives a reported ratio of 87% armed when data was available. While the number not armed would seem high and hard to understand, it should be remembered that it is generally recorded by an investigator who arrives on the scene long after the police, search, or fire teams do. It is possible that the position of the switch observed by the investigator is different from that at impact due to attempts to turn the ELT off after search completion, tampering by observers or an attempt to turn everything off to secure the wreckage. This subject is explored further in analysis of the SAR set (section 5.2).

4.1.2 ELT Usefulness

Activation is recorded as occurring in 38% of the installed ELT units, and no activation in 25%. The activation ratio is defined as

$$\frac{\text{ELT Activated Yes}}{\text{ELT Activated (Yes + No)}}$$

In the BASIC set, this figure is 60%.

The ELT Destruction Ratio is defined as:

$$\frac{\text{ELT Destroyed/Damaged By Impact}}{\text{ELT Installed}}$$

For the BASIC group, this is 23%. Some of this data is summarized in Table 4.1.1.

4.1.3 ELT Activation Versus Destruction

Table 7.22B covers the 223 cases of ELT activation, and Table 7.23B covers the 135 cases where the ELT was destroyed by impact. Note the overlap of 11 cases where the ELT activated, but was destroyed or damaged.

The activated units were reported as aiding in 82 searches in this subset. However, comparison of the search required group (Table 7.46) shows 13 cases were reported as aiding in a search when no search was required. (see section 5.2) Seven percent of the units were reported to be in the cabin and cockpit, and this represents 20% of all reported locations. Location data was rarely reported.

In the "ELT destroyed" group, search was required in 31% of the cases and not required in 61% of the cases. The ELT was again reported to be in the cockpit/cabin in 7% of the total cases, and in the aft fuselage in 12%.

The damage tables for ELT activated and ELT destroyed are Tables 7.22A and 7.23A and is summarized in Figures 4.1.1 and 4.1.2. The damage is somewhat less severe for the ELT activated set than the whole BASIC set. In particular, the cabin, cockpit, and aft fuselage area is in slightly better shape overall. Fire occurred in only 13% of these cases, and inflight breakup in only 2%. The distribution of fire damage is similar. Final resting attitude is nearly the same.

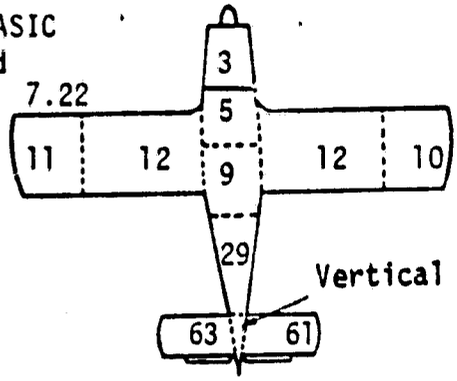
However, in the ELT destroyed set, fire occurred in 56% of these cases, and the tail of the aircraft was more often involved. Damage overall is much more severe, with only 4% of the cockpit and cabin areas in near normal shape, and only 18% of the aft fuselages less than crushed. These aircraft were inverted only half as often as the average, 11% had inflight breakup, almost 100% prop bending, and more severe landing gear damage. The portion of the aircraft with smallest percentage of "destroyed/pieces separated" was the vertical tail, and it was coded this way 31% of the time.

4.1.4 U.S. Versus Canada

In reviewing the ELT data in fatal accidents only, Tables 7.15B and 7.16B for U.S. and Canada, and Table 7.14B for the BASIC group, a much greater percentage of U.S. accidents had the ELT recorded as installed, but both had the same percentage of "not installed" responses. Over half of the Canadian units were reported as activated, while less than one-third of the U.S. units were so reported. However, the activation ratios were 66% for Canada and 57% for the U.S. Forty percent of the activated units aided in the search, with initial alerting being most significant in Canada and final homing more important in the U.S.

SECTION DAMAGE

DATA SET: BASIC
ELT Activated
Ref: Table 7.22

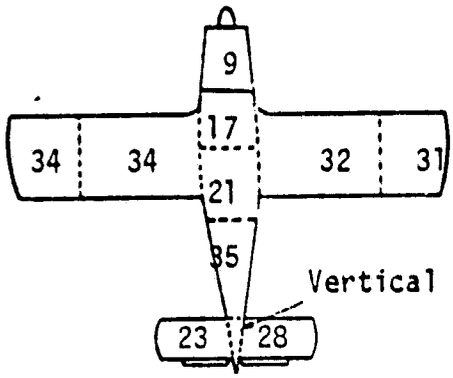


Main Gear 26

Nose or Tail Gear 36

Vertical Tail 62

% of aircraft where section indicated was basically undamaged (Code 1)

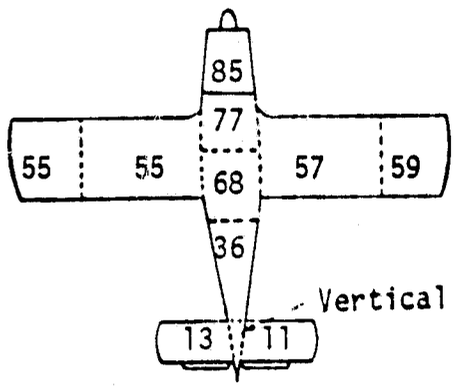


Main Gear 19

Nose or Tail Gear 15

Vertical Tail 27

% of aircraft where section was dented or torn (Code 2)



Main Gear 44

Nose or Tail Gear 46

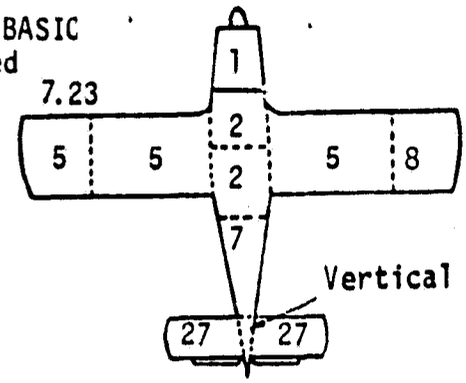
Vertical Tail 12

% of aircraft where section was at least crushed (includes destroyed)(Codes 3 & 4)

FIGURE 4.1.1

SECTION DAMAGE

DATA SET: BASIC
ELT Destroyed
Ref: Table 7.23

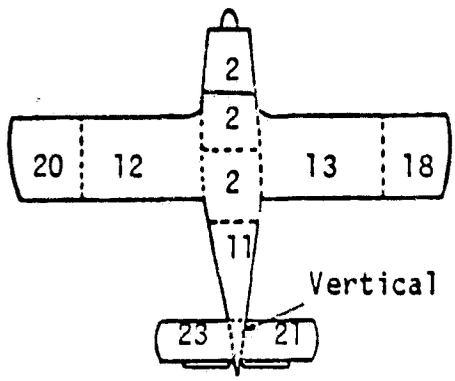


Main Gear 11

Nose or Tail Gear 11

Vertical Tail 30

% of aircraft where section indicated was basically undamaged (Code 1)

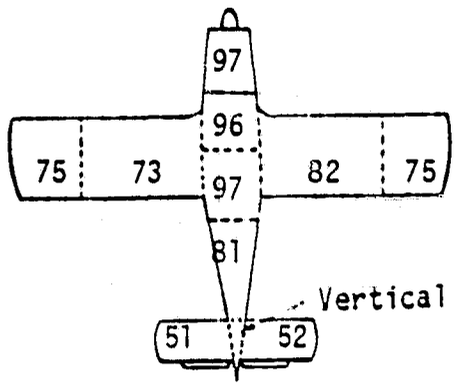


Main Gear 5

Nose or Tail Gear 6

Vertical Tail 22

% of aircraft where section was dented or torn (Code 2)



Main Gear 78

Nose or Tail Gear 82

Vertical Tail 49

% of aircraft where section was at least crushed (includes destroyed)(Codes 3 & 4)

FIGURE 4.1.2

Over one-half of the Canadian cases required a search, while only 26% of the U.S. cases indicated this need.

In both groups, about one-quarter of all ELT units were destroyed or damaged by impact. About 4% of the Canadian units and 8% of the U.S. units came out of their mounts.

A similar comparison can be made of the fatal with survivors accidents and the serious group, and the results are summarized in Table 4.1.1.

TABLE 4.1.1

ELT DATA IN THE BASIC FILE

		BASIC	BASIC FATAL	BASIC FATAL WITH SURVIVORS	BASIC SERIOUS
1.	Cases in File	916	629	146	141
2.	ELT Installed	593	441	106	46
3.	% Installed $\frac{2}{1}$	65	70	73	33
4.	ELT Not Installed	128	105	12	11
5.	% Not Installed $\frac{4}{1}$	14	17	8	8
6.	Installation Ratio $\frac{2}{2+4}$	82	81	90	81
7.	Activation Yes	223	145	48	30
8.	Activation No	149	114	26	9
9.	Activation Ratio $\frac{7}{7+8}$	60	56	65	77
10.	Number Destroyed	135	122	10	3
11.	Destruction Ratio $\frac{10}{2}$	23	28	9	7
12.	Number Out of Mount	38	32	4	2
13.	% Reported Out of Mount $\frac{12}{2}$ *	6	7	4	4
14.	No. Antenna Disc. Cable	57	47	9	1
15.	% Antenna Disc Cable $\frac{14}{2}$ *	10	11	8	2
16.	Number Armed	316	215	63	38
17.	Number Not Armed	48	40	6	2
18.	% Armed $\frac{16}{16+17}$	87	84	91	95

* Row 13 and 15 are considered lower limits of this statistic since an out of mount condition or cable disconnect condition is more likely to be reported than the normal condition.

4.1.5 Compliance With Regulations Regarding ELT Use

An attempt was made in each case studied to determine whether an ELT was required to be installed for the accident flight, based on the national regulations in force at the time of the accident. This status was determined in 77% of the BASIC file.

Table 4.1.2 shows that there was a substantial non-compliance with the ELT regulations, in that 8% of those aircraft in the BASIC group that required ELT installations did not have them. In those BASIC cases where the requirement was determined, 19% of the aircraft were not required to have ELTs, but over one-third of these aircraft did have ELT units installed.

TABLE 4.1.2

COMPLIANCE WITH REGULATIONS REGARDING ELT USE

	ELT Required		ELT Not Required	
	ELT Installed	Not Installed	ELT Installed	Not Installed
ALL	670	44	92	83
BASIC	529	44	50	81

Within the BASIC group where ELT installation status was established, 82% had an ELT installed. This is consistent with the BASIC search data (Table 7.46B) where 80% of the accidents requiring a search had an ELT installed, 14% did not, and 6% were unreported.

4.2 ELT DATA BY MAKE AND MODEL IN THE BASIC FILE

4.2.1 The ELT manufacturer was identified in 221 cases of the BASIC group. Only five manufacturers were identified more than 10 times and together these accounted for 192 (87%) entries.

> NOTE
>
> These five groupings are reviewed in this section, but the sample size is small, so caution must be used in extrapolating this data to the total general aviation population.

Within each grouping are all types of ELTs produced by the stated manufacturer, regardless of their different characteristics, switches, mountings, etc.

4.2.2 Sharc 7

Tables 7.31A and 7.31B cover the 66 cases with the Sharc 7 ELT. This unit was often provided with a Velcro attachment kit, is made of a plastic material, has provisions for an external antenna, either attached or remote.

The data indicates it is most often installed in the aft fuselage; it activated in about half the cases where this data was obtained, and was destroyed in about 22% of the cases. It was more common in Canada (59%) than in the U.S.

4.2.3 Narco ELT-10

This unit appeared 43 times, as shown in Tables 7.32A and 7.32B. It is normally provided with a metal mount plate, with the ELT held to the mount by a metal strap. It is mounted with its long axis longitudinal and is provided with an antenna connector for external or portable antenna.

The data indicates it is most often installed in the aft fuselage; it activated in 62% of the cases where data was obtained, and it was destroyed in about 19% of the cases.

4.2.4 Garrett Manufacturing, Ltd.

This unit has had several variations, including one designed for installation in the vertical fin. The data is inadequate to break down this listing by individual model. Tables 7.33A and 7.33B provide the data on 49 cases with these ELTs. They are most often installed in the aft fuselage, and are much more common in Canadian cases.

Over 60% of the installed units were recorded as activating, with an activation ratio of 79%, and 20% were destroyed on impact.

4.2.5 Pointer

Several versions of the Pointer unit have been produced by Aero Electronics Corporation and its successors. The early Pointer II was a 2" diameter tube with integral antenna designed to be mounted just inside the skin of the aircraft. The later units are rectangular and have an antenna connector for external or portable antennas. No discrimination between units is possible with this data.

Three-quarters of these cases are Canadian, and while half the units are reported to have activated, only 1 aided in the search by providing initial alert. No ready explanation of this low number is available in the data. Nineteen percent were destroyed and none were reported out of mount. Tables 7.34A and 7.34B cover these units.

4.2.6 Emergency Beacon Corporation

Several versions of the EBC unit are available, ranging from a small unit with external switching to a unit with voice capability. All are designed for cockpit mounting with integral whip antenna. All are claimed to withstand 1000 Gs.

Of the 18 cases reported, 11 activated for an activation ratio of 73%. It was most often used for final homing rather than alerting. It is the only unit of the five specifically designed to have its antenna inside the aircraft.

All the reported activations were automatic, and the 4 non-activations were all explained by damage and dead battery. Tables 7.35A and 7.35B provide the data.

4.2.7 Comparison Between the Five ELT Units

The ELT Comparison (Table 4.2.1) shows some of the differences between these five ELT manufacturers. As expressed earlier, caution must be used in interpreting these comparisons due to the small sample size.

The damage data is very similar in the cockpit and cabin areas for all five units. There were some differences in fire and aft fuselage data.

4.2.8 ELT Comparison in the ALL File

These same five ELT manufacturers were the only ones to have more than 10 units in the ALL file, and they accounted for 334 of the 373 cases where the manufacturer was known. Tables 7.24 through 7.30 contain data on these units.

Since case selection beyond the BASIC file was not random with respect to ELT data, but in fact was based on the presence of ELT data and is mostly Canadian, no comparisons can be made between units from this data.

Tables 7.24 and 7.25 were prepared, covering these five ELT manufacturers, but dividing on the basis of the U.S. and Canadian data. Canadian data constituted 69% of these files since they are from the ALL set and that set includes all Canadian cases with ELT data for three years.

The U.S. data has more fire, more inflight breakup, generally more severe damage, more ELT units destroyed, and a 5% greater number of search pertinent responses. All battery date data is in the U.S. file. Most ELT location data is from the Canadian files. Final homing is much more important in the U.S., possibly indicating greater use of D.F. equipment by the U.S. search community. Initial alerting occurs more often in Canada, possibly indicating better coverage by ground or airborne receivers, or less alerting by other means. Further study of the search data would be required to determine these issues.

4.3 ELT DATA BY AIRCRAFT TYPE CODE

4.3.1 Very Light/Home Built Aircraft (Type Code A)

The data in Table 7.3B is very sparse, with only 5 installed ELT units in the 33 cases (15%). Only 10 of these accidents had a requirement for ELT since a major exception to the rule is that home built and local training aircraft do not need ELT units. Three searches were required, and the ELT only aided in one. Search data was not obtained in half of the cases.

Both ELTs that did not activate were destroyed in the crash.

TABLE 4.2.1

ELT COMPARISON IN BASIC GROUP

		Sharc	Garrett	Narco	EBC	Pointer
1.	# of Units Installed	65	49	42	18	16
2.	# of Cases in U.S.	27	11	21	17	4
3.	% U.S. (2/1)	41	22	49	94	25
4.	# Activated	25	30	21	11	8
5.	# Not Activated	24	8	13	4	4
6.	Activation Ratio $\left(\frac{4}{4+5}\right)$	51	79	62	73	67
7.	# Destroyed	14	10	8	3	3
8.	% Destroyed (7/1)	22	20	19	17	19
9.	# Out of Mount	7	5	6	2	0
10.	# Aid in Search	7	12	9	6	1
11.	Initial Alerting	5	9	8	1	1
12.	Searches Required	33	29	27	9	9
13.	% Cockpit Severe Damage (Codes 3, 4, 5)	75	83	84	88	72
14.	% Cabin Severe Damage	78	71	78	75	75
15.	% Aft Fuselage Severe Damage	35	51	54	33	42
16.	% Ground Fire	20	16	14	11	0

4.3.2 Light Utility/Trainer Aircraft (Type Code B)

The data in Table 7.4B is similar to the BASIC file. An ELT was required in 70% of these cases, and was installed in 58%, slightly less than the BASIC set. Forty-two percent of these units activated and 16% were destroyed, for an activation ratio of 64%, slightly better than BASIC.

4.3.3 Cabin Class, Single Engine (Type Code C)

The ELT data in Table 7.5B is nearly the same as the BASIC group, just as the almost identical damage data. A total of 74% had an ELT installed, and only 7% were reported as not installed. About the same ratio were armed and not armed, and about the same ratio activated and did not activate. A search was required in 38% of these cases--up 8% from BASIC. The same 23% were destroyed.

4.3.4 Unpressurized Twins (Type Code E)

Table 7.6B indicates that these aircraft have an ELT installed more often than the whole BASIC group, but they activate slightly less often. The activation ratio is 53%. A search is required in 29% of the cases, which is almost the same as the BASIC group.

The ELT was destroyed in 25% of the cases where it was installed.

4.3.5 Pressurized Twins (Type Code F)

The much more severe accidents to this type aircraft took their toll on the ELT, as almost half of the installed units were destroyed. Only 25% of the installed units activated with an activation ratio of 33%. Table 7.7B summarizes this data.

This group did have a high ratio of installed units, at 84%, with no negative replies.

4.3.6 Commuter Type (Type Code G or H)

See Table 7.8B for these aircraft. Six of the seven aircraft were reported to have an ELT installed, and half of them were destroyed. Of the 3 which activated, one aided in search and one was underwater.

4.3.7 Unusual Aircraft (Type Code J)

Table 7.9B shows a very low ratio of installed units, with only 27% installed and 55% not installed. Only 36% were required to have an ELT, since agricultural use is exempted. However, six searches were required. The one ELT that activated when a search was needed did its job. Twenty-nine percent of the installed units were destroyed.

4.3.8 Landing Gear

In comparing the single-engine fixed-gear aircraft, the tail wheel types have an ELT installed less often, activate less often, and is destroyed more often than the tricycle aircraft. The ELT aided in search almost 3 times as often in the tri-gear types. See Tables 7.39 and 7.40.

4.3.9 Wing Location

Comparison of low-wing and high-wing aircraft (Tables 7.41 and 7.42) shows only minor differences in ELT data. ELT destruction is identical, the activation ratio is 66% for low wing and 58% for high wing.

4.4 ELT COMPARISON BY INJURY LEVELS IN THE ALL FILES

Refer to Tables 7.10 through 7.13.

At the fatal injury level, an ELT was reported installed in 72% and not installed in 15% of the cases. The ELT was armed in 53% and not armed in 8% of the installed units. The ELT activated in 38% of the cases where it was installed and did not activate in 23% of the cases, with an activation ratio of 62%. The ELT was destroyed/damaged by impact in 25% of the cases where it was known to be installed. At least 7% of the ELT units came out of their mounts and at least 10% of the antennas were disconnected. Batteries had expired in at least 4% of the cases. A search was required in 38% of the fatal group, or in 42% of the cases where search information was determined. The ELT aided in 38% of the searches, most often in final homing, but also in initial alerting. Ten cases involved the ELT being underwater.

When the injury index was fatal with survivors, few changes are noted. The percent installed rises to 75 and the activation ratio to 69. The number destroyed drops to 8%, which is substantially lower.

When the injury level was serious, ELT installation was recorded as 36% yes and 8% no. Eighty-three percent of the installed units were armed and 4% were not. The ELT activated in 70% of the cases where it was installed, and did not activate in 17% of those cases, with an activation ratio of 80%. It aided in about one-half of the searches that were required.

The criteria for inclusion of minor/none injury cases was the presence of ELT data in the file, or successful ELT search. Sixty-six percent of the installed ELT units were reported as armed and 48% of the installed units activated, while 36% did not. This results in an activation ratio of only 57%. Most of the non-activated were recorded as insufficient force to activate. Two units were recorded as destroyed by impact, one was underwater, and the other was burned. The ELT aided in about half of the searches, with initial alerting and final homing both important.

Table 4.4.1 summarizes some of the ELT data from these comparisons.

TABLE 4.4.1
ELT DATA BY INJURY IN ALL FILE
(1135 Cases)

		Fatal	Fatal With Surv.	Serious	Minor/None
1.	# Cases	679	159	149	148
2.	# ELT Installed	491	119	53	144
3.	% ELT Installed $\frac{2}{1}$	72	75	36	97
4.	# Activated	188	59	37	69
5.	# Not Activated	114	27	9	52
6.	Activation Ratio $\frac{4}{4+5}$	62	69	80	57
7.	# Aid in Search	98	24	18	27
8.	# Searches Required	255	47	34	49
9.	# Destroyed	125	10	3	2
10.	% Destroyed $\frac{9}{2}$	25	8	6	1

5.0 SPECIAL AREAS OF STUDY

5.1 COMPARISON OF THE ALL AND BASIC FILES

The study effort is focused on the BASIC file group since this contains the most nearly random set of cases, and focuses on the most severe accidents. The balance of the cases in the ALL file (219 cases or 19% of the total) are there specifically because of their ELT content. Therefore, the ALL file is used for study of ELT information, and study of the less severe accidents. In no sense is the ALL file to be assumed to be statistically representative of the total U.S. and Canadian general aviation fleet, but it does contain nearly all the ELT data obtainable from the official accident reports in the general study group (see Table 1.3.1).

Referring to Table 7.1 for the ALL set and Table 7.2 for the BASIC set, it is seen that nearly all the fires occurring in the ALL group are part of the BASIC set (206 of 211), as are most of the inflight breakups (57 or 60). The percentage of U.S. and Canadian cases shifts only slightly, 63% of BASIC and 59% of ALL files are U.S. data. However, nearly all the low injury cases are Canadian.

The Location and Deformation Tables reflect the different makeup of the file sets, but the final attitude data is almost identical in both groups. About 1/2 of all aircraft, whether intact or broken up, remain within 30° of upright, and about 1/3 end up inverted.

Over 93% of all propellers are bent in the accident sequence, somewhat more in the more severe BASIC set.

The ELT data is considerably different for these two sets of data. This is expected due to the fact that the criteria for additional data beyond the BASIC set was the existence of ELT data or relevance in the case.

In the ALL file, 71% of the cases had an ELT installed, and 12% reported no ELT installed. Almost all the "no ELT" are in the BASIC set. Of the 807 reported ELTs, 58% were reported armed and 7% not armed. This is a ratio of 90% armed of all cases with an entry in this box. Of the 807 installed ELTs, 44% are reported to have activated and 25% to have not activated, or an activation ratio of 64%. This ratio drops to 60% in the BASIC file.

Of the 354 activated ELTs, 47% aided in the search, but this data is biased by the nature of the data collection plan. In the BASIC file, only 37% of the activated ELTs (14% of the total installed) aided in the search.

Of the ELT problems noted in the ALL file, ELT destroyed/damaged by impact was the most significant, with 17% of all installed ELTs suffering this fate. This becomes 23% in the BASIC set. Antenna cable disconnect occurs twice as often as antenna damage in both groups, with most of this data coming from the BASIC group.

Expired batteries were noted in 34% of the cases where battery data was reported, but some bias could be expected to occur since an expired battery is more likely to be reported than a good one. Five percent of all installed ELTs in the BASIC group recorded expired batteries, and seven percent of the ELTs that did not activate were reported to have had dead batteries.

Final homing and initial alerting were the most common reports of ELT usefulness, with voice communications being recorded in only 2 cases. Searches were required in about 40% of cases where search data was obtained, but again this could be biased in that a search is more likely to be recorded compared to a non-search.

In cases where the temperature was reported, 16% of ALL accidents occurred below 0°C, while only 13% of the BASIC cases were in that range. (See Tables 5.1.1 and 3.1.3 for temperature data). Overall, there is little difference in temperature distribution between ALL and BASIC sets, except that in the BASIC set, a fatal accident is 3 times more likely to be below zero in Canada than in the U.S. Twenty-six percent of the Canadian fatal accidents in the BASIC set were below freezing.

Tables were prepared for the ALL file showing injury indexes of Fatal, Fatal With Survivors, Serious and Minor/None (Tables 7.10 through 7.13). Due to the case selection criteria, these cases are not a random set of data, but are biased by the presence of ELT data in the file. The two fatal groups are 76% U.S. data, while the serious accidents are only 5% U.S., and the minor/none are 17% U.S. data.

TABLE 5.1.1

TEMPERATURE COMPARISONS

Temperature Reported at Time of Accident in °C

Data Set	-30 or less	-29 to -20	-19 to -10	-9 to 0	1 to 10	11 to 20	21 to 30	31 or more	No Data
ALL	3	14	35	90	182	294	232	34	251
ALL Fatal	3	4	12	47	100	169	147	25	172
ALL Fatal With Survivors	0	2	3	13	30	33	42	8	28
ALL Serious	0	2	7	16	32	45	26	0	21
ALL Minor/None	0	6	13	14	20	47	17	1	30
ALL Search Required	2	7	11	43	86	81	48	3	104
ALL ELT Activated	0	6	13	48	69	84	47	6	78
IN % OF REPORTED CASES									
ALL	0	2	4	10	21	33	26	4	
ALL Fatal	1	1	2	9	20	33	29	5	
ALL Fatal With Survivors	0	2	2	10	23	25	32	6	
ALL Serious	0	2	5	13	25	35	20	0	
ALL Minor/None	0	5	11	12	17	40	14	1	
ALL Search Required	1	2	4	15	31	29	17	1	
ALL ELT Activated	0	2	5	18	25	31	17	2	

As would be expected, location and damage codes reflect significant differences in these tables. The Minor/None table shows the cockpit-cabin remains together and in near normal shape in all but a few cases. The high figure for the landing gear damage represents the criteria for being called an accident in the greatest percentage of these cases. Inflight fire occurred once, a gear motor with no subsequent damage, and ground fire occurred once consuming the entire aircraft. Over one-third of these aircraft ended up inverted, and the prop was bent in 83% of these accidents.

When the most severe injury was serious, cabin damage and cockpit damage increases somewhat, with 12% of the passenger cabins broken up and 14% of the cockpit areas destroyed. A higher percentage of these aircraft wind up inverted (also true of Canadian fatal accidents). Prop, engine, and gear damage are more severe, but the empennage is still in near normal shape in 90% of these accidents. Ground fire is involved in 9% of the serious cases, with cockpit and cabin most often involved. Less than one-third of the fires involve the vertical tail and 23% involve the horizontal tail areas.

When there are both fatalities and survivors, ground fire involvement is up to 16%, cockpit and cabin destruction is around 20%, but the tail section is still in one piece in about 93% of the cases.

In the fatal group, ground fire is involved in 25% of all cases, with 5% of those also having an inflight fire. Fire damage involves the passenger and crew areas in over 80% of these fires, the wings about 70% of the time, and the empennage about 40% of the time. The cockpit remained in near normal shape in only 8% of these cases, and the cabin in only 12%. However, even in these accidents, the empennage was in near normal shape in 70% of the cases, and the aft fuselage in 43%. Only half of these aircraft remained upright. Prop bending occurred in 97% of the cases.

5.2 SEARCH AND RESCUE DATA

Table 5.2.1 is a summary of the search statistics from the ALL, BASIC, SAR, and other subset files. For the accident files with search data "Search Required" ranged from 27% for U.S. fatal accidents to 81% for the Canadian fatal accidents. Since only 67% of the Canadian fatal cases had search data, it may be possible that the negative answer was less likely to be recorded, and the true figure is closer to the 54% (87/160) actually recorded. In any event, the ELT can be seen to be a necessary tool for the search and rescue community, especially in Canada. Temperature data, Table 3.1.3, also confirms that severe cold temperatures are more likely in Canada, complicating the rescue task and requiring that it be accomplished more quickly.

It is interesting to note the figures for the SAR set, Table 7.47, which were specifically identified as ELT search success cases by the U.S. Air Force. The NTSB record indicated a search was not required in 8% of these cases. It also indicated that the ELT did not aid in 20 cases (17%), in direct contradiction to the Rescue Coordination Center reports.

TABLE 5.2.1

SEARCH REQUIREMENTS

	ALL	BASIC	BASIC U.S. Fatal	BASIC Can. Fatal	BASIC Can. Ser.	SAR
1. Cases in File	1135	916	469	160	141	118
2. Search Required	385	272	122	87	27	106
3. Search Not Required	525	450	323	20	21	10
4. % Search Data Available $\frac{2 + 3}{1}$	80	79	95	67	34	98
5. % Search Required in Total File $\frac{2}{1}$	34	30	26	54	19	90
6. % Search Required if Search Data Available $\frac{2}{2 + 3}$	42	38	27	81	56	91

In the set of Search Required data, Tables 7.45 and 7.46, the ELT is recorded as installed more often, and as activating more often than in the whole comparable set. This may be due to a tendency to report ELT data more often in cases where a search was also reported. In this BASIC group, the activation ratio is only 67%, comparable to the whole BASIC group's 60%. The ELT was recorded destroyed in 19% of these cases, compared to 23% of the BASIC set. Ground fire only occurred in 14% of the cases. If it had occurred at the BASIC average of 22%, there would have been 21 more fires, and probably would have resulted in a similar ELT destruction rate. It is also possible that a burning aircraft is less likely to require a search.

Seven percent of these cases were recorded as "wreckage not recovered-water". This compares to five percent in the BASIC set. A search is more likely if the aircraft is underwater, and the ELT is almost useless. In one case, the ELT signal was detected by a helicopter while hovering over an oil slick.

Note that the BASIC set has 13 more cases of ELT aid in search for the same number of search required. This is due to the accepting and recording of a statement that ELT aided in search (as recorded in the accident files), even when the balance of the file indicated that a search was not necessary.

Discussion with search and rescue (SAR) personnel indicates that it is normal to shut off an ELT after a successful search, most often with the switch on the unit, but sometimes by disconnecting or breaking the antenna. The accident investigator does not leave his office until the aircraft is found and so may not even meet or talk to search personnel. He may not obtain accurate data on search or ELT use.

The data tends to confirm these ideas, since the disagreement in the SAR file is substantial.

Additional search parameters were obtained as shown on the data collection form, and some are listed in Table 5.2.2 for the BASIC and SAR groups.

Additional search data is available in the CRISIS data base, but is not applicable to this study.

TABLE 5.2.2

METHODS AND TIME DATA FOR SEARCHES

		BASIC		SAR	
Method of Search -	Ground	35		8	
	Air	108		48	
	Boat	11		0	
	Air & Boat	8		0	
	Ground & Air	23		15	
	All Modes	6		0	
Aids in Detection -	LF Radio	0		0	
	Automatic CPI VHF/UHF Homing	42		68	
	Visual Mirror	0		0	
	Visual Smoke	7		0	
	Visual Wreckage	115		5	
	Visual Pyro	1		0	
	Visual Other	13		0	
Time from Accident to Notification		#	%	#	%
	0 - 2 Hours	111	59	51	67
	3 - 6 Hours	31	16	11	14
	7 - 24 Hours	23	12	10	13
Time from Accident to Search Success					
	0 - 2 Hours	47	22	15	16
	3 - 6 Hours	28	13	7	8
	7 - 24 Hours	58	28	35	38
	Greater than 24 Hrs.	77	37	34	37

5.3 GROUND CONTACT AND FINAL REST DATA

Page 3 of the data collection form provided a pictorial example for coding the aircraft attitude in pitch, roll, and yaw at ground contact and final rest. This is difficult to determine, and experienced investigators will often disagree on the meaning of specific evidence. However, the Canadian form provides for this data, and it was established for the U.S. data, whenever possible, by the researcher from narrative, witness, or photographic evidence.

Since it relates to "whole body" position, it is more accurate for ground contact, and less representative for final rest since the aircraft may be broken into many pieces.

Only 50% of the BASIC file had ground contact data, and 59% had final rest data. Tables 5.3.1 and 5.3.2 present the combined roll and pitch attitude at ground contact and final rest for the BASIC and ALL files, respectively. These tables show that the data clusters around normal flight attitudes of wings nearly level and nose level or down. Nose-high attitudes are rare, as are banks in excess of 30°. Ground contact inverted is rare, but final rest inverted is quite common.

Table 5.3.3 is an attempt to indicate the impact dynamics by showing the relationship between ground contact and final rest in individual cases. Figure 5.3.1 shows the boundaries of the groupings used, and then the first part of Table 5.3.3 shows how many accidents were in each group. For example, the total number of accidents in Table 5.3.1 with ground contact roll attitudes of G or H or I and pitch attitudes of D or E or F (Group 1) is 156.

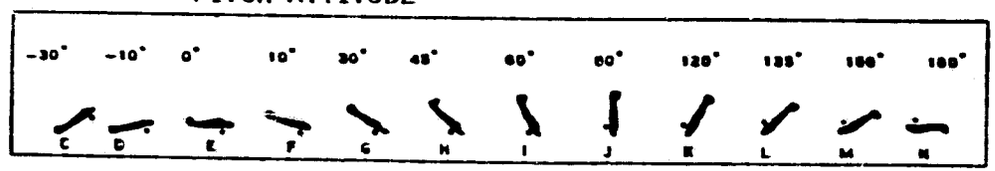
This summation continues for all the groups shown. Table 5.3.3 then provides a cross tabulation showing how many of the accidents in a particular ground contact group ended up in a particular final rest group.

For example, 156 aircraft hit the ground with 30° of less of roll and 0 to 30° nose-down pitch. However, 243 aircraft ended up in this position, including 72 from the first group. Of the 156 aircraft in group 1, 25 ended up nearly inverted, and the rest were distributed in many other attitudes.

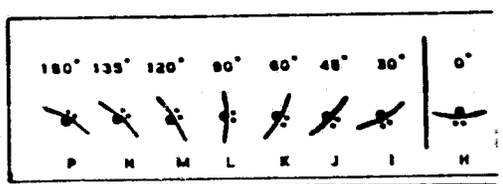
TABLE 5.3.1

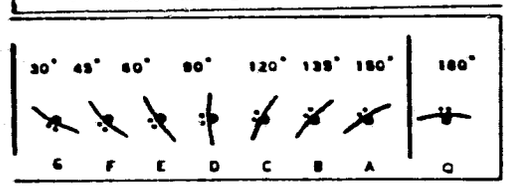
BASIC SET
916 Cases

PITCH ATTITUDE



ROLL ATTITUDE





GROUND CONTACT

	Z	C	D	E	F	G	H	I	J	K	L	M	N
Z	448	0	0	0	1	0	2	1	3	1	1	0	0
A	0	0	0	0	1	0	0	1	0	0	1	0	0
B	0	0	0	0	1	0	0	1	0	0	1	0	0
C	0	0	0	0	1	0	2	1	0	0	0	0	0
D	0	0	0	0	1	0	3	1	0	0	0	0	0
E	1	0	0	2	1	0	6	1	1	0	0	0	0
F	0	0	1	3	1	0	5	1	1	0	0	0	0
G	1	1	1	9	1	0	9	1	2	1	0	0	0
H	2	4	16	53	3	1	22	5	9	2	0	0	0
I	0	0	1	7	1	1	8	1	2	0	0	0	0
J	0	0	0	2	1	0	5	1	1	0	0	0	0
K	0	0	0	2	1	0	5	1	0	0	0	0	0
L	0	0	0	1	1	0	0	1	0	0	0	0	0
M	0	0	0	0	1	0	0	1	0	0	0	0	0
N	0	0	0	0	1	0	0	1	0	0	0	0	0
P	0	0	0	0	1	0	0	1	0	0	0	0	0
Q	1	0	0	2	1	1	1	1	2	2	1	5	4

FINAL REST

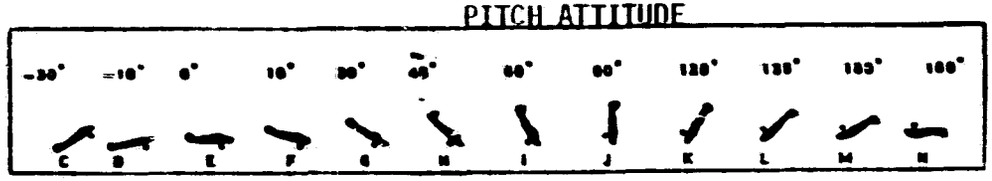
	Z	C	D	E	F	G	H	I	J	K	L	M	N
Z	370	0	0	0	0	1	1	1	1	0	0	0	1
A	0	0	0	2	1	0	0	1	0	0	0	0	0
B	0	0	0	1	1	0	0	1	0	0	0	0	0
C	0	0	0	0	1	0	0	1	0	0	0	0	0
D	0	0	0	1	1	0	2	1	0	0	0	0	0
E	0	0	1	2	1	0	1	1	0	0	0	0	0
F	0	0	0	0	1	0	3	1	0	0	0	0	0
G	0	0	0	2	1	0	2	1	0	0	0	0	0
H	0	0	0	9	1	0	2	1	0	0	0	0	0
I	6	1	8	181	21	15	17	11	25	5	1	0	0
J	1	0	5	7	4	2	3	1	1	0	0	0	0
K	0	0	0	4	1	0	1	1	0	0	0	0	0
L	0	0	0	6	1	0	0	1	0	0	0	0	0
M	0	0	0	3	1	0	0	1	0	0	0	0	0
N	0	0	0	1	1	0	0	1	0	0	0	0	0
P	0	0	0	0	1	0	0	1	0	0	0	0	0
Q	2	0	0	24	4	0	1	1	1	1	3	8	6

Z = Unknown

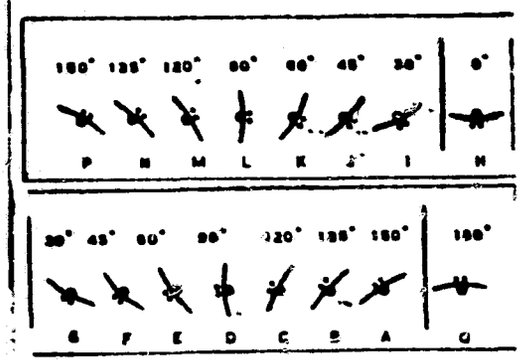
TABLE 5.3.2

ALL Set
1136 Cases

PITCH ATTITUDE



ROLL ATTITUDE



Z = Unknown

GROUND CONTACT

	Z	C	D	E	F	G	H	I	J	K	L	M	N
Z	498	0	0	1	1	0	2	0	3	1	0	0	0
A	0	0	0	0	0	1	0	0	0	0	1	0	0
B	0	0	0	0	0	1	0	0	0	0	0	0	0
C	0	0	0	0	1	0	2	0	0	0	0	0	0
D	1	0	0	2	1	3	3	0	1	0	0	0	0
E	0	1	0	2	0	6	5	0	1	0	0	0	0
F	1	1	4	12	26	7	10	2	2	1	0	0	0
G	16	5	45	124	43	22	24	4	40	2	0	0	0
H	0	0	6	11	21	19	8	0	2	0	0	0	0
I	0	0	1	2	8	6	7	0	2	0	0	0	0
J	0	0	0	2	4	3	1	0	1	0	0	0	0
K	0	0	0	1	2	2	0	0	0	0	0	0	0
L	0	0	0	0	0	0	0	0	0	1	0	0	0
M	0	0	0	0	1	0	0	0	0	1	0	2	0
N	0	0	0	0	0	0	0	0	0	0	0	0	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	1	0	0	2	1	1	1	0	3	2	1	5	7

FINAL REST

	Z	C	D	E	F	G	H	I	J	K	L	M	N
Z	424	0	0	0	1	1	1	1	2	0	0	0	3
A	0	0	1	2	1	0	0	0	0	0	0	3	4
B	0	0	0	1	1	0	0	0	0	0	0	1	0
C	0	0	0	1	1	0	0	0	0	0	0	0	0
D	0	0	1	12	4	1	2	1	1	0	0	0	0
E	0	0	0	0	5	1	1	0	1	0	0	0	0
F	0	1	0	2	9	2	3	1	1	0	0	0	0
G	1	6	14	29	29	8	3	1	0	0	0	1	0
H	1	7	19	222	29	23	20	14	28	5	2	0	0
I	0	1	7	12	9	5	4	1	1	0	0	0	0
J	0	0	0	4	0	2	1	0	1	0	0	0	0
K	0	0	0	6	1	1	0	0	0	0	0	0	0
L	0	0	2	4	1	0	0	1	0	0	0	0	0
M	0	0	0	3	1	0	1	0	0	1	0	0	1
N	0	0	0	1	0	0	0	0	0	0	0	2	0
P	0	0	0	0	0	0	0	0	0	0	0	1	0
Q	4	0	0	29	4	0	1	0	2	1	3	13	95

<table>
<tr><th rowspan="2">ROLL</th><th colspan="11">PITCH</th></tr>
<tr><th colspan="3">D E F
-10° 0° +10°</th><th colspan="2">G H
+30° +45°</th><th colspan="2">I J
+60° +90°</th><th colspan="4">K L M N
+120° +135° +150° +180°</th></tr>
<tr><td>G +30°
H 0°
I -30°</td><td colspan="3">Group 1

Group 6</td><td colspan="2">Group 2

Group 7</td><td colspan="2">Group 3

Group 8</td><td colspan="4">Group 9</td></tr>
<tr><td>D +90°
E +60°
F +45°
J -45°
K -60°
L -90°</td><td colspan="3">Group 4

Group 10</td><td colspan="2">Group 5

Group 11</td><td colspan="6"></td></tr>
<tr><td>A +150°
B +135°
C +120°
M -120°
N -135°
P -150°
Q ±180°</td><td colspan="7"></td><td colspan="4">Group 12</td></tr>
</table>

FIGURE 5.3.1

GROUP DEFINITION IN TERMS OF ROLL AND PITCH

TABLE 5.3.3

GROUND CONTACT KINEMATICS IN THE BASIC SET

Number of Accidents in Ground Contact Group

Group	Accidents
1	156
2	73
3	95
4	29
5	39

Groups are defined by Figure 5.3.1

Number of Accidents in Final Rest Group

Group	Accidents
6	243
7	47
8	47
9	15
10	38
11	12
12	85

Ground Contact and Final Rest Cross Tabulation

	6	7	8	9	10	11	12
1	72	6	1	3	7	4	25
2	27	19	5	0	1	0	6
3	25	3	26	4	0	0	4
4	6	1	0	1	6	0	3
5	7	1	1	0	4	1	3

5.4 CANADIAN IMPACT DATA

The Canadian aircraft accident investigation form has provisions for calculating the acceleration level experienced by the aircraft, based on impact velocity change, stopping distance, and other parameters. This form is reproduced on our data collection form at the top of page 4. This data was obtained from Canadian files whenever possible. It was never available in the U.S. files.

Thirty-three cases had an entry for the primary impact acceleration force. The values ranged from 0.96G to 258G. Twenty of these did not have ELT data.

In four cases, the ELT activated but did not aid for other reasons. The G levels were 2, 30, 71, and 129.

In one case, the ELT was reported as not activating because it was destroyed. The reported accident was 93G. Another case reported an internal malfunction after 26G.

In two cases, the ELT was reported as not activating because of insufficient force. One was .96G and the other was 29G.

In five cases, the ELT was reported as not activating for unknown reasons. The G levels were 20, 46, 50, 92, and 108.

The above summary would indicate that no consistent data can be drawn between the calculated G force and the ELT performance. The sample of data is small, and so additional study of these cases with both G force and ELT data would not yield meaningful results.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

The following general conclusions regarding the general aviation fixed-wing accident are applicable to the question of ELT system reliability.

1. Nearly one-third of all aircraft came to rest inverted.

2. Ground fire occurs in 22% of the cases, and where the ELT is destroyed, in 56% of the cases.

3. The ELT is destroyed in about one-quarter of all fatal accidents.

4. When it is installed and activation status is reported, the ELT activated in about 62% of the fatal accidents, 69% of the fatal with survivors accidents, nearly 80% of the serious accidents, and about 57% of the minor/none injury accidents.

5. In fatal accidents, the aircraft section least likely to be destroyed and separated into pieces is the vertical tail, but it is destroyed 16% of the time and crushed/distorted another 16% of the time. Almost the same condition is true of the horizontal tail surface.

6. In fatal accidents, the nose is undamaged in only 1% of the cases, the cockpit in only 2%. The prop is unbent in 2% of these cases. In serious accidents, the nose is undamaged in only 3% of the cases. In fatal with survivors cases, the nose was undamaged in 7% of the cases.

7. No ELT is installed in about 8% of the aircraft that are required by law to have them. Overall installation data shows ELT units in 82% of all aircraft, regardless of requirement.

8. Antenna cable disconnection and antenna breakage are also important, although low percentage, causes of failure to transmit usable signals. However, a number of cases of final homing were done on units with no antenna.

9. In about 7% of the accidents where a search is required, the aircraft was underwater.

10. Initial alerting occurred in about half of the situations where the ELT aided in search. This indicates that the total system (transmitter, detection receiver, and homing receiver) is less than optimum. The SARSAT program should dramatically change this situation.

6.2 SYSTEM RECOMMENDATION - NEAR TERM

The greatest single cause of unreliable operation in ELT units now in use appears to have been the battery. Many of these problems will be corrected by current activities of the FAA on Lithium battery improvements.

The problem of false activation of current units was not a specific element of this study, but is being addressed in other work. It is believed that improvement in mounting will play an important role in decreasing false alarms.

Based on the general conclusions in this study, the following recommendations apply to the work of SC-136, on ELT units built to DO-168. It should be remembered that the ELT is not intended for use in a whole aircraft, but in aircraft wreckage.

1. Mount as far aft as possible in the empennage or immediately forward of it.

2. Antenna should be integral to the ELT if possible, projecting through the skin at an angle to the vertical sufficient to provide some upward signal if the aircraft is inverted. A dual antenna should be considered. (Do not create a hazard to personnel from eye injury, etc.). If a cable is required, keep the run short and not across any production break, with at least 50% slack in the cable, and locking connectors.

3. Mount to primary load carrying longitudinal structure, with minimal freedom of motion due to vibration. Any shelf or bracket should have the same degree of strength and rigidity as the primary structure in that area.

4. Require a greater degree of crashworthiness. For example, a steel case, potting of internal electronic components, secure case closures, battery mass at the forward end, some fire protection, and high-strength flexible antenna would increase crashworthiness. The unit should not come out of the mount without the use of tools. Do not provide for quick release. (The DO-168 requirement for 100G mounting is not considered sufficient, as the unit itself must survive, regardless of damage to aircraft).

5. A remote control must be clearly labled and available to all occupants. It should indicate if the unit is transmitting and have no failure mode in its electrical circuits that would disable the ELT after activation due to a crash. This could be accomplished simply by requiring a specific sequence of two different electrical signals to shut off the unit after automatic activation.

6. Require the use of remote crash sensing if it can be accomplished on a cost effective basis. The DO-168 specified crash pulse will be detected at the main gear attachment or forward structure more often than in the tail.

6.3 SYSTEM RECOMMENDATIONS - 406 MHz ELT

1. The ELT units must be crash survivable. The technology exists to produce a low cost ELT that will survive the impact force of most general aviation accidents. It should also have thermal protection for a short duration fire.

2. The antenna system should be crash survivable and have the capability of transmitting a usable signal when the aircraft is inverted as well as upright. Conformal or high-strength flexible antennas should be required.

3. Mounting of the unit should be secure to primary structure, with metallic, semi-permanent attachment devices. No quick release or single-point attachment should be provided. The total attachment strength should exceed that of the surrounding structure by a small margin. An alternative, automatically deployable unit should be permitted.

4. The ability to remove and carry out the ELT is of very low importance, and should not compromise the basic system requirement. A second, small, non-crashworthy unit operating only on 121.5 MHz could be carried in the aircraft by those persons who judge that this use is cost effective. If the people are sufficiently uninjured to walk out, such a personal unit should also be undamaged. The compromise in mounting and location necessitated by multiple use is undesirable.

5. Regardless of the degree of crash survivability designed into the ELT unit, the ELT unit is most likely to survive undamaged in the empennage of the aircraft.

6. Crash sensing should be done in the forward part of the aircraft, using acceleration, deformation, or other appropriate sensors in the nose, cabin, or forward structure. Severe deformation and deceleration in the forward part of the aircraft is a characteristic of fatal and serious accidents. Any sensor that detects this without ambiguity would constitute a good design approach. A small amount of logic and three sensors should be sufficient to achieve 100% sensing of all serious or fatal crashes and eliminate sensor caused false alarms.

7. Remote manual activation should be provided for any surviving occupant in the passenger or crew area, with clearly described instructions for use. Proper design and labeling of the remote control should eliminate the need for 100% sensing of minor injury accidents, permitting the pilot or occupant to override the logic in the few cases where the crash was not sensed.

8. There are no significant differences between types of aircraft that would necessitate a variation in the above recommendations. Even unusual configurations, such as rear engines, would require some form of vertical stabilizer in which the transmitter could be mounted. (See Ref. 8 for a discussion of future aircraft designs).

9. Increased compliance with ELT regulations would also increase the usefulness of the system. All new aircraft should be required to have approved factory installations.

6.4 ASSESSMENT OF CURRENT RELIABILITY

Using projections of the BASIC data, the following assessment is made of actual ELT reliability in service today, assuming that the absence of ELT data in the file is random.

Refer to Table 7.2B.

916 accidents in BASIC file
82% ELT installed

Therefore: 753 ELTs installed
60% activation ratio

Therefore: 451 ELTs activated (49% of accidents)

916 accidents x 38% search requirement

Therefore: 348 searches
less 7% underwater

Therefore: 324 searches on land
49% activated

Therefore: 159 ELTs activated when search is required
less 7% where antenna was disconnected
148 useful signals

Potential useful signals for alerting and homing should occur in 43% (148/348) of searches. But initial alerting occurred in only 15% of the searches.

6.5 PROJECTED RELIABILITY FOR 406 MHz SYSTEM FOR FATAL AND SERIOUS ACCIDENTS

Assumption:

1. ELT required on all fixed-wing general aviation aircraft.
2. 8% non-compliance ratio (same as today).
3. 7% of aircraft underwater when search is required.
4. 96% activation ratio in fatal and serious accidents. (4% do not sense crash).
5. 100% detection of any activated signal.
6. 95% survival of ELT units (5% destroyed).
7. No antenna disconnect, no dead batteries.

These assumptions are believed to be technically achievable. 95% ELTs survive crash on land. Of these, 96% activate and send usable signal.

Therefore: 91% of ELTs transmit usable signal
93% of aircraft requiring search are on land and 92% have ELT

Therefore: 86% ELT on land and 91% transmit usable signal

Therefore: 78% initial alerting of crash by ELT in all cases where search is required

This is a marked improvement over the current 15% recorded in this study. If the assumption of a perfect ELT is made (all activate, none destroyed), then the initial alerting goes to 86%. Adding 100% compliance with regulations puts the maximum at 93%, for all crashes on land.

With the addition of only the satellite portion of the system, but no improvement in activation or survival, the initial detection rate could approach 43% from the current 15%.

TABLE 6.5.1

INITIAL ALERTING BY ELT IN ALL SEARCHES

Current System	15%
100% detection by satellite of current units	43%
Achievable improvement in 406 MHz ELT	78%
Perfect 406 MHz ELT	86%
100% installation with perfect 406 MHz ELT	93%

7.0 CRISIS DATA TABLES

CODES USED IN DATA TABLES

LOCATION CODES

0 Unknown
1 Continuity of structure back to section A
2 Attached to next inboard section, but not back to A
3 Almost separated, most structural continuity gone
4 Separated completely

DEFORMATION CODES

0 Unknown
1 Basically undamaged, minor dents and tears
2 Major dents, tears but still in near normal shape
3 Crushed/distorted/crumpled
4 Destroyed, pieces separated
5 Buried in wreckage/dirt/debris

ATTITUDE AT REST (PITCH OR ROLL)

1 $\pm$ 30 degrees of upright/normal attitude in both pitch and roll
2 30 degrees - 90 degrees from normal in pitch or roll
3 90 degress from normal (inverted)

AIRCRAFT TYPE CODE

A Very light/home built
B Light utility/trainer
C Cabin class, single engine, unpressurized
D Cabin class, single engine, pressurized
E Cabin class, twin, unpressurized
F Cabin class, twin, pressurized
G Commuter 10+ passenger, unpressurized
H Commuter 10+ passenger, pressurized
J Unusual configurations

INDEX OF DATA TABLES IN CHAPTER SEVEN

7.37 BASIC, ELT Installed, Not Activated

7.38 BASIC, Ground Fire

7.39 BASIC, Type Code A or B or C, Tricycle Fixed Gear

7.40 BASIC, Type Code A or B or C, Tailwheel Fixed Gear

7.41 BASIC, Type Code C, High Wing

7.42 BASIC, Type Code C, Low Wing

7.43 BASIC, ELT in Cockpit or Cabin

7.44 BASIC, ELT in Aft Fuselage

7.45 ALL, Search Required

7.46 BASIC, Search Required

7.47 ALL, SAR Report

7.48 ALL, ELT Aid in Search

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	10	16	40	32	1	51	17	32
CABIN	83	56	0	20	25	14	19	37	29	1	51	17	32
NOSE	73	38	0	30	32	4	12	48	33	3	49	19	32
AFT FUS.	61	54	3	16	26	30	26	28	16	0	50	18	32
TAIL CONE	24	44	15	12	28	47	9	20	25	0	58	17	25
RT INBD WING	69	43	0	14	44	18	26	34	21	0	51	19	30
RT OTBD WING	46	38	23	8	31	15	26	39	20	0	51	18	31
LT INBD WING	67	42	0	16	42	19	28	33	20	0	51	18	32
LT OTBD WING	49	39	26	7	28	14	31	35	19	0	50	19	31
RT HORIZONTAL	38	53	24	5	18	55	19	13	12	1	49	18	32
LT HORIZONTAL	38	53	24	4	18	57	18	13	12	0	49	18	32
VERTICAL	38	54	23	7	15	55	20	13	11	0	50	17	33
MAIN GEAR	44	45	7	13	36	24	16	33	18	8	-	-	-
NOSE/TAIL GEAR	40	42	7	18	34	32	14	27	23	4	-	-	-
ENG #1	64	34	1	25	40	12	26	39	18	5	43	20	37
ENG #2	-	26	11	12	51	15	23	45	17	1	50	17	33

											Bent	Yes	No
PROP #1	-	31	25	4	40	10	26	42	13	9		94	6
PROP #2	-	23	35	1	40	8	24	47	18	2		93	7

DATA SET: ALL Files

No. of Cases: 1135

U.S. 59 %

In Flight Breakup

60 ; 5 %

Ground Fire Cases

211 ; 19 %

In Flight Fire Cases

12 ; 1 %

TABLE 7.1 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files

No. of Cases 1135 US: 673 CAN: 462

	Yes	No	Unk
ELT Installed	807	131	197
ELT Armed	469	54	284
ELT Activated	353	202	252
ELT Aid in Search	167	269	371
ELT in Mount After Impact	102	41	664
Antenna Intact	107	26	674
Antenna Cable Connected	7	59	741
ELT Battery Expired	29	56	722
Search Required	385	525	225

How Did ELT Aid in Search?

Initial Alerting	76
Detection by Airborne SAR	34
Final Homing	95
Voice Communication	2

Activate		ELT Location	
Auto	323	Aft Fuselage	197
Man.	22	Cabin	41
		Cockpit	15

ELT Activated, But Did Not Aid in Search

Search Not Required	105
Battery Went Dead	1
Antenna Disconnected	25
Antenna Shielded	8
Searchers Not Equipped	4
Under Water	19

Why ELT Did Not Activate

Battery Dead	10
Corrosion Damage	13
Insufficient Force to Activate	48
Destroyed/Damaged by Impact	140
Broke Loose From Mount	12
Internal Malfunction	27
Tested OK After Accident	14

	Fatal	Serious	Minor	None
Pilot	761	184	55	133
Crew	17	22	11	10
Passengers	822	218	120	179
Outsiders	17	3	7	0

TABLE 7.1 B

CRI REPORT 7846-14

SUM OF ENTRIES IN FILES

DATA SET: ALL Files

AIRCRAFT SECTION	Burned	LOCATION					DEFORMATION						ATTITUDE			
		1	2	3	4	UNK NR	1	2	3	4	5	UNK NR	1	2	3	UNK NR
COCKPIT	175	-	-	-	-	-	92	146	363	289	13	232	330	109	208	487
CABIN	178	503	0	177	221	234	122	174	331	262	12	234	326	109	209	490
NOSE	157	340	0	262	285	248	40	111	430	292	24	238	310	117	204	403
AFT FUS.	131	500	30	148	242	216	267	236	248	148	0	236	352	128	223	431
TAILCONE	52	122	42	34	78	859	126	23	53	67	0	866	108	31	46	950
RT INBD WING	148	385	0	124	395	231	159	228	300	188	0	260	321	116	187	511
RT OTBD WING	99	342	202	73	272	246	133	224	338	175	0	265	308	112	187	528
LT INBD WING	144	379	0	147	378	231	163	242	291	179	2	268	312	110	195	528
LT OTBD WING	105	351	231	61	250	242	124	271	307	166	2	265	308	114	193	520
RT HORIZONTAL	81	472	212	45	163	243	476	166	109	103	5	276	350	129	230	426
LT HORIZONTAL	82	470	218	40	162	245	492	152	113	103	2	273	356	131	234	414
VERTICAL	81	481	206	62	136	250	482	178	113	93	3	226	362	126	242	405
MAIN GEAR	94	280	41	84	224	506	150	99	204	118	50	514	-	-	-	-
NOSE/TAIL GEAR	85	210	34	90	169	632	153	65	128	107	19	663	-	-	-	-
ENG #1	136	293	11	211	340	280	98	219	331	147	45	295	189	88	161	697
ENG #2	17	29	12	13	56	30	15	23	45	17	1	39	18	6	12	99

													Bent	Yes	No	
PROP #1	-	230	187	33	295	390	79	197	318	96	69	377		700	42	392
PROP #2	-	22	33	1	38	46	7	21	41	16	2	53		83	6	51

TABLE 7.1 C

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	5	14	45	35	2	49	19	32
CABIN	84	50	0	23	28	7	17	42	32	2	49	19	32
NOSE	74	31	0	33	36	2	7	52	36	3	47	21	32
AFT FUS.	62	50	4	17	29	25	26	29	19	0	48	20	31
TAIL CONE	24	42	16	13	29	45	8	21	26	0	58	18	25
RT INBD WING	70	38	0	15	47	12	28	37	23	0	58	21	30
RT OTBD WING	46	34	26	8	33	12	26	42	21	0	49	20	31
LT INBD WING	68	36	0	18	46	12	29	37	22	0	48	20	32
LT OTBD WING	50	34	29	7	30	10	31	39	20	0	47	21	32
RT HORIZONTAL	38	50	25	5	20	52	21	14	13	1	48	19	33
LT HORIZONTAL	38	50	25	5	20	54	19	14	13	0	48	19	33
VERTICAL	38	51	24	7	18	51	22	14	12	0	48	18	34
MAIN GEAR	44	41	8	14	38	21	15	35	20	9	-	-	-
NOSE/TAIL GEAR	39	39	7	19	34	31	12	29	23	5	-	-	-
ENG #1	64	26	1	28	45	8	23	43	19	6	41	23	36
ENG #2	-	15	12	12	60	9	20	49	20	1	48	11	41

											Bent	Yes	No
PROP #1	-	23	28	5	44	6	25	45	13	10		96	4
PROP #2	-	14	39	1	46	7	19	51	21	3		95	5

DATA SET: BASIC Group

No. of Cases: 916

U.S. 63 %

In Flight Breakup

57 ; 6 %

Ground Fire Cases

206 ; 22 %

In Flight Fire Cases

10 ; 1 %

TABLE 7.2 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group

No. of Cases 916 US: 577 CAN: 339

	Yes	No	Unk
ELT Installed	593	128	195
ELT Armed	316	48	229
ELT Activated	223	149	221
ELT Aid in Search	82	227	284
ELT in Mount After Impact	50	38	505
Antenna Intact	70	25	502
Antenna Cable Connected	6	57	530
ELT Battery Expired	27	43	523
Search Required	272	450	194

ELT Activated, But Did Not Aid in Search

Search Not Required	76
Battery Went Dead	1
Antenna Disconnected	23
Antenna Shielded	7
Searchers Not Equipped	4
Under Water	17

	Fatal	Serious	Minor	None
Pilot	707	169	22	17
Crew	41	21	7	2
Passengers	745	199	88	43
Outsiders	15	3	7	0

How Did ELT Aid in Search?

Initial Alerting	48
Detection by Airborne SAR	23
Final Homing	35
Voice Communication	2

Activate	
Auto	218
Man.	3

ELT Location	
Aft Fuselage	109
Cabin	25
Cockpit	9

Why ELT Did Not Activate

Battery Dead	10
Corrosion Damage	13
Insufficient Force to Activate	5
Destroyed/Damaged by Impact	135
Broke Loose From Mount	11
Internal Malfunction	26
Tested OK After Accident	14

TABLE 7.2 B

CRI REPORT 7846-14

SUM OF ENTRIES IN FILES

DATA SET: BASIC Group

AIRCRAFT SECTION	Burned	LOCATION					DEFORMATION						ATTITUDE			
		1	2	3	4	UNK NR	1	2	3	4	5	UNK NR	1	2	3	UNK NR
COCKPIT	171	-	-	-	-	-	34	102	336	262	13	169	248	95	160	412
CABIN	174	369	0	168	204	175	52	130	313	238	12	171	245	95	160	415
NOSE	154	224	0	244	262	186	15	53	384	264	24	176	230	102	156	427
AFT FUS.	128	384	28	130	224	151	192	199	221	142	0	162	269	114	175	357
TAILCONE	50	106	41	33	74	662	112	20	52	64	0	668	92	28	239	757
RT INBD WING	145	282	0	114	355	165	90	205	271	167	0	183	247	103	148	418
RT OTBD WING	96	250	189	60	242	175	84	188	305	149	0	190	240	98	149	429
LT INBD WING	142	268	0	136	348	164	91	210	269	164	2	180	234	99	157	426
LT OTBD WING	103	252	215	53	226	170	73	228	280	144	2	189	232	102	158	424
RT HORIZONTAL	79	370	183	38	152	173	372	149	98	96	5	196	272	108	184	352
LT HORIZONTAL	80	368	188	34	150	176	392	135	99	94	2	194	276	110	189	341
VERTICAL	79	375	173	54	130	184	372	160	100	90	3	191	179	104	196	337
MAIN GEAR	91	213	40	74	198	392	112	79	181	103	49	392	-	-	-	-
NOSE/TAIL GEAR	82	168	31	84	148	485	125	50	117	92	19	513	-	-	-	-
ENG #1	133	184	10	195	319	207	58	164	301	136	43	214	144	79	128	565
ENG #2	16	14	11	11	55	25	8	17	42	17	1	31	13	3	11	889

	Bent	Yes	No	
PROP #1	-	142	168	30	269	307	41	158	285	83	66	283	594	27	295
PROP #2	-	11	31	1	36	37	5	14	38	16	2	41	72	4	840

TABLE 7.2 C

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	100	-	-	-	-	0	15	46	31	8	45	20	35
CABIN	86	60	0	10	30	5	14	38	33	10	40	13	47
NOSE	86	33	0	8	58	0	15	42	38	4	44	28	28
AFT FUS.	86	59	4	11	26	30	37	22	11	0	43	24	33
TAIL CONE	14	0	0	0	0	0	0	0	0	0	0	0	0
RT INBD WING	100	52	0	4	44	4	33	48	15	0	52	14	33
RT OTBD WING	86	52	19	7	22	7	37	44	11	0	52	14	33
LT INBD WING	86	59	0	4	37	11	33	41	15	0	52	19	29
LT OTBD WING	86	59	15	7	19	11	41	37	11	0	52	19	29
RT HORIZONTAL	71	57	21	4	18	59	21	7	14	0	50	18	32
LT HORIZONTAL	86	50	25	0	25	59	17	10	14	0	50	18	32
VERTICAL	86	50	21	7	21	45	24	17	14	0	48	17	35
MAIN GEAR	57	50	0	6	44	20	33	13	20	13	-	-	-
NOSE/TAIL GEAR	57	67	8	8	17	64	18	0	9	9	-	-	-
ENG #1	43	26	0	9	65	4	4	54	29	11	42	33	25
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

DATA SET: BASIC Group, Aircraft Type Code A

No. of Cases: 33

U.S. 36 %

In Flight Breakup

3 ; 9 %

Ground Fire Cases

7 ; 21 %

In Flight Fire Cases

0 ; 0 %

											Bent	Yes	No
PROP #1	-	30	20	10	40	13	8	25	29	25		86	14
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

TABLE 7.3 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code A

No. of Cases	US: Yes	US: No	US: Unk	CAN:
ELT Installed	5	15	13	
ELT Armed	3	0	2	
ELT Activated	3	0	2	
ELT Aid in Search	1	2	2	
ELT in Mount After Impact	2	0	3	
Antenna Intact	1	0	4	
Antenna Cable Connected	0	0	5	
ELT Battery Expired	0	0	5	
Search Required	3	14	16	

ELT Activated, But Did Not Aid in Search

Search Not Required	2
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

	Fatal	Serious	Minor	None
Pilot	22	11	0	0
Crew	1	0	0	0
Passengers	7	4	0	0
Outsiders	0	0	0	0

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate		ELT Location	
Auto	3	Aft Fuselage	2
Man.	0	Cabin	1
		Cockpit	0

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	2
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	0

TABLE 7.3 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	97	-	-	-	-	5	13	54	26	2	37	30	33
CABIN	97	57	0	24	19	7	18	49	24	2	38	29	33
NOSE	95	37	0	36	27	2	6	63	24	5	38	29	33
AFT FUS.	78	57	4	16	23	32	26	30	13	0	41	28	31
TAIL CONE	35	65	0	4	31	38	4	19	38	0	53	16	32
RT INBD WING	89	46	0	17	37	15	33	38	14	0	41	29	30
RT OTBD WING	54	42	31	8	19	15	26	45	14	0	41	28	31
LT INBD WING	78	46	0	23	31	15	36	37	11	0	37	29	34
LT OTBD WING	57	46	34	7	13	12	38	40	11	0	38	28	35
RT HORIZONTAL	59	61	24	3	12	61	17	12	9	1	41	22	37
LT HORIZONTAL	57	61	23	3	13	66	14	10	9	0	42	22	36
VERTICAL	54	61	24	4	10	60	19	11	9	1	41	22	37
MAIN GEAR	65	56	1	15	28	26	18	36	11	8	-	-	-
NOSE/TAIL GEAR	51	62	7	15	17	57	7	22	10	4	-	-	-
ENG #1	86	38	0	32	30	10	21	46	14	10	39	27	34
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

											Bent	Yes	No
PROP #1	-	34	29	5	32	10	33	36	9	12		97	3
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

DATA SET: BASIC Group, Aircraft Type Code B

No. of Cases: 225

U.S. 62 %

In Flight Breakup

7 ; 3 %

Ground Fire Cases

37 ; 16 %

In Flight Fire Cases

0 ; 0 %

TABLE 7.4 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code B

No. of Cases 225 **US:** 140 **CAN:** 85

	Yes	No	Unk
ELT Installed	130	44	51
ELT Armed	79	10	41
ELT Activated	54	30	46
ELT Aid in Search	10	55	65
ELT in Mount After Impact	14	8	108
Antenna Intact	20	7	103
Antenna Cable Connected	3	10	117
ELT Battery Expired	10	10	110
Search Required	45	130	50

ELT Activated, But Did Not Aid in Search

Search Not Required	24
Battery Went Dead	1
Antenna Disconnected	4
Antenna Shielded	2
Searchers Not Equipped	1
Under Water	7

	Fatal	Serious	Minor	None
Pilot	174	44	4	3
Crew	18	5	1	1
Passengers	70	27	2	2
Outsiders	6	0	1	0

How Did ELT Aid in Search?

Initial Alerting	7
Detection by Airborne SAR	5
Final Homing	6
Voice Communication	0

Activate	
Auto	54
Man.	0

ELT Location	
Aft Fuselage	22
Cabin	7
Cockpit	2

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	3
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	21
Broke Loose From Mount	2
Internal Malfunction	9
Tested OK After Accident	4

TABLE 7.4 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	84	-	-	-	-	4	14	43	37	2	54	15	31
CABIN	84	48	0	24	27	6	18	41	33	.2	53	16	31
NOSE	71	29	0	35	35	2	8	49	38	3	50	18	32
AFT FUS.	60	50	3	18	29	23	27	32	18	0	51	18	30
TAIL CONE	21	45	14	16	25	47	10	22	20	0	60	19	22
RT INBD WING	65	35	0	17	48	13	27	36	24	0	52	19	28
RT OTBD WING	38	31	26	8	36	11	26	43	20	0	52	19	29
LT INBD WING	63	31	0	19	50	12	27	35	24	1	51	19	30
LT OTBD WING	38	29	29	8	34	11	29	39	20	1	50	20	30
RT HORIZONTAL	29	47	26	6	21	49	24	15	12	1	51	19	30
LT HORIZONTAL	31	48	27	5	20	51	21	16	12	1	50	18	31
VERTICAL	30	51	24	9	16	50	24	15	11	0	52	16	32
MAIN GEAR	37	35	12	14	39	20	14	35	21	10	-	-	-
NOSE/TAIL GEAR	34	26	7	25	42	16	17	34	27	6	-	-	-
ENG #1	64	24	0	29	46	8	26	40	21	4	40	21	39
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

											Bent	Yes	No
PROP #1	-	21	26	5	49	5	23	50	11	10		96	4
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

DATA SET: BASIC Group
Aircraft Type Code C

No. of Cases: 482

U.S. 63 %

In Flight Breakup
32 ; 7 %

Ground Fire Cases
102 ; 21 %

In Flight Fire Cases
2 ; 0 %

TABLE 7.5 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code C

No. of Cases 482 **US:** 302 **CAN:** 180

	Yes	No	Unk
ELT Installed	356	32	94
ELT Armed	181	32	143
ELT Activated	136	83	137
ELT Aid in Search	55	136	165
ELT in Mount After Impact	30	24	302
Antenna Intact	43	14	299
Antenna Cable Connected	2	37	317
ELT Battery Expired	12	25	319
Search Required	184	206	92

ELT Activated, But Did Not Aid in Search

Search Not Required	44
Battery Went Dead	0
Antenna Disconnected	13
Antenna Shielded	4
Searchers Not Equipped	2
Under Water	6

	Fatal	Serious	Minor	None
Pilot	369	87	15	11
Crew	24	12	2	0
Passengers	499	132	44	27
Outsiders	4	0	3	0

How Did ELT Aid in Search?

Initial Alerting	28
Detection by Airborne SAR	16
Final Homing	26
Voice Communication	2

Activate		ELT Location	
Auto	134	Aft Fuselage	71
Man.	1	Cabin	12
		Cockpit	5

Why ELT Did Not Activate

Battery Dead	5
Corrosion Damage	7
Insufficient Force to Activate	3
Destroyed/Damaged by Impact	81
Broke Loose From Mount	8
Internal Malfunction	16
Tested OK After Accident	7

TABLE 7.5 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	68	-	-	-	-	3	7	42	48	0	53	18	29
CABIN	68	36	0	20	44	3	17	34	46	0	53	18	29
NOSE	68	20	0	26	55	3	3	43	49	2	53	19	28
AFT FUS.	52	31	7	16	46	17	26	23	33	0	50	16	34
TAIL CONE	24	24	32	7	37	50	8	13	30	0	61	17	22
RT INBD WING	76	26	0	10	64	4	16	38	42	0	55	12	33
RT OTBD WING	60	14	16	6	59	6	18	35	41	0	52	12	36
LT INBD WING	76	17	0	15	68	1	14	42	42	0	53	10	37
LT OTBD WING	76	13	24	6	58	1	19	37	43	0	53	13	34
RT HORIZONTAL	28	27	30	3	40	41	25	11	23	0	49	16	35
LT HORIZONTAL	28	26	32	3	38	41	21	15	23	0	46	22	33
VERTICAL	28	25	30	6	39	42	24	14	18	2	45	23	32
MAIN GEAR	56	26	10	12	52	18	3	36	36	8	-	-	-
NOSE/TAIL GEAR	52	23	9	11	57	16	6	32	42	3	-	-	-
ENG #1	56	10	7	13	69	5	21	51	19	5	56	0	44
ENG #2	-	12	12	17	58	7	18	58	15	2	48	10	43

											Bent	Yes	No
PROP #1	-	14	33	2	52	3	26	50	16	5		95	5
PROP #2	-	9	43	2	46	2	18	60	18	2		96	4

DATA SET: BASIC Group
Aviation Type Code E

No. of Cases: 83

U.S. 70 %

In Flight Breakup
8 ; 10 %

Ground Fire Cases
24 ; 29 %

In Flight Fire Cases
4 ; 5 %

TABLE 7.6 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code E

No. of Cases 83 US: 58 CAN: 25

	Yes	No	Unk
ELT Installed	63	2	18
ELT Armed	35	5	23
ELT Activated	21	19	23
ELT Aid in Search	12	21	30
ELT in Mount After Impact	1	4	58
Antenna Intact	4	0	59
Antenna Cable Connected	0	6	57
ELT Battery Expired	5	3	55
Search Required	24	42	17

How Did ELT Aid in Search?

Initial Alerting	9
Detection by Airborne SAR	0
Final Homing	2
Voice Communication	0

Activate		ELT Location	
Auto	19	Aft Fuselage	7
Man.	1	Cabin	4
		Cockpit	0

ELT Activated, But Did Not Aid in Search

Search Not Required	5
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	0
Searchers Not Equipped	1
Under Water	3

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	1
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	16
Broke Loose From Mount	1
Internal Malfunction	0
Tested OK After Accident	2

	Fatal	Serious	Minor	None
Pilot	69	11	1	1
Crew	14	3	1	1
Passengers	85	20	14	9
Outsiders	1	2	2	0

TABLE 7.6 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	64	-	-	-	-	6	0	39	56	0	64	9	27
CABIN	91	35	0	18	47	6	0	50	44	0	67	8	25
NOSE	55	33	0	22	44	6	0	35	59	0	64	9	27
AFT FUS.	55	13	0	13	73	6	17	22	56	0	50	10	40
TAIL CONE	18	0	33	17	50	25	0	33	42	0	40	20	40
RT INBD WING	45	12	0	12	76	6	17	33	44	0	71	0	29
RT OTBD WING	27	6	18	18	59	6	28	28	39	0	86	0	14
LT INBD WING	73	16	0	12	71	6	28	22	44	0	67	0	33
LT OTBD WING	45	18	18	0	65	6	29	29	35	0	67	0	33
RT HORIZONTAL	45	13	38	6	44	33	0	28	39	0	44	11	44
LT HORIZONTAL	36	13	38	6	44	33	11	17	39	0	44	11	44
VERTICAL	36	13	38	6	44	28	11	22	39	0	44	11	44
MAIN GEAR	27	22	0	0	78	10	20	20	40	10	-	-	-
NOSE/TAIL GEAR	27	33	0	11	56	30	0	30	40	0	-	-	-
ENG #1	45	6	18	6	71	13	19	38	31	0	67	0	33
ENG #2	-	6	19	0	75	6	29	24	41	0	67	0	32

DATA SET: BASIC Group
Aircraft Type Code F

No. of Cases: 19

U.S. 84 %

In Flight Breakup
3 ; 16 %

Ground Fire Cases
10 ; 53 %

In Flight Fire Cases
4 ; 21 %

											Bent	Yes	No
PROP #1	-	6	41	0	53	7	14	36	43	0		100	0
PROP #2	-	12	35	0	53	7	20	33	33	7		100	0

TABLE 7.7 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code F

No. of Cases 19 US: 16 CAN: 3

	Yes	No	Unk
ELT Installed	16	0	3
ELT Armed	8	0	8
ELT Activated	4	8	4
ELT Aid in Search	2	7	7
ELT in Mount After Impact	1	2	13
Antenna Intact	0	2	14
Antenna Cable Connected	1	3	12
ELT Battery Expired	0	3	13
Search Required	6	12	1

ELT Activated, But Did Not Aid in Search

Search Not Required	0
Battery Went Dead	0
Antenna Disconnected	2
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	0

	Fatal	Serious	Minor	None
Pilot	16	2	1	0
Crew	4	1	2	0
Passengers	43	8	12	0
Outsiders	2	0	0	0

How Did ELT Aid in Search?

Initial Alerting	2
Detection by Airborne SAR	1
Final Homing	1
Voice Communication	0

Activate

Auto	4
Man.	0

ELT Location

Aft Fuselage	3
Cabin	0
Cockpit	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	1
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	7
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	0

TABLE 7.7 B

CRI REPORT 7846-14

SUM OF ENTRIES IN FILES

DATA SET: BASIC Group, Aircraft Type Code F

AIRCRAFT SECTION	Burned	LOCATION					DEFORMATION						ATTITUDE			
		1	2	3	4	UNK NR	1	2	3	4	5	UNK NR	1	2	3	UNK NR
COCKPIT	7	-	-	-	-	-	1	0	7	10	0	1	7	1	3	8
CABIN	10	6	0	3	8	2	1	0	9	8	0	1	8	1	3	7
NOSE	6	6	0	4	8	1	1	0	6	10	0	2	7	1	3	8
AFT FUS.	6	2	0	2	11	4	1	3	4	10	0	1	5	1	4	9
TAILCONE	2	0	4	2	6	7	3	0	4	5	0	7	2	1	2	14
RT INBD WING	5	2	0	2	13	2	1	3	6	8	0	1	5	0	2	12
RT OTBD WING	3	1	3	3	10	2	1	5	5	7	0	1	6	0	1	12
LT INBD WING	8	3	0	2	12	2	1	5	4	8	0	1	4	0	2	13
LT OTBD WING	5	3	3	0	11	2	1	5	5	6	0	2	4	0	2	13
RT HORIZONTAL	5	2	6	1	7	3	6	0	5	7	0	1	4	1	4	10
LT HORIZONTAL	4	2	6	1	7	3	6	2	3	7	0	1	4	1	4	10
VERTICAL	4	2	6	1	7	3	5	2	4	7	0	1	4	1	4	10
MAIN GEAR	3	2	0	0	7	10	1	2	2	4	1	9	-	-	-	-
NOSE/TAIL GEAR	3	3	0	1	5	10	3	0	3	4	0	9	-	-	-	-
ENG #1	5	1	3	1	12	2	2	3	6	5	0	1	2	0	1	16
ENG #2	5	1	3	0	12	3	1	5	4	7	0	1	2	0	1	16

													Bent	Yes	No	
PROP #1	-	1	7	0	9	2	1	2	5	6	0	2		19	0	0
PROP #2	-	2	6	0	9	2	1	3	5	5	1	1		19	0	0

TABLE 7.7 C

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	0	-	-	-	-	20	0	20	60	0	0	50	50
CABIN	100	40	0	20	40	20	0	40	40	0	0	50	50
NOSE	0	20	0	40	40	20	0	20	60	0	0	33	67
AFT FUS.	0	20	20	40	20	20	20	40	20	0	0	33	67
TAIL CONE	0	50	0	0	50	50	0	0	50	0	0	0	100
RT INBD WING	0	17	0	0	83	20	20	40	20	0	0	0	100
RT OTBD WING	0	17	50	0	33	20	20	40	20	0	0	0	100
LT INBD WING	0	17	0	17	67	17	0	67	17	0	0	0	100
LT OTBD WING	0	17	67	0	17	17	17	50	17	0	0	0	100
RT HORIZONTAL	0	25	25	0	50	25	25	25	25	0	50	0	50
LT HORIZONTAL	0	25	50	0	25	25	50	0	25	0	33	33	33
VERTICAL	0	20	20	20	40	40	40	0	20	0	33	33	33
MAIN GEAR	0	33	0	0	67	33	0	33	33	0	-	-	-
NOSE/TAIL GEAR	0	33	33	0	33	67	0	0	33	0	-	-	-
ENG #1	0	17	33	0	50	25	25	25	25	0	0	0	100
ENG #2	-	17	0	0	83	20	0	60	20	0	0	0	100

											Bent	Yes	No
PROP #1	-	33	33	0	33	33	33	0	33	0		100	0
PROP #2	-	50	0	0	50	50	0	0	50	0		100	0

DATA SET: BASIC Group
Aircraft Type Code
G or H

No. of Cases: 7

U.S. 43 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
1 ; 14 %

In Flight Fire Cases
0 ; 0 %

TABLE 7.8 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code G or H

No. of Cases 7 **US:** 3 **CAN:** 4

	Yes	No	Unk
ELT Installed	6	0	1
ELT Armed	5	0	1
ELT Activated	3	2	1
ELT Aid in Search	1	1	4
ELT in Mount After Impact	1	0	5
Antenna Intact	0	2	4
Antenna Cable Connected	0	1	5
ELT Battery Expired	0	1	5
Search Required	4	2	1

ELT Activated, But Did Not Aid in Search

Search Not Required	0
Battery Went Dead	0
Antenna Disconnected	1
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	1

	Fatal	Serious	Minor	None
Pilot	5	1	0	1
Crew	5	0	1	0
Passengers	29	1	16	1
Outsiders	0	0	0	0

How Did ELT Aid in Search?

Initial Alerting	0
Detection by Airborne SAR	1
Final Homing	0
Voice Communication	0

Activate		ELT Location	
Auto	2	Aft Fuselage	2
Man.	1	Cabin	0
		Cockpit	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	3
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	0

TABLE 7.8 B

CRI REPORT 7846-14

SUM OF ENTRIES IN FILES

DATA SET: BASIC Group, Aircraft Type Code G or H

AIRCRAFT SECTION	Burned	LOCATION					DEFORMATION						ATTITUDE			
		1	2	3	4	UNK NR	1	2	3	4	5	UNK NR	1	2	3	UNK NR
COCKPIT	0	-	-	-	-	-	1	0	1	3	0	2	0	1	1	5
CABIN	1	2	0	1	2	2	1	0	2	2	0	2	0	1	1	5
NOSE	0	1	0	2	2	2	1	0	1	3	0	2	0	1	2	4
AFT FUS.	0	1	1	2	1	2	1	1	2	1	0	1	0	1	2	4
TAILCONE	0	1	0	0	1	5	1	0	0	1	0	5	0	0	1	6
RT INBD WING	0	1	0	0	5	1	1	1	2	1	0	2	0	0	1	6
RT OTBD WING	0	1	3	0	2	1	1	1	2	1	0	2	0	0	1	6
LT INBD WING	0	1	0	1	4	1	1	0	4	1	0	1	0	0	2	5
LT OTBD WING	0	1	4	0	1	1	1	1	3	1	0	1	0	0	2	5
RT HORIZONTAL	0	1	1	0	2	3	1	1	1	1	0	3	1	0	1	5
LT HORIZONTAL	0	1	2	0	1	3	1	2	0	1	0	3	1	1	1	4
VERTICAL	0	1	1	1	2	2	2	2	0	1	0	2	1	1	1	4
MAIN GEAR	0	1	0	0	2	4	1	0	1	1	0	3	-	-	-	-
NOSE/TAIL GEAR	0	1	1	0	1	4	2	0	0	1	0	4	-	-	-	-
ENG #1	0	1	2	0	3	1	1	1	1	1	0	3	0	0	1	6
ENG #2	0	1	0	0	5	1	1	0	3	1	0	2	0	0	1	6

													Bent	Yes	No	
PROP #1	-	1	1	0	1	4	1	1	0	1	0	4		2	0	5
PROP #2	-	1	0	0	1	5	1	0	0	1	0	5		1	0	6

TABLE 7.8 C

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	72	-	-	-	-	12	28	30	30	0	59	11	30
CABIN	72	59	0	14	27	20	22	29	29	0	58	11	31
NOSE	72	32	0	32	36	2	7	55	33	2	58	14	28
AFT FUS.	52	60	0	16	24	41	20	20	20	0	56	14	31
TAIL CONE	28	46	8	15	31	36	0	27	36	0	62	15	23
RT INBD WING	60	50	0	9	41	14	33	33	19	0	56	15	28
RT OTBD WING	52	46	22	11	22	16	28	35	21	0	56	13	31
LT INBD WING	64	54	0	8	38	20	30	34	16	0	59	13	28
LT OTBD WING	52	53	19	6	21	4	40	33	19	0	56	15	28
RT HORIZONTAL	40	66	7	11	16	59	12	15	15	0	56	14	31
LT HORIZONTAL	40	63	9	11	17	60	14	12	14	0	57	11	32
VERTICAL	44	68	7	9	16	55	14	14	14	2	58	11	31
MAIN GEAR	32	41	4	22	33	13	17	33	23	13	-	-	-
NOSE/TAIL GEAR	32	67	4	13	17	42	8	25	21	4	-	-	-
ENG #1	56	27	0	37	37	6	29	38	21	6	46	25	29
ENG #2	-	100	0	0	0	67	33	0	0	0	50	50	0

DATA SET: BASIC Group
Aircraft Type Code J

No. of Cases: 64

U.S. 72 %

In Flight Breakup
4 ; 6 %

Ground Fire Cases
25 ; 39 %

In Flight Fire Cases
0 ; 0 %

											Bent Yes	Bent No
PROP #1	-	23	30	7	40	7	18	43	21	11	91	9
PROP #2	-	0	0	0	0	67	33	0	0	0	33	67

TABLE 7.9 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code J

No. of Cases 64 US: 46 CAN: 18

	Yes	No	Unk
ELT Installed	17	35	12
ELT Armed	5	1	11
ELT Activated	2	7	8
ELT Aid in Search	1	5	11
ELT in Mount After Impact	1	0	16
Antenna Intact	2	0	15
Antenna Cable Connected	0	0	17
ELT Battery Expired	0	1	16
Search Required	6	44	14

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate

Auto	2
Man.	0

ELT Location

Aft Fuselage	2
Cabin	1
Cockpit	1

ELT Activated, But Did Not Aid in Search

Search Not Required	1
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	1
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	5
Broke Loose From Mount	0
Internal Malfunction	1
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	51	12	0	1
Crew	5	0	0	0
Passengers	9	6	0	3
Outsiders	2	1	1	0

TABLE 7.9 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	2	6	47	43	2	52	20	28
CABIN	83	33	0	29	34	2	10	46	40	2	51	20	28
NOSE	75	24	0	37	34	1	3	51	43	3	51	22	27
AFT FUS.	61	39	4	22	35	18	25	34	23	0	51	22	27
TAIL CONE	26	35	16	15	33	38	8	24	30	0	60	21	20
RT INBD WING	70	30	0	17	53	6	24	41	30	0	52	22	26
RT OTBD WING	49	27	23	10	40	7	23	43	28	0	52	22	26
LT INBD WING	67	29	0	20	51	7	25	40	28	0	52	21	28
LT OTBD WING	51	27	27	9	37	6	27	41	26	0	52	21	27
RT HORIZONTAL	39	39	31	7	23	45	22	16	17	1	51	20	29
LT HORIZONTAL	40	39	32	6	23	47	20	16	17	0	50	20	29
VERTICAL	40	40	31	9	21	46	23	15	15	0	51	19	30
MAIN GEAR	46	34	9	16	41	19	13	35	25	7	-	-	-
NOSE/TAIL GEAR	43	33	7	20	39	27	11	30	29	4	-	-	-
ENG #1	64	19	1	29	50	6	21	44	23	5	45	22	33
ENG #2	-	16	8	14	62	7	19	49	23	1	57	14	29

DATA SET: ALL Files
Fatal Injury Index

No. of Cases: 679

U.S. 76 %

In Flight Breakup
59 ; 9 %

Ground Fire Cases
172 ; 25 %

In Flight Fire Cases
9 ; 1 %

											Bent	Yes	No
PROP #1	-	16	28	5	51	3	22	49	17	8		97	3
PROP #2	-	13	34	1	51	3	18	50	26	3		95	5

TABLE 7.10 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: All Files, Fatal Injury Index

No. of Cases 679	US: 519		CAN: 160
	Yes	No	Unk
ELT Installed	491	105	83
ELT Armed	250	40	193
ELT Activated	188	114	189
ELT Aid in Search	98	167	226
ELT in Mount After Impact	27	33	431
Antenna Intact	34	19	438
Antenna Cable Connected	3	49	439
ELT Battery Expired	22	37	432
Search Required	255	347	77

How Did ELT Aid in Search?

Initial Alerting	40
Detection by Airborne SAR	20
Final Homing	59
Voice Communication	2

Activate	
Auto	189
Man.	0

ELT Location	
Aft Fuselage	70
Cabin	14
Cockpit	4

ELT Activated, But Did Not Aid in Search

Search Not Required	50
Battery Went Dead	1
Antenna Disconnected	19
Antenna Shielded	2
Searchers Not Equipped	1
Under Water	10

Why ELT Did Not Activate

Battery Dead	9
Corrosion Damage	11
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	125
Broke Loose From Mount	9
Internal Malfunction	19
Tested OK After Accident	11

	Fatal	Serious	Minor	None
Pilot	677	0	0	0
Crew	70	0	0	0
Passengers	681	0	0	0
Outsiders	15	2	5	0

TABLE 7.10 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	80	-	-	-	-	12	23	43	22	0	49	20	31
CABIN	80	74	0	9	17	17	33	33	17	0	49	20	31
NOSE	64	45	0	29	26	7	17	49	25	2	49	21	30
AFT FUS.	64	71	2	10	16	43	29	18	10	0	45	22	34
TAIL CONE	16	73	13	2	12	76	14	4	6	0	57	13	30
RT INBD WING	68	50	0	16	34	24	33	30	13	0	50	25	26
RT OTBD WING	36	43	27	5	25	19	25	44	12	0	50	24	26
LT INBD WING	68	50	0	16	35	25	28	32	15	0	44	27	30
LT OTBD WING	44	44	32	3	21	18	35	35	12	0	44	28	28
RT HORIZONTAL	36	65	15	3	17	65	18	9	7	0	47	22	31
LT HORIZONTAL	32	66	17	2	15	67	15	12	7	0	46	23	30
VERTICAL	28	69	15	6	10	66	20	10	5	0	46	22	32
MAIN GEAR	36	49	6	4	38	33	17	32	14	4	-	-	-
NOSE/TAIL GEAR	28	49	7	17	26	42	14	28	14	2	-	-	-
ENG #1	64	39	1	27	34	21	35	26	12	6	51	21	29
ENG #2	-	33	13	7	47	31	38	31	0	0	57	0	43

	Bent	Yes	No
PROP #1	-	89	11
PROP #2	-	90	10

DATA SET: ALL Files
Fatal with Survivors

No. of Cases: 159

U.S. 76 %

In Flight Breakup
1 ; 1 %

Ground Fire Cases
25 ; 16 %

In Flight Fire Cases
1 ; 1 %

TABLE 7.11 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Fatal With Survivors

No. of Cases 159 US: 121 CAN: 38

	Yes	No	Unk
ELT Installed	119	12	28
ELT Armed	72	6	82
ELT Activated	59	27	33
ELT Aid in Search	24	58	37
ELT in Mount After Impact	10	4	105
Antenna Intact	17	4	98
Antenna Cable Connected	2	9	108
ELT Battery Expired	7	11	101
Search Required	47	88	24

How Did ELT Aid in Search?

Initial Alerting	8
Detection by Airborne SAR	9
Final Homing	15
Voice Communication	0

Activate		ELT Location	
Auto	51	Aft Fuselage	14
Man.	3	Cabin	6
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	22
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	2
Searchers Not Equipped	2
Under Water	6

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	2
Insufficient Force to Activate	4
Destroyed/Damaged by Impact	10
Broke Loose From Mount	1
Internal Malfunction	5
Tested OK After Accident	3

	Fatal	Serious	Minor	None
Pilot	83	62	6	8
Crew	7	18	4	0
Passengers	140	127	44	20
Outsiders	1	1	6	0

TABLE 7.11 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	92	-	-	-	-	12	45	30	12	2	44	13	43
CABIN	92	89	0	3	8	24	42	22	10	2	43	14	43
NOSE	77	56	0	15	28	4	22	53	16	5	36	20	45
AFT FUS.	62	78	2	6	14	39	34	23	4	0	43	13	43
TAIL CONE	15	0	0	0	0	0	0	0	0	0	0	0	100
RT INBD WING	62	60	0	4	36	32	36	25	7	0	42	14	45
RT OTBD WING	31	55	28	4	13	27	38	31	5	0	40	14	46
LT INBD WING	69	50	0	10	31	28	45	20	6	1	44	13	44
LT OTBD WING	38	57	28	3	12	24	46	25	4	1	40	15	46
RT HORIZONTAL	23	74	13	4	10	72	17	7	4	0	41	18	42
LT HORIZONTAL	23	73	13	4	10	74	15	8	3	0	42	16	42
VERTICAL	31	75	12	5	8	66	19	9	3	3	41	16	43
MAIN GEAR	31	72	2	10	17	22	20	28	7	24	-	-	-
NOSE/TAIL GEAR	15	66	6	9	19	43	29	9	6	14	-	-	-
ENG #1	69	55	4	17	24	8	25	52	7	9	22	25	53
ENG #2	-	42	33	8	17	17	17	58	8	0	29	29	43

DATA SET: All Files
Serious Injury Index

No. of Cases: 149

U.S. 5 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
13 ; 9 %

In Flight Fire Cases
1 ; 1 %

		Bent	Yes	No
PROP #1	-	44	33	2	20	9	40	23	4	24		92	8
PROP #2	-	30	50	0	20	10	60	30	0	0		80	20

TABLE 7.12A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Serious Injury Index

No. of Cases 149 US: 8 CAN: 141

	Yes	No	Unk
ELT Installed	53	12	84
ELT Armed	44	2	7
ELT Activated	37	9	7
ELT Aid in Search	18	13	22
ELT in Mount After Impact	18	2	33
Antenna Intact	24	2	27
Antenna Cable Connected	2	1	50
ELT Battery Expired	0	3	50
Search Required	34	22	93

How Did ELT Aid in Search?

Initial Alerting	12
Detection by Airborne SAR	1
Final Homing	9
Voice Communication	0

Activate		ELT Location	
Auto	34	Aft Fuselage	29
Man.	2	Cabin	6
		Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	7
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	4
Searchers Not Equipped	1
Under Water	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	3
Broke Loose From Mount	1
Internal Malfunction	2
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	0	122	16	10
Crew	0	4	3	2
Passengers	0	91	48	34
Outsiders	0	0	0	0

TABLE 7.12 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	50	-	-	-	-	57	37	7	0	0	59	6	35
CABIN	50	100	0	0	0	67	31	2	0	0	58	6	36
NOSE	59	96	0	3	1	26	53	20	1	0	58	7	35
AFT FUS.	50	96	1	1	2	74	21	5	0	0	58	5	37
TAIL CONE	50	100	0	0	0	100	0	0	0	0	59	0	41
RT INBD WING	50	90	0	3	7	74	17	9	[illegible]	0	60	5	35
RT OTBD WING	50	86	5	7	2	52	33	16	0	0	57	7	36
LT INBD WING	50	92	0	3	5	75	20	5	0	0	62	4	34
LT OTBD WING	50	91	4	4	2	53	33	14	0	0	60	5	34
RT HORIZONTAL	50	95	5	0	0	92	7	1	0	0	56	6	38
LT HORIZONTAL	50	94	5	0	1	88	9	1	1	0	57	6	37
VERTICAL	50	94	4	0	1	84	9	7	0	0	57	6	37
MAIN GEAR	50	71	0	9	20	41	25	26	7	1	-	-	-
NOSE/TAIL GEAR	50	76	2	10	12	49	24	20	7	0	-	-	-
ENG #1	0	98	0	1	1	39	47	12	1	1	51	5	44
ENG #2	-	100	0	0	0	57	43	0	0	0	0	100	0

DATA SET: ALL Files
Minor/None Injury Index

No. of Cases: 148

U.S. 17 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
1 ; 1 %

In Flight Fire Cases
1 ; 1 %

		Bent	Yes	No
PROP #1	-	87	1	1	10	47	[illegible]	14	1	3		83	17
PROP #2	-	83	0	0	17	25	[illegible]	0	0	0		100	0

TABLE 7.13 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Minor/None Injury Index

No. of Cases 148	US: 25	CAN: 123	
	Yes	No	Unk
ELT Installed	144	2	2
ELT Armed	95	6	43
ELT Activated	69	52	23
ELT Aid in Search	27	31	86
ELT in Mount After Impact	47	2	95
Antenna Intact	32	1	111
Antenna Cable Connected	0	0	144
ELT Battery Expired	0	5	139
Search Required	49	68	31

How Did ELT Aid in Search?

Initial Alerting	16
Detection by Airborne SAR	4
Final Homing	12
Voice Communication	0

Activate		ELT Location	
Auto	49	Aft Fuselage	84
Man.	17	Cabin	15
		Cockpit	6

ELT Activated, But Did Not Aid in Search

Search Not Required	26
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	2

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	42
Destroyed/Damaged by Impact	1
Broke Loose From Mount	1
Internal Malfunction	0
Tested OK After Accident	

	Fatal	Serious	Minor	None
Pilot	0	0	33	115
Crew	0	0	4	8
Passengers	0	0	28	125
Outsiders	1	0	0	0

TABLE 7.13 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	2	6	48	42	2	52	20	27
CABIN	84	36	0	30	34	2	9	48	39	2	52	20	28
NOSE	75	23	0	38	39	1	2	52	42	3	51	21	28
AFT FUS.	61	39	4	21	35	18	24	34	24	0	51	22	27
TAIL CONE	26	35	17	16	33	38	7	25	30	0	59	20	21
RT INBD WING	71	30	0	17	53	6	25	41	29	0	53	22	26
RT OTBD WING	49	27	24	10	39	7	24	43	26	0	52	21	27
LT INBD WING	68	28	0	20	52	7	25	41	27	0	51	21	28
LT OTBD WING	51	27	28	9	36	6	27	42	25	0	51	20	28
RT HORIZONTAL	39	40	30	6	24	44	22	16	17	1	51	19	30
LT HORIZONTAL	41	40	30	6	24	46	20	16	17	0	50	19	30
VERTICAL	40	41	28	9	22	44	23	16	16	0	51	18	31
MAIN GEAR	46	24	9	16	41	19	13	37	24	8	-	-	-
NOSE/TAIL GEAR	43	36	7	21	39	26	11	32	27	4	-	-	-
ENG #1	[illegible]	[illegible]	[illegible]	30	52	6	21	44	23	5	46	22	32
ENG #2	-	9	7	13	70	5	18	50	26	2	60	7	33

	Bent	Yes	No
PROP #1	-	15	28	6	52	3	21	50	16	9	98	2
PROP #2	-	7	36	2	56	2	13	53	29	4	98	2

DATA SET: BASIC Group
Fatal Injury Index

No. of Cases: 529

U.S. 75 %

In Flight Breakup
56 ; 9 %

Ground Fire Cases
168 ; 27 %

In Flight Fire Cases
8 ; 1 %

TABLE 7.14 A

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	2	6	48	42	2	52	20	27
CABIN	84	36	0	30	34	2	9	48	39	2	52	20	28
NOSE	75	23	0	38	39	1	2	52	42	3	51	21	28
AFT FUS.	61	39	4	21	35	18	24	34	24	0	51	22	27
TAIL CONE	26	35	17	16	33	38	7	25	30	0	59	20	21
RT INBD WING	71	30	0	17	53	6	25	41	29	0	53	22	26
RT OTBD WING	49	27	24	10	39	7	24	43	26	0	52	21	27
LT INBD WING	68	28	0	20	52	7	25	41	27	0	51	21	28
LT OTBD WING	51	27	28	9	36	6	27	42	25	0	51	20	28
RT HORIZONTAL	39	40	30	6	24	44	22	16	17	1	51	19	30
LT HORIZONTAL	41	40	30	6	24	46	20	16	17	0	50	19	30
VERTICAL	40	41	28	9	22	44	23	16	16	0	51	18	31
MAIN GEAR	46	24	9	16	41	19	13	37	24	8	-	-	-
NOSE/TAIL GEAR	43	30	7	21	39	26	11	32	27	4	-	-	-
ENG #1	-	-	-	30	52	6	21	44	23	5	46	22	32
ENG #2	-	9	7	13	70	5	18	50	26	2	60	7	33

											Bent	Yes	No
PROP #1	-	15	28	6	52	3	21	50	16	9		98	2
PROP #2	-	7	36	2	56	2	13	53	29	4		98	2

DATA SET: BASIC Group Fatal Injury Index

No. of Cases: 529

U.S. 75 %

In Flight Breakup

56 ; 9 %

Ground Fire Cases

168 ; 27 %

In Flight Fire Cases

8 ; 1 %

TABLE 7.14 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Fatal Injury Index

No. of Cases 629 US: 469 CAN: 160

	Yes	No	Unk
ELT Installed	441	105	83
ELT Armed	215	40	186
ELT Activated	145	114	182
ELT Aid in Search	58	157	226
ELT in Mount After Impact	24	32	385
Antenna Intact	31	19	391
Antenna Cable Connected	2	47	392
ELT Battery Expired	20	34	387
Search Required	209	343	77

How Did ELT Aid in Search?

Initial Alerting	33
Detection by Airborne SAR	17
Final Homing	26
Voice Communication	2

Activate		ELT Location	
Auto	146	Aft Fuselage	68
Man.	0	Cabin	13
		Cockpit	4

ELT Activated, But Did Not Aid in Search

Search Not Required	47
Battery Went Dead	1
Antenna Disconnected	17
Antenna Shielded	2
Searchers Not Equipped	1
Under Water	10

Why ELT Did Not Activate

Battery Dead	9
Corrosion Damage	11
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	122
Broke Loose From Mount	9
Internal Malfunction	19
Tested OK After Accident	11

	Fatal	Serious	Minor	None
Pilot	628	0	0	0
Crew	65	0	0	0
Passengers	619	0	0	0
Outsiders	15	2	5	0

TABLE 7.14 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	79	-	-	-	-	2	7	53	38	0	59	20	20
CABIN	81	37	0	34	29	2	11	51	36	0	59	21	21
NOSE	71	23	0	44	33	1	3	58	38	0	59	21	20
AFT FUS.	59	45	3	22	30	22	22	33	22	0	60	20	21
TAIL CONE	31	35	17	16	33	38	7	25	30	0	58	20	21
RT INBD WING	68	34	0	20	46	7	26	40	27	0	56	23	21
RT OTBD WING	47	31	22	10	37	8	25	41	26	0	56	22	22
LT INBD WING	68	31	0	24	45	7	26	40	27	0	56	23	21
LT OTBD WING	52	30	24	10	36	6	27	42	25	0	56	22	22
RT HORIZONTAL	39	45	24	8	23	47	18	17	18	0	57	19	24
LT HORIZONTAL	40	45	25	7	23	47	18	18	17	0	56	19	24
VERTICAL	39	47	25	9	19	46	20	17	16	0	57	19	24
MAIN GEAR	54	35	9	17	40	22	13	38	27	0	-	-	-
NOSE/TAIL GEAR	53	32	6	22	40	25	10	34	30	0	-	-	-
ENG #1	59	18	1	34	47	7	27	46	18	2	55	22	24
ENG #2	-	7	7	15	71	4	22	45	29	0	75	0	25

											Bent	Yes	No
PROP #1	-	16	27	5	52	3	22	55	18	2		97	3
PROP #2	-	6	35	2	57	0	15	55	30	0		100	0

DATA SET: BASIC Group
U.S. Accidents
Fatal Injury Index

No. of Cases: 469
U.S. 100 %
In Flight Breakup
50 ; 11 %
Ground Fire Cases
131 ; 30 %
In Flight Fire Cases
8 ; 2 %

TABLE 7.15 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, U.S. Accidents, Fatal Injury Index

No. of Cases 469 US: 469 CAN: 0

	Yes	No	Unk
ELT Installed	365	78	26
ELT Armed	152	31	182
ELT Activated	105	93	167
ELT Aid in Search	42	146	177
ELT in Mount After Impact	12	29	324
Antenna Intact	20	11	334
Antenna Cable Connected	1	43	321
ELT Battery Expired	20	34	311
Search Required	122	323	24

ELT Activated, But Did Not Aid in Search

Search Not Required	43
Battery Went Dead	0
Antenna Disconnected	14
Antenna Shielded	1
Searchers Not Equipped	1
Under Water	7

	Fatal	Serious	Minor	None
Pilot	468	0	0	0
Crew	51	0	0	0
Passengers	436	0	0	0
Outsiders	15	2	5	0

How Did ELT Aid in Search?

Initial Alerting	20
Detection by Airborne SAR	15
Final Homing	25
Voice Communication	2

Activate	
Auto	106
Man.	0

ELT Location	
Aft Fuselage	12
Cabin	4
Cockpit	2

Why ELT Did Not Activate

Battery Dead	8
Corrosion Damage	8
Insufficient Force to Activate	8
Destroyed/Damaged by Impact	104
Broke Loose From Mount	9
Internal Malfunction	16
Tested OK After Accident	11

TABLE 7.15 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	92	-	-	-	-	2	2	31	56	9	33	20	47
CABIN	92	33	0	18	49	2	5	37	49	8	34	19	47
NOSE	92	22	0	17	61	0	2	33	53	12	31	22	47
AFT FUS.	70	21	9	19	51	5	30	37	28	0	28	28	43
TAIL CONE	8	0	0	0	0	0	0	0	0	0	100	0	0
RT INBD WING	78	18	0	8	74	3	19	45	34	0	40	17	43
RT OTBD WING	57	15	33	9	43	3	19	50	27	0	39	18	43
LT INBD WING	70	19	0	7	74	6	21	44	29	1	36	15	49
LT OTBD WING	49	18	39	6	37	3	29	42	25	1	37	15	47
RT HORIZONTAL	41	24	48	2	27	34	35	12	15	4	32	19	49
LT HORIZONTAL	43	24	46	1	29	43	36	10	15	2	32	19	49
VERTICAL	43	23	41	8	29	37	34	12	17	0	33	15	52
MAIN GEAR	16	30	9	15	47	6	13	31	12	38	-	-	-
NOSE/TAIL GEAR	8	56	38	0	6	41	11	7	0	41	-	-	-
ENG #1	81	16	2	13	68	1	3	38	42	17	16	23	60
ENG #2	-	17	8	8	67	9	0	73	9	9	0	33	67

DATA SET: BASIC Group
Canadian Accidents,
Fatal Injury Index

No. of Cases: 160

U.S. 0 %

In Flight Breakup
6 ; 4 %

Ground Fire Cases
37 ; 23 %

In Flight Fire Cases
0 ; 0 %

											Bent	Yes	No
PROP #1	-	11	29	7	53	5	20	33	9	33		99	1
PROP #2	-	13	38	0	50	13	0	38	25	25		83	17

TABLE 7.16 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Canadian Accidents, Fatal Injury Index

No. of Cases 160 US: 0 CAN: 160

	Yes	No	Unk
ELT Installed	76	27	57
ELT Armed	63	9	4
ELT Activated	40	21	15
ELT Aid in Search	16	11	49
ELT in Mount After Impact	12	3	61
Antenna Intact	11	8	57
Antenna Cable Connected	1	4	71
ELT Battery Expired	0	0	76
Search Required	87	20	53

ELT Activated, But Did Not Aid in Search

Search Not Required	4
Battery Went Dead	1
Antenna Disconnected	3
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	3

	Fatal	Serious	Minor	None
Pilot	160	0	0	0
Crew	14	0	0	0
Passengers	183	0	0	0
Outsiders	0	0	0	0

How Did ELT Aid in Search?

Initial Alerting	13
Detection by Airborne SAR	2
Final Homing	1
Voice Communication	0

Activate		ELT Location	
Auto	40	Aft Fuselage	56
Man.	0	Cabin	9
		Cockpit	2

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	3
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	18
Broke Loose From Mount	0
Internal Malfunction	3
Tested OK After Accident	0

TABLE 7.16 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	80	-	-	-	-	11	21	45	23	0	47	20	33
CABIN	80	73	0	9	18	16	31	34	19	0	47	20	33
NOSE	64	42	0	30	28	7	15	49	26	3	47	21	32
AFT FUS.	64	70	2	10	17	44	28	17	11	0	43	22	35
TAIL CONE	16	71	14	2	12	76	13	4	7	0	56	12	33
RT INBD WING	68	50	0	17	34	23	36	39	12	0	48	25	27
RT OTBD WING	36	42	29	5	24	18	26	46	10	0	49	24	27
LT INBD WING	68	48	0	15	37	24	30	31	15	0	41	27	32
LT OTBD WING	44	43	33	2	21	17	36	35	11	0	41	28	30
RT HORIZONTAL	36	66	16	2	16	68	19	8	6	0	45	22	33
LT HORIZONTAL	32	66	19	1	14	69	14	10	6	0	44	23	33
VERTICAL	28	69	17	3	10	68	19	8	5	0	44	22	34
MAIN GEAR	36	48	6	7	38	32	17	32	14	4	-	-	-
NOSE/TAIL GEAR	28	49	7	17	26	42	13	29	13	3	-	-	-
ENG #1	64	36	1	27	35	20	33	28	13	6	47	21	32
ENG #2	-	25	17	8	50	27	36	36	0	0	40	0	60

											Bent	Yes	No
PROP #1	-	44	24	4	28	19	27	42	6	6		89	11
PROP #2	-	40	50	0	10	30	10	60	0	0		89	11

DATA SET: BASIC Group, Fatal With Survivors

No. of Cases: 146

U.S. 74 %

In Flight Breakup

1 ; 1 %

Ground Fire Cases

25 ; 17 %

In Flight Fire Cases

1 ; 1 %

TABLE 7.17 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Fatal With Survivors

No. of Cases 146 US: 108 CAN: 38

	Yes	No	Unk
ELT Installed	106	12	28
ELT Armed	63	6	37
ELT Activated	48	26	32
ELT Aid in Search	13	57	36
ELT in Mount After Impact	9	4	93
Antenna Intact	15	4	87
Antenna Cable Connected	2	9	95
ELT Battery Expired	7	9	90
Search Required	36	86	24

How Did ELT Aid in Search?

Initial Alerting	5
Detection by Airborne SAR	6
Final Homing	6
Voice Communication	0

Activate		ELT Location	
Auto	43	Aft Fuselage	13
Man.	2	Cabin	6
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	22
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	1
Searchers Not Equipped	2
Under Water	6

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	2
Insufficient Force to Activate	3
Destroyed/Damaged by Impact	10
Broke Loose From Mount	5
Internal Malfunction	3
Tested OK After Accident	

	Fatal	Serious	Minor	None
Pilot	79	54	6	7
Crew	6	17	4	0
Passengers	126	115	43	9
Outsiders	0	1	2	0

TABLE 7.17 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	79	-	-	-	-	13	25	48	13	0	52	20	28
CABIN	79	80	0	11	9	18	36	36	11	0	52	20	28
NOSE	43	48	0	36	15	8	17	61	15	0	50	23	28
AFT FUS.	50	79	0	11	11	54	25	15	6	0	49	19	32
TAIL CONE	29	73	13	2	13	76	13	4	7	0	54	12	34
RT INBD WING	71	59	0	17	24	30	35	27	8	0	52	23	25
RT OTBD WING	36	51	21	5	22	23	27	42	8	0	53	21	25
LT INBD WING	64	55	0	18	27	28	34	28	10	0	45	26	29
LT OTBD WING	50	50	29	1	20	22	39	31	9	0	46	26	28
RT HORIZONTAL	43	76	12	1	12	71	18	6	4	0	51	19	31
LT HORIZONTAL	36	74	14	0	12	73	14	10	3	0	50	20	30
VERTICAL	29	77	13	1	10	73	15	9	3	0	50	18	32
MAIN GEAR	43	53	8	6	32	40	18	27	14	1	-	-	-
NOSE/TAIL GEAR	43	51	5	19	24	41	14	30	12	3	-	-	-
ENG #1	50	41	1	30	28	25	42	25	7	1	48	24	28
ENG #2	-	33	22	0	44	33	44	22	0	0	50	0	50

DATA SET: BASIC Group
U.S., Fatal With Survivors

No. of Cases: 108

U.S. 100 %

In Flight Breakup
1 ; 1 %

Ground Fire Cases
14 ; 13 %

In Flight Fire Cases
1 ; 1 %

											Bent	Yes	No
PROP #1	-	46	27	1	26	19	27	46	6	2		91	9
PROP #2	-	40	50	0	10	30	10	60	0	0		89	11

TABLE 7.18 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, U.S. Fatal With Survivors

No. of Cases 108 US: 108 CAN: 0

	Yes	No	Unk
ELT Installed	90	11	7
ELT Armed	49	5	36
ELT Activated	40	22	28
ELT Aid in Search	11	53	26
ELT in Mount After Impact	7	4	79
Antenna Intact	11	3	76
Antenna Cable Connected	2	9	79
ELT Battery Expired	7	9	74
Search Required	23	81	4

ELT Activated, But Did Not Aid in Search

Search Not Required	20
Battery Went Dead	0
Antenna Disconnected	2
Antenna Shielded	1
Searchers Not Equipped	1
Under Water	4

	Fatal	Serious	Minor	None
Pilot	63	39	3	3
Crew	3	17	2	0
Passengers	89	86	26	1
Outsiders	0	1	0	0

How Did ELT Aid in Search?

Initial Alerting	3
Detection by Airborne SAR	6
Final Homing	6
Voice Communication	0

Activate		ELT Location	
Auto	36	Aft Fuselage	3
Man.	1	Cabin	4
		Cockpit	1

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	2
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	7
Broke Loose From Mount	1
Internal Malfunction	4
Tested OK After Accident	3

TABLE 7.18 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	82	-	-	-	-	3	10	34	52	0	27	23	50
CABIN	82	48	0	3	48	10	17	30	43	0	27	23	50
NOSE	91	22	0	7	70	3	10	14	62	10	33	17	50
AFT FUS.	82	42	10	10	39	13	40	23	23	0	23	32	45
TAIL CONE	0	0	100	0	0	100	0	0	0	0	100	0	0
RT INBD WING	64	17	0	17	66	0	37	37	26	0	29	35	35
RT OTBD WING	35	11	56	4	30	0	22	59	19	0	29	35	35
LT INBD WING	73	42	0	7	69	10	17	41	31	0	24	29	47
LT OTBD WING	36	19	48	7	26	4	29	50	18	0	22	39	39
RT HORIZONTAL	27	34	31	3	31	56	20	12	12	0	21	37	42
LT HORIZONTAL	27	39	36	4	21	56	16	12	16	0	23	36	41
VERTICAL	27	47	30	10	13	50	32	7	11	0	22	35	43
MAIN GEAR	27	26	0	11	63	5	15	50	15	15	-	-	-
NOSE/TAIL GEAR	9	29	29	0	43	57	0	14	29	0	-	-	-
ENG #1	82	20	0	20	60	4	4	38	31	23	42	8	50
ENG #2	-	0	0	33	67	0	0	100	0	0	0	0	0

											Bent	Yes	No
PROP #1	-	31	13	19	38	16	32	26	5	21		86	14
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

DATA SET: BASIC Group Canadian, Fatal With Survivors

No. of Cases: 38

U.S. 0 %

In Flight Breakup

0 ; 0 %

Ground Fire Cases

11 ; 29 %

In Flight Fire Cases

0 ; 0 %

TABLE 7.19 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Canadian, Fatal With Survivors

No. of Cases 38 US: 0 CAN: 38

	Yes	No	Unk
ELT Installed	16	1	12
ELT Armed	14	1	1
ELT Activated	8	4	4
ELT Aid in Search	2	4	10
ELT in Mount After Impact	2	0	14
Antenna Intact	4	1	11
Antenna Cable Connected	0	0	16
ELT Battery Expired	0	0	16
Search Required	13	5	20

How Did ELT Aid in Search?

Initial Alerting	2
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate		ELT Location	
Auto	7	Aft Fuselage	10
Man.	1	Cabin	2
		Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	2
Battery Went Dead	0
Antenna Disconnected	1
Antenna Shielded	0
Searchers Not Equipped	1
Under Water	2

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	3
Broke Loose From Mount	0
Internal Malfunction	1
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	16	15	3	4
Crew	3	0	2	0
Passengers	37	29	17	8
Outsiders	0	0	2	0

TABLE 7.19 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	92	-	-	-	-	9	45	31	12	2	43	13	44
CABIN	92	89	0	3	8	22	42	23	10	2	42	14	44
NOSE	77	56	0	16	28	3	22	53	16	6	35	20	45
AFT FUS.	62	81	2	4	14	39	35	21	5	0	43	13	44
TAIL CONE	15	0	0	0	0	0	0	0	0	0	0	0	100
RT INBD WING	62	59	0	5	36	31	35	26	8	0	41	13	46
RT OTBD WING	31	55	29	3	13	27	37	30	5	0	40	13	47
LT INBD WING	69	58	0	10	32	27	44	21	7	1	43	12	45
LT OTBD WING	38	55	30	3	12	24	46	25	4	1	38	14	47
RT HORIZONTAL	23	77	10	3	10	71	17	8	4	0	42	17	42
LT HORIZONTAL	23	76	11	4	9	75	15	8	3	0	43	15	42
VERTICAL	31	78	9	5	8	66	19	9	3	0	42	15	43
MAIN GEAR	31	70	2	11	18	21	21	27	7	25	-	-	-
NOSE/TAIL GEAR	15	72	7	10	10	47	28	6	3	16	-	-	-
ENG #1	69	56	4	17	22	7	23	54	7	9	21	25	54
ENG #2	-	42	33	8	17	17	17	58	8	0	29	29	43

											Bent	Yes	No
PROP #1	-	45	32	3	21	8	40	22	5	25		92	8
PROP #2	-	30	50	0	20	10	60	30	0	0		80	20

DATA SET: BASIC Group
Serious Injury Index

No. of Cases: 141

U.S. 0 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
13 ; 9 %

In Flight Fire Cases
1 ; 1 %

TABLE 7.20 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Serious Injury Index

No. of Cases 141 US: 0 CAN: 141

	Yes	No	Unk
ELT Installed	46	11	84
ELT Armed	38	2	6
ELT Activated	30	9	7
ELT Aid in Search	11	13	22
ELT in Mount After Impact	17	2	27
Antenna Intact	24	2	20
Antenna Cable Connected	2	1	43
ELT Battery Expired	0	0	46
Search Required	27	21	93

How Did ELT Aid in Search?

Initial Alerting	10
Detection by Airborne SAR	0
Final Homing	3
Voice Communication	0

Activate

Auto	29
Man.	1

ELT Location

Aft Fuselage	28
Cabin	6
Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	7
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	4
Searchers Not Equipped	1
Under Water	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	3
Broke Loose From Mount	1
Internal Malfunction	2
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	0	115	16	10
Crew	0	4	3	2
Passengers	0	84	45	34
Outsiders	0	0	0	0

TABLE 7.20 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	85	-	-	-	-	14	20	41	24	1	49	20	32
CABIN	88	66	0	18	15	18	24	35	21	1	49	20	31
NOSE	71	48	0	32	20	6	17	50	26	2	47	21	32
AFT FUS.	59	63	4	16	17	34	32	27	6	0	50	20	30
TAIL CONE	9	67	18	8	7	74	10	11	4	0	56	23	21
RT INBD WING	68	51	0	13	37	20	26	37	16	0	52	20	28
RT OTBD WING	41	45	22	7	27	16	27	40	17	0	52	19	29
LT INBD WING	62	51	0	17	33	22	30	24	14	0	49	20	31
LT OTBD WING	47	46	27	6	21	17	33	35	15	0	50	21	29
RT HORIZONTAL	26	58	27	4	10	64	23	8	5	0	48	22	30
LT HORIZONTAL	26	60	27	4	9	65	19	11	5	0	48	23	29
VERTICAL	26	60	27	7	7	66	23	8	3	0	49	22	29
MAIN GEAR	32	54	7	13	27	32	19	30	12	8	-	-	-
NOSE/TAIL GEAR	29	46	6	19	29	36	18	25	19	3	-	-	-
ENG #1	74	43	1	29	27	16	34	36	12	2	41	20	39
ENG #2	-	35	12	15	38	16	26	52	6	0	59	18	24

	Bent	Yes	No
PROP #1	-	95	5
PROP #2	-	87	13

DATA SET: ALL Files
ELT Activated

No. of Cases: 353

U.S. 65 %

In Flight Breakup
6 ; 2 %

Ground Fire Cases
34 ; 10 %

In Flight Fire Cases
2 ; 1 %

TABLE 7.21 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, ELT Activated

No. of Cases 353 US: 228 CAN: 125

	Yes	No	Unk
ELT Installed	353	0	0
ELT Armed	335	0	18
ELT Activated	353	0	0
ELT Aid in Search	167	151	35
ELT in Mount After Impact	55	11	287
Antenna Intact	53	7	293
Antenna Cable Connected	3	12	338
ELT Battery Expired	10	23	320
Search Required	195	126	32

How Did ELT Aid in Search?

Initial Alerting	76
Detection by Airborne SAR	34
Final Homing	95
Voice Communication	1

Activate		ELT Location	
Auto	322	Aft Fuselage	109
Man.	22	Cabin	18
		Cockpit	6

ELT Activated, But Did Not Aid in Search

Search Not Required	103
Battery Went Dead	1
Antenna Disconnected	16
Antenna Shielded	8
Searchers Not Equipped	4
Under Water	5

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	12
Broke Loose From Mount	1
Internal Malfunction	1
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	223	51	29	49
Crew	23	11	6	3
Passengers	265	90	56	68
Outsiders	2	0	0	0

TABLE 7.21 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	87	-	-	-	-	5	17	51	26	2	46	24	30
CABIN	90	59	0	24	16	9	21	45	23	2	46	24	30
NOSE	73	38	0	42	21	3	9	57	20	3	44	26	31
AFT FUS.	60	60	6	16	19	29	35	28	8	0	48	24	28
TAIL CONE	7	68	20	8	3	79	7	13	2	0	55	24	22
RT INBD WING	70	46	0	15	39	12	32	41	16	0	50	23	27
RT OTBD WING	40	40	27	5	28	10	31	45	14	0	50	22	28
LT INBD WING	67	42	0	19	38	12	34	40	15	0	44	25	31
LT OTBD WING	50	39	34	5	22	11	34	42	13	0	44	26	30
RT HORIZONTAL	27	58	28	4	10	61	28	7	4	1	47	23	30
LT HORIZONTAL	27	61	27	3	9	63	23	9	4	1	46	25	29
VERTICAL	27	59	26	7	8	62	27	8	4	0	48	22	30
MAIN GEAR	30	48	9	14	29	26	19	35	9	12	-	-	-
NOSE/TAIL GEAR	27	43	6	24	27	36	15	31	15	4	-	-	-
ENG #1	73	31	2	36	32	12	30	41	13	3	36	24	40
ENG #2	-	18	14	14	55	9	23	59	9	0	67	0	33

DATA SET: BASIC Group
ELT Activated

No. of Cases: 223

U.S. 65 %

In Flight Breakup

4 ; 2 %

Ground Fire Cases

30 ; 13 %

In Flight Fire Cases

1 ; 1 %

											Bent	Yes	No
PROP #1	-	28	29	4	39	5	30	50	7	9		98	2
PROP #2	-	21	42	0	37	5	32	47	11	5		90	10

TABLE . 7 .22 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Activated

No. of Cases 223 US: 145 CAN: 78

	Yes	No	Unk
ELT Installed	223	0	0
ELT Armed	221	0	2
ELT Activated	223	0	0
ELT Aid in Search	82	118	23
ELT in Mount After Impact	32	9	182
Antenna Intact	32	7	184
Antenna Cable Connected	2	10	211
ELT Battery Expired	8	12	203
Search Required	105	100	18

ELT Activated, But Did Not Aid in Search

Search Not Required	75
Battery Went Dead	1
Antenna Disconnected	14
Antenna Shielded	7
Searchers Not Equipped	4
Under Water	4

	Fatal	Serious	Minor	None
Pilot	177	37	7	2
Crew	18	10	2	0
Passengers	204	72	31	4
Outsiders	2	0	0	0

How Did ELT Aid in Search?

Initial Alerting	48
Detection by Airborne SAR	23
Final Homing	35
Voice Communication	1

Activate		ELT Location	
Auto	217	Aft Fuselage	66
Man.	3	Cabin	11
		Cockpit	5

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	11
Broke Loose From Mount	1
Internal Malfunction	1
Tested OK After Accident	0

TABLE 7.22 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	83	-	-	-	-	2	2	31	65	0	78	7	16
CABIN	87	17	0	24	59	2	2	33	64	0	77	7	16
NOSE	75	14	0	27	59	1	2	34	63	0	76	9	16
AFT FUS.	67	20	2	23	56	7	11	35	46	0	74	10	16
TAIL CONE	29	16	16	18	50	23	8	25	44	0	70	15	15
RT INBD WING	63	15	0	17	68	5	13	38	44	0	71	13	16
RT OTBD WING	42	15	23	10	52	8	18	37	38	0	70	13	18
LT INBD WING	68	13	0	18	70	5	12	35	48	0	70	17	13
LT OTBD WING	50	13	23	9	55	5	20	34	41	0	68	14	18
RT HORIZONTAL	43	17	35	8	40	27	21	19	33	0	64	14	22
LT HORIZONTAL	45	16	38	6	41	27	23	18	33	0	62	14	23
VERTICAL	39	18	35	11	36	30	22	18	31	0	64	12	24
MAIN GEAR	53	14	5	16	64	11	5	36	42	5	-	-	-
NOSE/TAIL GEAR	50	19	5	17	59	11	6	37	45	1	-	-	-
ENG #1	61	9	0	18	73	4	18	44	31	3	64	18	18
ENG #2	-	0	13	0	88	10	10	38	38	5	50	0	50

DATA SET: BASIC Group
ELT Destroyed/Damaged By Crash

No. of Cases: 135

U.S. 82 %

In Flight Breakup
15 ; 11 %

Ground Fire Cases
75 ; 56 %

In Flight Fire Cases
4 ; 3 %

											Bent	Yes	No
PROP #1	-	7	22	2	69	2	22	52	19	5		99	1
PROP #2	-	11	28	0	61	6	6	35	41	12		100	1

TABLE 7.23 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Destroyed/Damaged By Crash

No. of Cases 135 US: 111 CAN: 24

	Yes	No	Unk
ELT Installed	135	0	0
ELT Armed	30	3	102
ELT Activated	11	58	66
ELT Aid in Search	0	32	103
ELT in Mount After Impact	4	8	123
Antenna Intact	1	4	130
Antenna Cable Connected	0	12	123
ELT Battery Expired	1	7	127
Search Required	42	83	10

How Did ELT Aid in Search?

Initial Alerting	0
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate	
Auto	10
Man.	1

ELT Location	
Aft Fuselage	16
Cabin	7
Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	1
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	135
Broke Loose From Mount	2
Internal Malfunction	1
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	129	4	1	0
Crew	11	3	2	0
Passengers	160	13	16	2
Outsiders	3	2	3	0

TABLE 7.23 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	81	-	-	-	-	29	26	18	23	4	51	9	40
CABIN	81	78	0	7	15	37	25	18	17	3	50	10	40
NOSE	81	68	0	13	20	12	31	28	22	7	48	11	40
AFT FUS.	69	69	3	8	20	41	31	20	9	0	45	14	42
TAIL CONE	13	63	17	0	0	100	0	0	0	0	73	0	27
RT INBD WING	56	59	0	4	36	42	22	23	13	0	52	9	38
RT OTBD WING	38	56	21	6	17	30	28	32	10	0	49	10	40
LT INBD WING	63	59	0	6	35	44	21	23	12	0	49	10	41
LT OTBD WING	38	58	25	2	16	30	33	25	12	0	47	13	40
RT HORIZONTAL	k9	67	20	1	12	70	20	5	3	1	46	12	42
LT HORIZONTAL	19	69	20	1	11	74	18	3	5	0	46	13	42
VERTICAL	13	69	17	4	11	64	26	7	3	0	46	11	43
MAIN GEAR	6	59	2	14	25	22	19	33	6	21	-	-	-
NOSE/TAIL GEAR	6	67	6	8	20	40	31	13	4	13	-	-	-
ENG #1	69	66	2	9	24	18	29	30	12	10	37	10	53
ENG #2	-	53	11	5	32	32	21	36	5	5	0	50	50

											Bent	Yes	No
PROP #1	-	59	12	3	26	24	33	21	3	19		92	8
PROP #2	-	50	21	0	29	18	55	18	0	9		90	10

DATA SET: ALL Files Canadian Accidents, ELT Unit is One of Five Most Common Types

No. of Cases: 229

U.S. 0 %

In Flight Breakup

1 ; 1 %

Ground Fire Cases

15 ; 7 %

In Flight Fire Cases

1 ; 1 %

TABLE 7.24 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Canadian Accidents, ELT Unit is One of Five Most Common Types

No. of Cases 229 US: 0 CAN: 229

	Yes	No	Unk
ELT Installed	225	2	2
ELT Armed	172	14	39
ELT Activated	106	80	39
ELT Aid in Search	32	48	145
ELT in Mount After Impact	68	6	151
Antenna Intact	53	9	163
Antenna Cable Connected	1	4	220
ELT Battery Expired	0	0	225
Search Required	105	87	37

How Did ELT Aid in Search?

Initial Alerting	28
Detection by Airborne SAR	3
Final Homing	6
Voice Communication	0

Activate		ELT Location	
Auto	92	Aft Fuselage	160
Man.	13	Cabin	30
		Cockpit	9

ELT Activated, But Did Not Aid in Search

Search Not Required	33
Battery Went Dead	1
Antenna Disconnected	6
Antenna Shielded	3
Searchers Not Equipped	2
Under Water	7

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	3
Insufficient Force to Activate	41
Destroyed/Damaged by Impact	21
Broke Loose From Mount	2
Internal Malfunction	6
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	70	32	25	102
Crew	5	4	4	8
Passengers	90	44	57	119
Outsiders	0	0	0	0

TABLE 7.24 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	63	-	-	-	-	9	16	44	30	0	45	25	30
CABIN	63	58	0	25	17	13	18	41	28	0	45	25	30
NOSE	38	39	1	37	22	5	11	52	32	0	39	30	31
AFT FUS.	56	61	4	18	16	31	30	26	14	0	51	24	25
TAIL CONE	25	63	13	5	20	54	14	16	16	0	46	29	25
RT INBD WING	69	48	0	14	38	15	29	34	22	0	52	28	21
RT OTBD WING	50	37	17	7	39	6	28	44	22	0	52	27	21
LT INBD WING	50	47	0	16	37	17	27	36	20	0	53	26	21
LT OTBD WING	44	45	20	9	26	13	30	38	19	0	52	27	21
RT HORIZONTAL	31	60	21	6	13	53	20	17	10	0	51	21	27
LT HORIZONTAL	31	58	21	7	14	52	19	19	10	0	51	21	27
VERTICAL	31	60	20	10	9	53	21	17	8	0	52	20	28
MAIN GEAR	44	48	7	11	34	28	20	26	26	0	-	-	-
NOSE/TAIL GEAR	44	45	6	16	33	32	16	24	27	0	-	-	-
ENG #1	63	33	1	24	42	13	39	38	11	0	43	29	29
ENG #2	-	14	0	0	86	0	43	43	14	0	50	0	50

DATA SET: ALL Files
U.S. Accidents,
ELT Unit is One of Five
Most Common **Types**

No. of Cases: 105
U.S. 100 %
In Flight Breakup
6 ; 6 %
Ground Fire Cases
16 ; 15 %
In Flight Fire Cases
2 ; 2 %

											Bent	Yes	No
PROP #1	-	24	29	4	43	5	28	52	15	0		98	2
PROP #2	-	0	57	0	43	0	0	86	14	0		100	0

TABLE 7.25 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: All Files, U.S. Accidents, ELT Unit is One of Five Most Common Types

No. of Cases 105 US: 105 CAN: 0

	Yes	No	Unk
ELT Installed	105	0	0
ELT Armed	75	2	28
ELT Activated	58	23	24
ELT Aid in Search	36	36	33
ELT in Mount After Impact	22	16	67
Antenna Intact	10	3	92
Antenna Cable Connected	3	11	91
ELT Battery Expired	16	38	51
Search Required	54	49	2

ELT Activated, But Did Not Aid in Search

Search Not Required	15
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	1
Searchers Not Equipped	1
Under Water	0

	Fatal	Serious	Minor	None
Pilot	84	14	3	4
Crew	9	1	1	0
Passengers	86	16	3	1
Outsiders	2	0	0	0

How Did ELT Aid in Search?

Initial Alerting	10
Detection by Airborne SAR	13
Final Homing	33
Voice Communication	0

Activate	
Auto	57
Man.	0

ELT Location	
Aft Fuselage	16
Cabin	6
Cockpit	4

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	3
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	18
Broke Loose From Mount	4
Internal Malfunction	2
Tested OK After Accident	6

TABLE 7.25 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	69	-	-	-	-	24	31	22	22	0	51	12	38
CABIN	69	73	0	12	14	32	25	22	20	1	49	12	39
NOSE	69	63	0	19	19	8	31	34	24	3	47	16	37
AFT FUS.	62	69	4	10	18	47	30	12	12	0	47	13	40
TAIL CONE	23	65	29	0	6	67	7	20	7	0	47	18	35
RT INBD WING	62	64	0	4	32	39	27	22	12	0	50	17	33
RT OTBD WING	38	58	17	8	17	24	33	33	11	0	47	18	35
LT INBD WING	54	65	0	8	26	43	20	24	12	0	49	15	36
LT OTBD WING	38	63	21	2	14	30	30	29	11	0	48	16	36
RT HORIZONTAL	23	67	21	4	8	64	21	12	3	0	47	13	39
LT HORIZONTAL	23	67	21	2	10	72	14	9	5	0	48	13	39
VERTICAL	23	72	20	3	5	62	42	9	5	0	49	13	39
MAIN GEAR	23	56	3	9	32	21	27	24	14	14	-	-	-
NOSE/TAIL GEAR	23	62	5	5	28	43	27	8	14	8	-	-	-
ENG #1	54	61	1	13	25	18	40	27	10	5	40	18	42
ENG #2	-	50	0	0	50	15	46	31	0	8	0	0	0

DATA SET: ALL Files
Sharc ELT

No. of Cases: 123

U.S. 27 %

In Flight Breakup
1 ; 1 %

Ground Fire Cases
13 ; 11 %

In Flight Fire Cases
1 ; 1 %

											Bent	Yes	No
PROP #1	-	53	16	3	28	17	38	29	3	14		94	6
PROP #2	-	30	30	0	40	11	22	56	0	11		88	12

TABLE 7.26 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Sharc ELT

No. of Cases 123 US: 33 CAN: 90

	Yes	No	Unk
ELT Installed	120	2	1
ELT Armed	87	7	29
ELT Activated	47	48	28
ELT Aid in Search	17	27	79
ELT in Mount After Impact	41	9	73
Antenna Intact	31	5	87
Antenna Cable Connected	2	5	116
ELT Battery Expired	3	15	105
Search Required	50	53	20

How Did ELT Aid in Search?

Initial Alerting	11
Detection by Airborne SAR	4
Final Homing	7
Voice Communication	0

Activate		ELT Location	
Auto	44	Aft Fuselage	68
Man.	3	Cabin	15
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	14
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	3
Searchers Not Equipped	1
Under Water	2

Why ELT Did Not Activate

Battery Dead	2
Corrosion Damage	5
Insufficient Force to Activate	22
Destroyed/Damaged by Impact	14
Broke Loose From Mount	4
Internal Malfunction	4
Tested OK After Accident	3

	Fatal	Serious	Minor	None
Pilot	52	16	11	44
Crew	6	0	1	2
Passengers	62	22	19	55
Outsiders	0	0	0	0

TABLE 7.26 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	38	-	-	-	-	20	18	30	28	3	48	12	40
CABIN	38	70	0	13	16	23	20	31	23	3	46	16	38
NOSE	25	54	2	18	26	15	18	30	32	5	43	13	43
AFT FUS.	38	61	7	15	18	29	34	32	5	0	44	15	40
TAIL CONE	0	69	0	8	23	58	17	17	8	0	67	22	11
RT INBD WING	50	49	0	8	42	27	25	29	20	0	46	15	39
RT OTBD WING	13	83	21	5	36	12	30	39	19	0	47	11	42
LT INBD WING	38	49	0	6	44	31	29	24	17	0	49	12	39
LT OTBD WING	0	45	25	5	25	16	41	30	13	0	40	12	39
RT HORIZONTAL	0	57	26	3	14	57	21	14	7	0	51	11	38
LT HORIZONTAL	0	58	25	5	12	51	25	18	7	0	51	11	38
VERTICAL	0	58	25	7	11	54	23	20	4	0	48	13	40
MAIN GEAR	0	44	10	14	32	21	19	40	13	8	-	-	-
NOSE/TAIL GEAR	0	42	11	16	32	28	19	31	19	3	-	-	-
ENG #1	63	47	4	13	36	17	31	33	11	7	39	11	50
ENG #2	-	60	20	0	20	33	17	33	17	0	25	25	50

	Bent	Yes	No
PROP #1	-	94	6
PROP #2	-	100	0

DATA SET: ALL Files
Narco ELT

No. of Cases: 77

U.S. 44 %

In Flight Breakup

4 ; 5 %

Ground Fire Cases

7 ; 9 %

In Flight Fire Cases

1 ; 1 %

TABLE 7.27 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Narco ELT

No. of Cases 77 US: 34 CAN: 43

	Yes	No	Unk
ELT Installed	76	0	1
ELT Armed	62	2	12
ELT Activated	44	20	12
ELT Aid in Search	25	19	32
ELT in Mount After Impact	16	6	54
Antenna Intact	14	2	60
Antenna Cable Connected	1	3	72
ELT Battery Expired	6	10	60
Search Required	47	21	9

How Did ELT Aid in Search?

Initial Alerting	13
Detection by Airborne SAR	6
Final Homing	16
Voice Communication	0

Activate	
Auto	40
Man.	2

ELT Location	
Aft Fuselage	37
Cabin	5
Cockpit	1

ELT Activated, But Did Not Aid in Search

Search Not Required	11
Battery Went Dead	0
Antenna Disconnected	2
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	1
Insufficient Force to Activate	5
Destroyed/Damaged by Impact	8
Broke Loose From Mount	2
Internal Malfunction	2
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	40	10	7	20
Crew	2	1	1	1
Passengers	37	15	20	19
Outsiders	0	0	0	0

TABLE 7.27 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	100	-	-	-	-	19	15	33	29	4	47	19	33
CABIN	100	67	0	11	22	25	24	25	24	2	49	18	33
NOSE	88	48	0	26	26	6	19	42	28	6	42	25	33
AFT FUS.	88	61	4	9	26	24	30	30	17	0	44	27	29
TAIL CONE	25	67	17	0	17	60	20	0	20	0	60	40	0
RT INBD WING	75	48	0	9	43	29	24	24	22	0	61	9	30
RT OTBD WING	75	40	18	6	36	25	21	33	21	0	57	10	33
LT INBD WING	75	39	0	17	44	27	25	25	23	0	54	11	35
LT OTBD WING	75	38	23	8	31	22	31	24	24	0	50	15	35
RT HORIZONTAL	38	50	20	2	19	67	20	2	8	2	43	20	36
LT HORIZONTAL	38	62	21	2	15	65	21	4	10	0	43	20	36
VERTICAL	25	58	15	5	22	63	22	10	6	0	45	17	38
MAIN GEAR	38	50	0	25	25	20	10	23	17	30	-	-	-
NOSE/TAIL GEAR	38	44	6	13	38	21	21	21	21	16	-	-	-
ENG #1	75	43	2	14	41	12	21	38	19	10	33	21	46
ENG #2	-	29	14	14	43	33	0	50	17	0	0	33	67

		Bent	Yes	No
PROP #1	-		93	7
PROP #2	-		100	0

DATA SET: ALL Files
Garrett ELT

No. of Cases: 73

U.S. 18 %

In Flight Breakup
2 ; 3 %

Ground Fire Cases
8 ; 11 %

In Flight Fire Cases
0 ; 0 %

TABLE 7.28 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Garrett ELT

No. of Cases 73 US: 13 CAN: 60

	Yes	No	Unk
ELT Installed	73	0	0
ELT Armed	51	4	18
ELT Activated	40	16	17
ELT Aid in Search	15	20	38
ELT in Mount After Impact	19	5	49
Antenna Intact	12	3	58
Antenna Cable Connected	1	6	66
ELT Battery Expired	2	5	66
Search Required	37	31	5

How Did ELT Aid in Search?

Initial Alerting	11
Detection by Airborne SAR	3
Final Homing	8
Voice Communication	6

Activate	
Auto	36
Man.	4

ELT Location	
Aft Fuselage	47
Cabin	8
Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	11
Battery Went Dead	1
Antenna Disconnected	3
Antenna Shielded	0
Searchers Not Equipped	2
Under Water	2

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	0
Insufficient Force to Activate	7
Destroyed/Damaged by Impact	10
Broke Loose From Mount	0
Internal Malfunction	1
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	35	12	6	20
Crew	5	3	2	3
Passengers	48	15	4	19
Outsiders	1	0	0	0

TABLE 7.28 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	0	-	-	-	-	40	28	12	12	8	54	13	13
CABIN	0	88	0	8	4	46	19	23	8	4	54	13	33
NOSE	0	81	0	14	5	17	33	30	4	8	52	12	36
AFT FUS.	0	81	0	12	8	52	24	24	0	0	50	15	35
TAIL CONE	0	100	0	0	0	100	0	0	0	0	67	0	33
RT INBD WING	0	56	0	7	37	41	22	30	7	0	58	13	29
RT OTBD WING	0	57	36	4	4	32	29	36	4	0	54	17	29
LT INBD WING	0	68	0	4	28	40	24	36	0	0	50	23	27
LT OTBD WING	0	64	28	4	4	42	21	33	4	0	45	27	27
RT HORIZONTAL	0	83	13	0	4	76	17	8	0	0	48	16	36
LT HORIZONTAL	0	88	8	0	4	88	8	4	0	0	48	16	36
VERTICAL	0	81	12	4	16	73	27	0	0	0	46	12	42
MAIN GEAR	0	79	0	5	14	45	5	40	0	10	-	-	-
NOSE/TAIL GEAR	0	71	0	14	17	62	31	8	0	0	-	-	-
ENG #1	0	75	0	8	100	17	39	35	0	0	38	6	56
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

DATA SET: ALL Files
Pointer ELT

No. of Cases: 40

U.S. 13 %

In Flight Breakup

0 ; 0 %

Ground Fire Cases

0 ; 0 %

In Flight Fire Cases

0 ; 0 %

											Bent	Yes	No
PROP #1	-	65	10	5	20	27	36	23	0	14		94	6
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

TABLE 7.29 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Pointer ELT

No. of Cases 40 US: 5 CAN: 35

	Yes	No	Unk
ELT Installed	40	0	0
ELT Armed	29	3	8
ELT Activated	19	15	16
ELT Aid in Search	2	11	27
ELT in Mount After Impact	12	0	28
Antenna Intact	6	2	32
Antenna Cable Connected	0	1	39
ELT Battery Expired	2	1	37
Search Required	13	22	5

How Did ELT Aid in Search?

Initial Alerting	2
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate		ELT Location	
Auto	15	Aft Fuselage	23
Man.	4	Cabin	7
		Cockpit	4

ELT Activated, But Did Not Aid in Search

Search Not Required	8
Battery Went Dead	0
Antenna Disconnected	1
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	2

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	9
Destroyed/Damaged by Impact	4
Broke Loose From Mount	0
Internal Malfunction	1
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	11	4	4	21
Crew	0	1	1	2
Passengers	11	5.	16	27
Outsiders	1	0	0	0

TABLE 7.29 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	100	-	-	-	-	5	11	47	37	0	42	25	33
CABIN	100	56	0	28	17	11	21	37	32	0	42	25	33
NOSE	33	39	0	44	17	0	11	53	37	0	42	25	33
AFT FUS.	67	61	0	17	22	33	33	17	17	0	53	20	27
TAIL CONE	33	50	0	13	38	38	13	13	38	0	40	20	40
RT INBD WING	67	50	0	22	28	11	16	53	21	0	50	25	25
RT OTBD WING	67	50	11	6	33	5	21	53	21	0	50	25	25
LT INBD WING	67	50	0	17	33	11	16	53	21	0	50	25	25
LT OTBD WING	67	56	17	6	22	5	26	47	21	0	54	23	23
RT HORIZONTAL	67	61	11	0	28	56	17	11	17	0	50	21	29
LT HORIZONTAL	67	58	16	5	21	53	26	5	16	0	47	27	27
VERTICAL	67	61	6	22	11	44	33	6	17	0	53	20	27
MAIN GEAR	67	57	0	21	21	23	23	31	23	0	-	-	-
NOSE/TAIL GEAR	67	62	0	23	15	33	17	25	25	0	-	-	-
ENG #1	100	35	0	35	29	19	25	38	19	0	50	25	25
ENG #2	-	0	0	0	100	0	0	0	0	0	0	0	0

DATA SET: ALL Files
EBC ELT

No. of Cases: 21

U.S. 95 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
3 ; 14 %

In Flight Fire Cases
1 ; 5 %

											Bent: Yes	Bent: No
PROP #1	-	33	27	7	33	7	27	47	20	0	100	0
PROP #2	-	0	0	0	0	0	0	0	0	0	0	0

TABLE 7.30 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, EBC ELT

No. of Cases 21 US: 20 CAN: 1

	Yes	No	Unk
ELT Installed	21	0	0
ELT Armed	18	0	3
ELT Activated	14	4	3
ELT Aid in Search	9	7	5
ELT in Mount After Impact	2	2	17
Antenna Intact	0	0	21
Antenna Cable Connected	0	0	21
ELT Battery Expired	3	7	11
Search Required	12	9	0

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	3
Final Homing	8
Voice Communication	0

Activate		ELT Location	
Auto	14	Aft Fuselage	1
Man.	0	Cabin	1
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	4
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	3
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	16	4	0	1
Crew	1	0	0	0
Passengers	18	3	1	0
Outsiders	0	0	0	0

TABLE 7.30 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	69	-	-	-	-	4	23	35	38	2	38	15	48
CABIN	69	54	0	21	25	6	21	37	36	6	38	15	48
NOSE	69	42	0	29	29	0	12	46	37	0	33	21	46
AFT FUS.	62	53	7	12	28	26	39	15	20	0	31	21	48
TAIL CONE	23	57	36	0	7	62	8	23	8	0	36	27	36
RT INBD WING	62	43	0	4	53	14	35	31	20	0	37	26	37
RT OTBD WING	38	37	27	10	27	11	24	46	20	0	35	26	38
LT INBD WING	54	43	0	13	43	21	21	38	21	0	33	23	44
LT OTBD WING	38	42	38	0	21	13	27	40	19	0	33	25	43
RT HORIZONTAL	23	52	30	4	14	52	27	15	6	0	36	21	43
LT HORIZONTAL	23	54	31	0	15	67	18	10	6	0	36	21	43
VERTICAL	23	58	30	2	9	47	35	10	8	0	38	20	42
MAIN GEAR	23	51	5	8	35	18	24	21	13	24	-	-	-
NOSE/TAIL GEAR	23	56	8	0	36	38	25	8	17	13	-	-	-
ENG #1	43	37	2	20	41	4	29	39	18	10	23	27	50
ENG #2	-	25	0	0	75	11	33	44	0	11	0	100	0

DATA SET: BASIC Group
Sharc ELT

No. of Cases: 66

U.S. 41 %

In Flight Breakup
1 ; 1 %

Ground Fire Cases
13 ; 20 %

In Flight Fire Cases
1 ; 2 %

											Bent	Yes	No
PROP #1	-	25	25	5	45	2	31	43	5	19		97	3
PROP #2	-	14	43	0	43	14	0	71	0	14		83	17

TABLE 7.31 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Sharc ELT

No. of Cases 66 US: 27 CAN: 39

	Yes	No	Unk
ELT Installed	65	1	0
ELT Armed	45	5	15
ELT Activated	25	24	16
ELT Aid in Search	7	17	41
ELT in Mount After Impact	17	7	41
Antenna Intact	12	5	48
Antenna Cable Connected	1	5	59
ELT Battery Expired	3	12	50
Search Required	33	28	5

How Did ELT Aid in Search?

Initial Alerting	5
Detection by Airborne SAR	3
Final Homing	3
Voice Communication	0

Activate		ELT Location	
Auto	25	Aft Fuselage	34
Man.	0	Cabin	7
		Cockpit	1

ELT Activated, But Did Not Aid in Search

Search Not Required	6
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	2
Searchers Not Equipped	1
Under Water	1

Why ELT Did Not Activate

Battery Dead	2
Corrosion Damage	5
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	14
Broke Loose From Mount	3
Internal Malfunction	4
Tested OK After Accident	3

	Fatal	Serious	Minor	None
Pilot	50	13	2	1
Crew	6	0	1	0
Passengers	61	20	9	3
Outsiders	0	0	0	0

TABLE 7.31 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	50	-	-	-	-	6	11	42	36	6	36	14	50
CABIN	50	59	0	22	19	5	16	43	30	5	32	21	46
NOSE	33	35	0	30	35	8	0	42	42	8	28	16	56
AFT FUS.	50	49	8	21	23	22	24	46	8	0	32	19	48
TAIL CONE	-	-	-	-	-	-	-	-	-	-	60	20	20
RT INBD WING	67	34	0	11	54	15	24	32	29	0	27	18	55
RT OTBD WING	17	23	26	0	51	6	29	35	29	0	30	10	60
LT INBD WING	50	32	0	11	58	19	22	33	25	0	29	14	57
LT OTBD WING	0	30	27	5	38	14	32	35	19	0	39	14	57
RT HORIZONTAL	0	44	33	6	17	53	21	18	9	0	36	12	52
LT HORIZONTAL	0	46	32	8	14	46	23	23	9	0	37	11	52
VERTICAL	0	43	3k	kk	k4	44	29	21	6	0	33	15	52
MAIN GEAR	0	33	13	20	33	17	10	47	17	10	-	-	-
NOSE/TAIL GEAR	0	32	14	23	32	30	15	35	15	5	-	-	-
ENG #1	67	26	6	21	47	9	26	41	15	9	32	11	58
ENG #2	-	0	50	0	50	0	33	33	33	0	0	0	100

DATA SET: BASIC Group
Narco ELT

No. of Cases: 43

U.S. 49 %

In Flight Breakup
3 ; 7 %

Ground Fire Cases
6 ; 14 %

In Flight Fire Cases
0 ; 0 %

											Bent	Yes	No
PROP #1	-	17	30	3	50	6	29	48	10	6		97	3
PROP #2	-	0	100	0	0	0	67	33	0	0		100	0

TABLE 7.32 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Narco ELT

No. of Cases 43 US: 21 CAN: 22

	Yes	No	Unk
ELT Installed	42	0	1
ELT Armed	34	2	6
ELT Activated	21	13	8
ELT Aid in Search	9	15	18
ELT in Mount After Impact	6	6	30
Antenna Intact	8	2	32
Antenna Cable Connected	1	3	38
ELT Battery Expired	6	5	31
Search Required	27	13	3

ELT Activated, But Did Not Aid in Search

Search Not Required	7
Battery Went Dead	0
Antenna Disconnected	2
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	1

	Fatal	Serious	Minor	None
Pilot	33	8	1	1
Crew	1	1	0	0
Passengers	31	11	8	2
Outsiders	0	0	0	0

How Did ELT Aid in Search?

Initial Alerting	8
Detection by Airborne SAR	3
Final Homing	3
Voice Communication	0

Activate	
Auto	20
Man.	1

ELT Location	
Aft Fuselage	18
Cabin	4
Cockpit	0

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	1
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	8
Broke Loose From Mount	2
Internal Malfunction	1
Tested OK After Accident	1

TABLE 7.32 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	100	-	-	-	-	8	8	39	39	5	43	29	29
CABIN	100	54	0	15	31	13	18	35	33	3	43	26	30
NOSE	88	29	0	34	37	3	8	42	39	8	33	38	29
AFT FUS.	88	52	5	10	33	15	34	39	22	0	40	37	23
TAIL CONE	25	67	17	0	17	60	20	0	20	0	60	40	0
RT INBD WING	75	33	0	13	55	14	25	33	28	9	60	15	25
RT OTBD WING	75	24	24	8	43	8	25	33	22	0	56	17	28
LT INBD WING	75	22	0	20	59	10	26	33	31	0	46	17	38
LT OTBD WING	75	23	28	10	40	10	31	28	31	9	41	23	36
RT HORIZONTAL	38	53	20	3	25	62	22	3	11	3	40	27	33
LT HORIZONTAL	38	56	21	3	21	61	22	3	14	0	40	27	33
VERTICAL	25	53	13	8	23	57	27	8	8	0	41	22	38
MAIN GEAR	38	45	0	27	27	11	6	22	11	50	-	-	-
NOSE/TAIL GEAR	38	44	11	11	33	25	17	17	17	25	-	-	-
ENG #1	75	25	3	16	57	5	13	42	26	13	31	31	38
ENG #2	-	17	17	17	50	20	0	60	20	0	0	33	67

DATA SET: BASIC Group
Garrett ELT

No. of Cases: 49

U.S. 22 %

In Flight Breakup
2 ; 4 %

Ground Fire Cases
8 ; 16 %

In Flight Fire Cases
0 ; 0 %

											Bent	Yes	No
PROP #1	-	16	29	3	52	8	25	25	14	38		97	3
PROP #2	-	25	25	0	50	0	33	33	33	0		100	0

TABLE 7.33 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Garrett ELT

No. of Cases 49 US: 11 CAN: 38

	Yes	No	Unk
ELT Installed	40	0	0
ELT Armed	40	2	7
ELT Activated	30	8	11
ELT Aid in Search	12	15	22
ELT in Mount After Impact	11	5	33
Antenna Intact	8	2	39
Antenna Cable Connected	1	6	42
ELT Battery Expired	2	5	42
Search Required	29	19	1

How Did ELT Aid in Search?

Initial Alerting	9
Detection by Airborne SAR	3
Final Homing	5
Voice Communication	0

Activate	
Auto	30
Man.	0

ELT Location	
Aft Fuselage	31
Cabin	4
Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	7
Battery Went Dead	1
Antenna Disconnected	3
Antenna Shielded	0
Searchers Not Equipped	2
Under Water	2

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	10
Broke Loose From Mount	0
Internal Malfunction	1
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	33	12	4	0
Crew	5	3	0	0
Passengers	44	15	2	4
Outsiders	1	0	0	0

TABLE 7.33 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box 1	2	3	4	Deformation Data: % of total cases with data in "Deformation" code box 1	2	3	4	5	Final Attitude Data: % of total cases with data in "Attitude" code box 1	2	3
COCKPIT	0	-	-	-	-	0	27	27	27	18	50	25	25
CABIN	0	70	0	20	10	8	17	50	17	8	50	25	25
NOSE	0	63	0	25	13	8	9	64	9	18	44	22	33
AFT FUS.	0	55	0	27	18	25	33	42	0	0	40	30	30
TAIL CONE	0	0	0	0	0	0	0	0	0	0	0	0	0
RT INBD WING	0	23	0	15	62	8	23	54	15	0	63	25	13
RT OTBD WING	0	23	69	0	8	8	23	62	8	0	63	25	13
LT INBD WING	0	33	0	8	58	0	25	75	0	0	43	57	0
LT OTBD WING	0	25	58	8	8	8	25	58	8	0	43	57	0
RT HORIZONTAL	0	60	30	0	10	45	36	18	0	0	33	33	33
LT HORIZONTAL	0	67	22	0	11	80	10	10	0	0	33	33	33
VERTICAL	0	55	27	9	9	67	33	0	0	0	30	20	50
MAIN GEAR	0	33	0	17	50	0	0	75	0	25	-	-	-
NOSE/TAIL GEAR	0	50	0	25	25	75	0	25	0	0	-	-	-
ENG #1	0	45	0	18	36	0	18	64	0	18	17	17	17
ENG #2	-	0	0	0	100	0	0	0	0	0	0	0	0

DATA SET: BASIC Group Pointer ELT

No. of Cases: 16

U.S. 25 %

In Flight Breakup

0 ; 0 %

Ground Fire Cases

0 ; 0 %

In Flight Fire Cases

0 ; 0 %

											Bent Yes	Bent No
PROP #1	-	50	17	0	33	0	33	33	0	33	100	0
PROP #2	-	0	0	0	0	0	0	0	0	0	0	0

TABLE 7.34 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Pointer ELT

No. of Cases 16 US: 4 CAN: 12

	Yes	No	Unk
ELT Installed	16	0	0
ELT Armed	12	2	2
ELT Activated	8	4	4
ELT Aid in Search	1	4	11
ELT in Mount After Impact	5	0	11
Antenna Intact	1	2	13
Antenna Cable Connected	0	1	15
ELT Battery Expired	2	0	14
Search Required	9	6	1

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate		ELT Location	
Auto	7	Aft Fuselage	9
Man.	1	Cabin	4
		Cockpit	1

ELT Activated, But Did Not Aid in Search

Search Not Required	1
Battery Went Dead	0
Antenna Disconnected	1
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	1

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	3
Broke Loose From Mount	-
Internal Malfunction	1
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	11	4	1	0
Crew	0	1	1	0
Passengers	11	5	14	0
Outsiders	0	0	0	0

TABLE 7.34 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	100	-	-	-	-	6	6	50	38	0	44	22	33
CABIN	100	53	0	27	20	13	13	44	31	0	44	22	33
NOSE	50	33	0	37	20	0	6	56	38	0	55	22	33
AFT FUS.	100	53	0	29	27	27	40	13	20	0	58	17	25
TAIL CONE	50	50	0	13	38	38	13	13	83	0	40	20	40
RT INBD WING	100	47	0	20	33	13	19	44	25	0	56	22	22
RT OTBD WING	100	47	13	0	40	6	25	44	25	0	56	22	22
LT INBD WING	100	47	0	13	40	13	19	44	25	0	56	22	22
LT OTBD WING	100	53	20	0	27	6	31	38	25	0	60	20	20
RT HORIZONTAL	100	53	13	0	33	47	20	13	20	0	55	18	27
LT HORIZONTAL	100	50	19	6	25	44	31	6	19	0	50	25	25
VERTICAL	100	53	7	27	13	33	40	7	20	0	58	17	25
MAIN GEAR	100	58	0	17	25	27	18	27	27	0	-	-	-
NOSE/TAIL GEAR	100	58	0	25	17	27	18	27	27	0	-	-	-
ENG #1	100	33	0	40	27	21	21	36	21	0	50	17	33
ENG #2	-	0	0	0	100	0	0	100	0	0	0	0	0

DATA SET: BASIC Group
E.B.C. ELT

No. of Cases: 18

U.S. 94 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
2 ; 11 %

In Flight Fire Cases
0 ; 0 %

											Bent	Yes	No
PROP #1	-	31	23	8	38	8	23	46	23	0		100	0
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

TABLE 7.35 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, E.B.C. ELT

No. of Cases 18 US: 17 CAN: 1

	Yes	No	Unk
ELT Installed	18	0	0
ELT Armed	15	0	3
ELT Activated	11	4	3
ELT Aid in Search	6	7	5
ELT in Mount After Impact	2	2	14
Antenna Intact	0	0	18
Antenna Cable Connected	0	0	18
ELT Battery Expired	2	6	10
Search Required	9	9	0

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	2
Final Homing	5
Voice Communication	0

Activate		ELT Location	
Auto	11	Aft Fuselage	1
Man.	0	Cabin	1
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	4
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	3
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	15	3	0	0
Crew	0	0	0	0
Passengers	18	3	1	0
Outsiders	0	0	0	0

TABLE 7.35 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	76	-	-	-	-	5	15	39	37	4	40	19	42
CABIN	76	56	0	20	24	8	18	39	31	3	39	20	41
NOSE	66	37	0	32	31	3	7	46	37	7	34	23	43
AFT FUS.	69	52	5	15	27	22	34	28	16	0	37	25	38
TAIL CONE	21	58	17	6	19	58	9	15	18	0	46	27	27
RT INBD WING	69	37	0	10	53	14	27	36	24	0	44	21	35
RT OTBD WING	48	30	28	5	36	8	26	44	22	0	43	20	37
LT INBD WING	62	35	0	14	52	15	22	39	23	0	38	22	40
LT OTBD WING	45	34	32	4	29	12	29	37	22	0	37	24	39
RT HORIZONTAL	28	51	27	3	19	54	24	13	9	1	39	21	40
LT HORIZONTAL	28	53	27	3	17	59	21	11	9	0	38	22	40
VERTICAL	24	53	23	8	16	49	32	11	8	0	39	19	42
MAIN GEAR	28	42	6	16	33	16	14	33	14	22	-	-	-
NOSE/TAIL GEAR	28	47	8	14	31	34	18	21	17	10	-	-	-
ENG #1	66	32	3	21	45	7	23	42	18	10	29	22	49
ENG #2	-	17	11	6	67	11	22	50	11	6	0	33	67

											Bent	Yes	No
PROP #1	-	23	27	4	47	5	28	39	10	18		98	2
PROP #2	-	14	50	0	36	8	23	54	8	8		92	8

DATA SET: BASIC Group
ELT Unit is one of Five Most Common Types

No. of Cases: 192

U.S. 42 %

In Flight Breakup
6 ; 3 %

Ground Fire Cases
29 ; 15 %

In Flight Fire Cases
1 ; 1 %

TABLE 7.36 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Unit is One of Five Most Common Types

No. of Cases 192 US: 80 CAN: 112

	Yes	No	Unk
ELT Installed	190	1	1
ELT Armed	146	11	33
ELT Activated	95	53	42
ELT Aid in Search	35	58	97
ELT in Mount After Impact	41	20	129
Antenna Intact	29	11	150
Antenna Cable Connected	3	15	172
ELT Battery Expired	15	28	147
Search Required	107	75	10

How Did ELT Aid in Search?

Initial Alerting	24
Detection by Airborne SAR	11
Final Homing	16
Voice Communication	0

Activate		ELT Location	
Auto	93	Aft Fuselage	93
Man.	2	Cabin	20
		Cockpit	7

ELT Activated, But Did Not Aid in Search

Search Not Required	25
Battery Went Dead	1
Antenna Disconnected	9
Antenna Shielded	3
Searchers Not Equipped	3
Under Water	5

Why ELT Did Not Activate

Battery Dead	4
Corrosion Damage	6
Insufficient Force to Activate	3
Destroyed/Damaged by Impact	38
Broke Loose From Mount	5
Internal Malfunction	7
Tested OK After Accident	6

	Fatal	Serious	Minor	None
Pilot	142	40	8	2
Crew	12	5	2	0
Passengers	165	54	34	9
Outsiders	1	0	0	0

TABLE 7.36 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	68	-	-	-	-	4	13	41	41	1	45	19	36
CABIN	73	40	0	25	35	4	17	41	37	1	44	21	36
NOSE	59	22	0	34	44	3	3	50	40	4	46	18	35
AFT FUS.	46	41	2	22	35	19	25	27	28	0	42	22	36
TAIL CONE	22	25	11	15	49	32	5	24	39	0	50	13	38
RT INBD WING	68	30	0	15	55	11	28	32	29	0	45	23	32
RT OTBD WING	32	27	20	11	42	14	21	38	27	0	45	20	35
LT INBD WING	62	26	0	20	55	14	23	36	27	0	43	21	36
LT OTBD WING	43	25	28	7	40	9	29	34	27	0	41	23	36
RT HORIZONTAL	32	40	21	5	34	44	17	18	21	0	44	20	36
LT HORIZONTAL	30	38	24	5	32	47	16	17	19	0	42	20	38
VERTICAL	24	42	23	6	30	40	26	15	20	0	44	18	38
MAIN GEAR	35	28	8	17	48	20	13	38	22	7	-	-	-
NOSE/TAIL GEAR	35	27	5	18	49	24	10	35	29	4	-	-	-
ENG #1	46	17	2	21	61	10	19	43	20	8	53	8	39
ENG #2	-	7	11	4	79	8	19	46	23	4	50	17	33

											Bent Yes	Bent No
PROP #1	-	14	26	4	55	4	18	53	17	8	98	2
PROP #2	-	13	62	4	57	10	10	48	29	5	95	5

DATA SET: BASIC Group
ELT Installed, But Did Not Activate

No. of Cases: 148

U.S. 77 %

In Flight Breakup
14 ; 10 %

Ground Fire Cases
36 ; 24 %

In Flight Fire Cases
4 ; 3 %

TABLE 7.37 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Installed, But Did Not Activate

No. of Cases 148 US: 114 CAN: 34

	Yes	No	Unk
ELT Installed	148	0	0
ELT Armed	67	5	76
ELT Activated	0	148	0
ELT Aid in Search	0	27	121
ELT in Mount After Impact	12	16	120
Antenna Intact	12	7	129
Antenna Cable Connected	3	12	133
ELT Battery Expired	10	20	118
Search Required	51	88	9

How Did ELT Aid in Search?

Initial Alerting	0
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate

Auto	0
Man.	0

ELT Location

Aft Fuselage	26
Cabin	8
Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	0
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	7
Corrosion Damage	12
Insufficient Force to Activate	5
Destroyed/Damaged by Impact	58
Broke Loose From Mount	8
Internal Malfunction	21
Tested OK After Accident	6

	Fatal	Serious	Minor	None
Pilot	127	16	1	3
Crew	16	3	2	0
Passengers	147	32	6	2
Outsiders	1	0	0	0

TABLE 7 37 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	83	-	-	-	-	1	1	20	78	0	67	11	22
CABIN	84	18	0	15	67	0	2	20	78	0	67	11	22
NOSE	75	13	0	17	69	1	3	21	75	1	66	14	21
AFT FUS.	62	23	3	10	64	8	15	23	55	0	65	15	20
TAIL CONE	24	22	25	8	45	32	6	15	47	0	69	13	17
RT INBD WING	70	16	0	12	72	3	12	62	60	0	63	16	22
RT OTBD WING	46	16	22	8	54	9	13	31	47	0	62	15	23
LT INBD WING	68	15	0	12	73	4	13	24	58	0	61	14	25
LT OTBD WING	50	14	26	6	55	5	19	29	46	0	59	14	27
RT HORIZONTAL	38	22	34	5	39	32	20	15	33	0	58	13	30
LT HORIZONTAL	39	23	34	3	40	32	20	15	33	0	56	13	31
VERTICAL	38	24	31	6	38	32	18	15	34	1	57	10	33
MAIN GEAR	44	20	5	12	63	6	9	27	52	7	-	-	-
NOSE/TAIL GEAR	40	21	7	13	50	14	6	27	51	2	-	-	-
ENG #1	65	14	1	14	71	4	17	33	44	2	63	15	22
ENG #2	-	7	11	4	79	0	22	41	37	0	67	0	33

DATA SET: BASIC Group
Ground Fire Occurred

No. of Cases: 206

U.S. 70 %

In Flight Breakup
8 ; 4 %

Ground Fire Cases
206 ; 100 %

In Flight Fire Cases
8 ; 4 %

											Bent	Yes	No
PROP #1	-	10	23	4	63	4	20	49	22	6		95	5
PROP #2	-	3	78	0	59	0	7	59	31	3		100	0

TABLE 7.38 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Ground Fire Occurred

No. of Cases 206 US: 145 CAN: 61

	Yes	No	Unk
ELT Installed	127	30	49
ELT Armed	45	4	78
ELT Activated	30	36	61
ELT Aid in Search	3	46	78
ELT in Mount After Impact	3	7	117
Antenna Intact	6	1	120
Antenna Cable Connected	2	8	117
ELT Battery Expired	3	10	114
Search Required	39	131	36

How Did ELT Aid in Search?

Initial Alerting	2
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate	
Auto	30
Man.	0

ELT Location	
Aft Fuselage	15
Cabin	5
Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	13
Battery Went Dead	0
Antenna Disconnected	5
Antenna Shielded	2
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	2
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	75
Broke Loose From Mount	1
Internal Malfunction	4
Tested OK After Accident	1

	Fatal	Serious	Minor	None
Pilot	181	22	3	0
Crew	17	6	2	0
Passengers	194	30	16	4
Outsiders	4	2	4	0

TABLE 7.38 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	86	-	-	-	-	5	14	43	36	2	46	21	33
CABIN	84	52	0	21	72	8	17	41	32	2	46	21	33
NOSE	73	32	0	32	37	2	8	51	36	3	42	23	35
AFT FUS.	60	49	4	18	29	24	28	32	15	0	42	25	33
TAIL CONE	17	57	11	10	22	54	10	17	19	0	55	20	25
RT INBD WING	65	39	0	16	45	15	28	38	19	0	43	25	32
RT OTBD WING	33	35	29	7	28	14	25	44	18	0	43	25	32
LT INBD WING	63	37	0	19	44	16	26	38	19	1	40	25	35
LT OTBD WING	40	34	30	7	29	14	27	41	17	1	40	24	36
RT HORIZONTAL	29	49	30	5	16	52	24	13	10	1	42	21	37
LT HORIZONTAL	29	51	29	5	15	56	21	13	9	0	42	21	37
VERTICAL	24	52	27	8	13	42	28	11	9	0	41	20	39
MAIN GEAR	41	44	7	12	38	29	15	20	17	9	-	-	-
NOSE/TAIL GEAR	38	28	3	27	42	15	16	40	23	6	-	-	-
ENG #1	67	25	0	31	44	10	25	40	18	6	35	24	41
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

											Bent	Yes	No
PROP #1	-	24	30	4	42	7	24	50	10	9		95	5
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

DATA SET: BASIC Group
Aircraft Type Code A or B or C
Tricycle-Fixed Landing Gear

No. of Cases: 358

U.S. 66 %

In Flight Breakup
14 ; 4 %

Ground Fire Cases
63 ; 18 %

In Flight Fire Cases
2 ; 1 %

TABLE 7.39 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code A or B or C, Tricycle-Fixed Landing Gear

No. of Cases 358 **US:** 238 **CAN:** 120

	Yes	No	Unk
ELT Installed	273	28	57
ELT Armed	146	23	104
ELT Activated	112	53	108
ELT Aid in Search	44	115	114
ELT in Mount After Impact	22	20	231
Antenna Intact	35	8	230
Antenna Cable Connected	1	27	245
ELT Battery Expired	10	23	240
Search Required	125	175	58

How Did ELT Aid in Search?

Initial Alerting	23
Detection by Airborne SAR	15
Final Homing	20
Voice Communication	2

Activate		ELT Location	
Auto	110	Aft Fuselage	50
Man.	1	Cabin	5
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	38
Battery Went Dead	0
Antenna Disconnected	9
Antenna Shielded	5
Searchers Not Equipped	1
Under Water	10

Why ELT Did Not Activate

Battery Dead	4
Corrosion Damage	7
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	48
Broke Loose From Mount	5
Internal Malfunction	14
Tested OK After Accident	6

	Fatal	Serious	Minor	None
Pilot	281	61	10	6
Crew	25	12	2	1
Passengers	282	88	19	6
Outsiders	5	0	3	0

TABLE 7.39 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	93	-	-	-	-	2	15	52	28	3	53	24	24
CABIN	93	54	0	23	22	4	18	49	26	3	52	24	24
NOSE	89	36	0	34	30	1	6	60	29	4	50	26	24
AFT FUS.	76	60	2	13	25	31	29	25	14	0	57	21	22
TAIL CONE	38	50	7	7	37	32	6	26	35	0	71	14	14
RT INBD WING	82	44	0	15	40	15	28	36	21	0	56	24	20
RT OTBD WING	56	43	25	9	23	11	30	42	17	0	57	23	20
LT INBD WING	76	46	0	19	35	14	35	34	17	0	54	22	24
LT OTBD WING	56	46	29	6	18	10	40	38	13	0	53	23	24
RT HORIZONTAL	58	63	19	2	15	58	17	12	12	1	58	20	22
LT HORIZONTAL	62	63	20	2	16	63	13	12	12	1	59	18	23
VERTICAL	60	63	19	4	15	57	18	13	11	0	59	18	23
MAIN GEAR	60	44	2	18	36	15	15	38	19	13	-	-	-
NOSE/TAIL GEAR	49	69	13	4	14	65	10	9	13	4	-	-	-
ENG #1	80	40	0	27	32	7	18	48	21	6	47	27	26
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

											Bent	Yes	No
PROP #1	-	34	23	8	35	6	29	37	16	12		97	3
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

DATA SET: BASIC Group
Aircraft Type Code
A or B or C

Tailwheel-Fixed Landing Gear

No. of Cases: 181

U.S. 57 %

In Flight Breakup
8 ; 4 %

Ground Fire Cases
45 ; 25 %

In Flight Fire Cases
0 ; 0 %

TABLE 7.40 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code A or B or C, Tailwheel-Fixed Landing Gear

No. of Cases 181 US: 103 CAN: 78

	Yes	No	Unk
ELT Installed	86	42	53
ELT Armed	49	8	29
ELT Activated	34	22	30
ELT Aid in Search	4	32	50
ELT in Mount After Impact	8	3	75
Antenna Intact	13	5	68
Antenna Cable Connected	3	5	78
ELT Battery Expired	8	3	75
Search Required	31	97	53

How Did ELT Aid in Search?

Initial Alerting	4
Detection by Airborne SAR	2
Final Homing	3
Voice Communication	0

Activate	
Auto	34
Man.	0

ELT Location	
Aft Fuselage	19
Cabin	4
Cockpit	1

ELT Activated, But Did Not Aid in Search

Search Not Required	15
Battery Went Dead	1
Antenna Disconnected	3
Antenna Shielded	1
Searchers Not Equipped	1
Under Water	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	2
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	21
Broke Loose From Mount	1
Internal Malfunction	4
Tested OK After Accident	3

	Fatal	Serious	Minor	None
Pilot	139	38	3	1
Crew	11	2	0	0
Passengers	86	27	9	8
Outsiders	2	0	1	0

TABLE 7.40 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	84	-	-	-	-	4	18	39	36	2	47	16	38
CABIN	84	52	0	17	31	6	20	39	34	2	46	17	37
NOSE	71	34	0	25	41	1	11	45	38	4	42	19	39
AFT FUS.	60	47	3	18	32	20	30	33	17	0	45	19	36
TAIL CONE	19	39	22	12	72	40	14	26	20	0	62	14	24
RT INBD WING	64	37	0	15	48	14	28	35	23	0	46	23	31
RT OTBD WING	34	33	27	7	32	10	27	44	20	0	45	22	32
LT INBD WING	62	34	0	15	50	14	24	38	24	1	47	17	36
LT OTBD WING	38	31	28	6	35	9	29	40	21	1	46	18	37
RT HORIZONTAL	28	46	32	5	17	47	28	14	10	1	45	19	36
LT HORIZONTAL	31	48	33	3	17	49	23	17	10	1	45	17	38
VERTICAL	28	49	30	9	13	49	29	13	10	0	44	18	38
MAIN GEAR	36	39	3	17	41	14	10	45	21	11	-	-	-
NOSE/TAIL GEAR	31	32	9	18	41	22	18	32	23	5	-	-	-
ENG #1	66	31	0	21	48	9	23	41	22	6	30	26	44
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

DATA SET: BASIC Group
Aircraft Type C
With High Wing

No. of Cases: 258

U.S. 49 %

In Flight Breakup
8 ; 3 %

Ground Fire Cases
58 ; 22 %

In Flight Fire Cases
2 ; 1 %

											Bent	Yes	No
PROP #1	-	23	24	5	47	3	25	51	9	12		98	2
PROP #2	-	0	100	0	0	0	0	0	0	0		0	0

TABLE 7.41 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type C With High Wing

No. of Cases 258 US: 127 CAN: 131

	Yes	No	Unk
ELT Installed	173	16	69
ELT Armed	88	25	60
ELT Activated	63	45	65
ELT Aid in Search	29	47	97
ELT in Mount After Impact	17	12	144
Antenna Intact	25	7	141
Antenna Cable Connected	2	13	158
ELT Battery Expired	3	7	163
Search Required	99	94	65

How Did ELT Aid in Search?

Initial Alerting	14
Detection by Airborne SAR	9
Final Homing	12
Voice Communication	0

Activate		ELT Location	
Auto	61	Aft Fuselage	48
Man.	1	Cabin	8
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	14
Battery Went Dead	0
Antenna Disconnected	5
Antenna Shielded	3
Searchers Not Equipped	1
Under Water	4

Why ELT Did Not Activate

Battery Dead	2
Corrosion Damage	3
Insufficient Force to Activate	3
Destroyed/Damaged by Impact	39
Broke Loose From Mount	6
Internal Malfunction	10
Tested OK After Accident	2

	Fatal	Serious	Minor	None
Pilot	183	57	7	11
Crew	10	7	1	0
Passengers	256	88	30	23
Outsiders	1	0	0	0

TABLE 7.41 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	84	-	-	-	-	3	10	48	37	2	63	13	24
CABIN	84	44	0	32	23	7	16	44	32	2	63	13	24
NOSE	70	24	0	47	29	2	5	54	38	2	59	17	24
AFT FUS.	59	54	4	19	24	27	23	30	20	0	59	18	24
TAIL CONE	23	48	11	17	24	50	8	21	21	0	59	21	21
RT INBD WING	66	32	0	19	48	12	26	37	25	0	59	15	25
RT OTBD WING	43	28	24	9	39	12	26	42	20	0	59	16	26
LT INBD WING	64	28	0	22	50	11	30	33	25	1	55	21	24
LT OTBD WING	39	26	31	9	33	12	30	38	20	1	55	22	23
RT HORIZONTAL	32	49	19	7	25	51	19	15	14	1	58	20	23
LT HORIZONTAL	32	49	20	7	23	53	19	14	14	0	57	20	23
VERTICAL	34	53	17	10	20	51	19	17	13	0	62	14	25
MAIN GEAR	39	31	21	11	37	28	18	25	21	8	-	-	-
NOSE/TAIL GEAR	39	21	6	31	42	11	16	37	30	6	-	-	-
ENG #1	61	17	0	38	45	8	29	40	20	3	51	16	33
ENG #2	-	0	0	0	0	0	0	0	0	0	0	0	0

DATA SET: BASIC Group Aircraft Type Code C With Low Wing

No. of Cases: 222

U.S. 79 %

In Flight Breakup

24 ; 11 %

Ground Fire Cases

44 ; 20 %

In Flight Fire Cases

0 ; 0 %

											Bent	Yes	No
PROP #1	-	18	27	5	50	7	21	50	13	9		95	5
PROP #2	-	0	0	0	0	0	0	0	0	0		0	0

TABLE 7.42 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Aircraft Type Code C, With Low Wing

No. of Cases 222 US: 175 CAN: 47

	Yes	No	Unk
ELT Installed	183	16	23
ELT Armed	93	7	83
ELT Activated	73	38	72
ELT Aid in Search	26	89	68
ELT in Mount After Impact	13	12	158
Antenna Intact	18	7	158
Antenna Cable Connected	0	24	159
ELT Battery Expired	9	18	156
Search Required	85	112	25

How Did ELT Aid in Search?

Initial Alerting	14
Detection by Airborne SAR	7
Final Homing	14
Voice Communication	2

Activate

Auto	73
Man.	0

ELT Location

Aft Fuselage	23
Cabin	4
Cockpit	2

ELT Activated, But Did Not Aid in Search

Search Not Required	30
Battery Went Dead	0
Antenna Disconnected	8
Antenna Shielded	1
Searchers Not Equipped	1
Under Water	2

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	4
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	42
Broke Loose From Mount	2
Internal Malfunction	6
Tested OK After Accident	5

	Fatal	Serious	Minor	None
Pilot	186	78	8	0
Crew	14	5	1	0
Passengers	243	42	12	4
Outsiders	3	0	3	0

TABLE 7.42 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	88	-	-	-	-	4	19	41	37	0	33	22	44
CABIN	88	59	0	14	28	10	24	34	31	12	33	22	44
NOSE	63	28	0	28	44	0	15	35	38	0	33	17	50
AFT FUS.	75	52	0	17	31	25	29	25	21	0	30	25	45
TAIL CONE	13	33	0	0	67	33	0	0	67	0	50	50	0
RT INBD WING	75	36	0	14	50	15	27	35	23	0	40	27	33
RT OTBD WING	75	35	23	0	42	15	27	31	27	0	42	25	33
LT INBD WING	75	39	0	14	64	12	31	31	27	0	38	19	44
LT OTBD WING	75	41	22	0	37	19	33	15	33	0	38	19	44
RT HORIZONTAL	50	54	12	0	35	50	21	13	17	0	22	22	56
LT HORIZONTAL	50	56	16	0	28	46	33	4	17	0	20	25	55
VERTICAL	50	54	13	13	21	46	29	8	17	0	28	11	61
MAIN GEAR	25	44	0	11	44	12	12	53	18	6	-	-	-
NOSE/TAIL GEAR	25	50	0	13	38	38	13	13	38	0	-	-	-
ENG #1	88	26	4	9	61	4	25	32	29	11	11	22	67
ENG #2	-	0	25	25	50	0	0	0	0	0	0	50	50

DATA SET: BASIC Group
ELT Installed in Cockpit or Cabin

No. of Cases: 34

U.S. 32 %

In Flight Breakup
0 ; 0 %

Ground Fire Cases
8 ; 24 %

In Flight Fire Cases
0 ; 0 %

											Bent	Yes	No
PROP #1	-	29	19	0	52	13	29	20	8	21		95	5
PROP #2	-	0	67	0	33	0	33	67	0	0		100	0

TABLE 7.43 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Installed in Cockpit or Cabin

No. of Cases 34 US: 11 CAN: 23

	Yes	No	Unk
ELT Installed	34	0	0
ELT Armed	23	5	6
ELT Activated	16	10	8
ELT Aid in Search	1	16	17
ELT in Mount After Impact	10	4	20
Antenna Intact	8	3	23
Antenna Cable Connected	2	0	32
ELT Battery Expired	2	1	31
Search Required	16	16	2

How Did ELT Aid in Search?

Initial Alerting	1
Detection by Airborne SAR	0
Final Homing	0
Voice Communication	0

Activate	
Auto	15
Man.	1

ELT Location	
Aft Fuselage	0
Cabin	25
Cockpit	9

ELT Activated, But Did Not Aid in Search

Search Not Required	8
Battery Went Dead	0
Antenna Disconnected	1
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	10
Broke Loose From Mount	2
Internal Malfunction	4
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	23	9	2	0
Crew	0	0	1	0
Passengers	25	8	2	2
Outsiders	0	0	0	0

TABLE 7.43 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	87	-	-	-	-	6	17	32	28	7	39	18	43
CABIN	87	54	0	18	29	10	18	35	31	6	38	21	41
NOSE	93	42	0	25	34	2	7	29	40	11	34	24	42
AFT FUS.	73	47	9	13	31	19	37	30	14	0	31	26	43
TAIL CONE	27	50	17	33	0	40	0	60	0	0	33	67	0
RT INBD WING	60	33	0	9	58	13	25	38	25	0	43	16	41
RT OTBD WING	33	30	30	9	30	11	23	47	19	0	40	17	42
LT INBD WING	67	32	0	11	57	15	21	44	19	0	34	20	46
LT OTBD WING	33	31	43	5	21	10	30	45	16	0	35	22	43
RT HORIZONTAL	33	47	33	5	16	49	32	12	6	1	36	20	43
LT HORIZONTAL	33	49	35	2	14	61	21	10	8	0	36	21	43
VERTICAL	27	48	27	7	18	48	35	11	6	0	36	18	46
MAIN GEAR	20	50	7	18	25	12	15	35	3	35	-	-	-
NOSE/TAIL GEAR	20	50	11	18	21	29	26	23	0	23	-	-	-
ENG #1	67	36	3	18	43	5	14	44	22	15	27	18	55
ENG #2	-	22	11	0	67	22	11	33	22	11	0	0	100

											Bent	Yes	No
PROP #1	-	26	28	7	39	5	30	33	5	27		100	0
PROP #2	-	33	17	0	50	17	50	0	0	33		80	20

DATA SET: BASIC Group
ELT Installed in Aft Fuselage or Tail

No. of Cases: 111

U.S. 14 %

In Flight Breakup
1 ; 1 %

Ground Fire Cases
15 ; 14 %

In Flight Fire Cases
0 ; 0 %

TABLE 7.4.4 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, ELT Installed in Aft Fuselage or Tail

No. of Cases 111 US: 16 CAN: 95

	Yes	No	Unk
ELT Installed	110	1	0
ELT Armed	95	4	11
ELT Activated	67	26	17
ELT Aid in Search	26	29	55
ELT in Mount After Impact	33	4	73
Antenna Intact	18	7	85
Antenna Cable Connected	1	5	104
ELT Battery Expired	1	6	103
Search Required	74	29	8

How Did ELT Aid in Search?

Initial Alerting	22
Detection by Airborne SAR	4
Final Homing	6
Voice Communication	0

Activate	
Auto	66
Man.	1

ELT Location	
Aft Fuselage	111
Cabin	0
Cockpit	0

ELT Activated, But Did Not Aid in Search

Search Not Required	14
Battery Went Dead	1
Antenna Disconnected	5
Antenna Shielded	3
Searchers Not Equipped	2
Under Water	6

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	4
Insufficient Force to Activate	2
Destroyed/Damaged by Impact	16
Broke Loose From Mount	0
Internal Malfunction	4
Tested OK After Accident	3

	Fatal	Serious	Minor	None
Pilot	76	29	5	1
Crew	9	4	1	0
Passengers	106	36	32	9
Outsiders	0	0	0	0

TABLE 7.44 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	77	-	-	-	-	11	14	35	38	2	45	18	37
CABIN	77	55	0	18	27	11	19	36	32	2	45	19	37
NOSE	73	38	0	27	35	5	10	43	38	4	45	17	38
AFT FUS.	66	47	4	19	30	20	29	35	16	0	44	20	36
TAIL CONE	26	39	16	13	32	45	11	20	25	0	57	18	25
RT INBD WING	66	36	0	12	51	15	25	35	25	0	47	18	35
RT OTBD WING	48	30	23	0	38	0	24	40	26	0	47	19	34
LT INBD WING	61	37	0	14	48	16	24	37	23	0	46	17	38
LT OTBD WING	45	33	26	7	34	12	27	37	23	0	46	18	36
RT HORIZONTAL	39	43	31	6	20	49	23	14	13	0	42	21	37
LT HORIZONTAL	39	42	31	6	20	50	21	16	13	0	43	20	37
VERTICAL	39	45	29	9	16	51	25	14	10	1	43	20	37
MAIN GEAR	34	44	7	12	38	23	16	30	21	10	-	-	-
NOSE/TAIL GEAR	34	36	6	15	43	29	14	24	30	4	-	-	-
ENG #1	61	32	1	20	47	14	20	36	22	8	41	17	41
ENG #2	-	30	8	14	49	18	18	47	15	3	46	31	23

DATA SET: ALL Files
Search Required

No. of Cases: 385

U.S. 59 %

In Flight Breakup
13 ; 3 %

Ground Fire Cases
43 ; 11 %

In Flight Fire Cases
2 ; 1 %

											Bent Yes	Bent No
PROP #1	-	26	25	4	45	8	22	44	14	12	95	5
PROP #2	-	32	29	0	39	7	36	43	7	7	89	11

TABLE 7.45 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, Search Required

No. of Cases 385 US: 228 CAN: 157

	Yes	No	Unk
ELT Installed	329	40	16
ELT Armed	299	22	78
ELT Activated	195	60	74
ELT Aid in Search	150	54	125
ELT in Mount After Impact	42	19	268
Antenna Intact	28	8	293
Antenna Cable Connected	1	23	305
ELT Battery Expired	11	28	290
Search Required	385	0	0

How Did ELT Aid in Search?

Initial Alerting	65
Detection by Airborne SAR	33
Final Homing	95
Voice Communication	0

Activate		ELT Location	
Auto	171	Aft Fuselage	102
Man.	18	Cabin	20
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	2
Battery Went Dead	1
Antenna Disconnected	10
Antenna Shielded	5
Searchers Not Equipped	4
Under Water	9

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	3
Insufficient Force to Activate	7
Destroyed/Damaged by Impact	46
Broke Loose From Mount	6
Internal Malfunction	9
Tested OK After Accident	7

	Fatal	Serious	Minor	None
Pilot	280	44	24	36
Crew	24	11	5	2
Passengers	384	71	47	55
Outsiders	0	0	0	0

TABLE 7.45 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	79	-	-	-	-	4	11	40	42	3	41	19	40
CABIN	79	47	0	44	31	3	14	44	36	3	41	20	39
NOSE	77	29	0	61	40	2	4	46	42	6	40	18	42
AFT FUS.	69	40	5	41	36	13	28	38	20	0	40	23	38
TAIL CONE	26	31	18	9	36	41	8	23	28	0	57	17	26
RT INBD WING	69	29	0	27	59	8	29	38	26	0	43	19	38
RT OTBD WING	49	23	28	15	41	6	25	44	25	0	44	19	37
LT INBD WING	67	27	0	32	57	8	24	42	25	0	40	18	42
LT OTBD WING	49	25	30	13	39	6	28	42	24	0	40	19	41
RT HORIZONTAL	41	40	31	11	24	43	26	16	15	0	38	21	42
LT HORIZONTAL	41	39	31	12	24	46	23	16	15	1	38	29	42
VERTICAL	41	42	27	20	22	42	29	14	13	1	40	19	41
MAIN GEAR	33	36	8	19	41	16	16	34	20	13	-	-	-
NOSE/TAIL GEAR	33	31	6	18	46	24	12	28	30	6	-	-	-
ENG #1	62	21	2	40	57	9	16	38	27	11	33	19	48
ENG #2	-	12	8	3	68	16	8	52	20	4	50	17	33

DATA SET: BASIC Group Search Required

No. of Cases: 272

U.S. 53 %

In Flight Breakup

10 ; 4 %

Ground Fire Cases

39 ; 14 %

In Flight Fire Cases

0 ; 0 %

											Bent	Yes	No
PROP #1	-	14	26	8	55	3	21	48	14	15		99	1
PROP #2	-	19	33	0	48	10	29	43	10	10		95	5

TABLE 7.46 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: BASIC Group, Search Required

No. of Cases 272	US: 145	CAN: 127
	Yes	No	Unk
ELT Installed	218	39	15
ELT Armed	145	21	52
ELT Activated	105	52	61
ELT Aid in Search	69	43	106
ELT in Mount After Impact	25	17	176
Antenna Intact	15	2	195
Antenna Cable Connected	0	21	197
ELT Battery Expired	9	16	193
Search Required	272	0	0

How Did ELT Aid in Search?

Initial Alerting	40
Detection by Airborne SAR	22
Final Homing	35
Voice Communication	0

Activate		ELT Location	
Auto	102	Aft Fuselage	74
Man.	3	Cabin	13
		Cockpit	3

ELT Activated, But Did Not Aid in Search

Search Not Required	1
Battery Went Dead	1
Antenna Disconnected	8
Antenna Shielded	4
Searchers Not Equipped	4
Under Water	8

Why ELT Did Not Activate

Battery Dead	3
Corrosion Damage	3
Insufficient Force to Activate	1
Destroyed/Damaged by Impact	42
Broke Loose From Mount	6
Internal Malfunction	9
Tested OK After Accident	7

	Fatal	Serious	Minor	None
Pilot	231	30	8	3
Crew	18	10	1	0
Passengers	322	53	29	15
Outsiders	0	0	0	0

TABLE 7.46 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	67	-	-	-	-	12	21	36	31	0	47	18	34
CABIN	67	64	0	18	18	15	27	30	28	0	47	18	34
NOSE	50	44	1	31	24	6	18	46	30	0	48	17	35
AFT FUS.	50	55	3	22	20	26	38	28	7	0	52	17	31
TAIL CONE	33	64	18	4	14	61	25	4	11	0	56	19	26
RT INBD WING	67	41	0	14	44	16	22	34	28	0	49	20	31
RT OTBD WING	50	34	16	14	37	11	21	35	33	0	52	19	29
LT INBD WING	33	48	0	17	35	20	32	30	18	0	54	16	30
LT OTBD WING	33	40	23	9	27	16	29	29	25	0	57	17	27
RT HORIZONTAL	33	44	35	9	13	61	20	11	9	0	47	24	29
LT HORIZONTAL	33	42	38	8	13	57	19	14	10	0	49	24	27
VERTICAL	33	46	39	9	6	67	19	10	4	0	48	25	27
MAIN GEAR	50	51	6	9	34	31	27	16	27	0	-	-	-
NOSE/TAIL GEAR	50	38	8	13	40	34	18	14	34	0	-	-	-
ENG #1	50	39	1	30	30	20	33	29	17	1	46	20	34
ENG #2	-	54	8	23	15	20	40	40	0	0	57	29	14

DATA SET: SAR Set (USAFRCC Reported ELT Aided in Search)

No. of Cases: 118

U.S. 100 %

In Flight Breakup

3 ; 3 %

Ground Fire Cases

6 ; 5 %

In Flight Fire Cases

1 ; 1 %

											Bent	Yes	No
PROP #1	-	34	29	2	35	11	20	50	18	1		91	9
PROP #2	-	55	27	0	18	10	40	50	0	0		82	18

TABLE 7.47 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: SAR Set

No. of Cases 118 US: 118 CAN: 0

	Yes	No	Unk
ELT Installed	116	0	2
ELT Armed	97	0	19
ELT Activated	105	1	10
ELT Aid in Search	94	20	2
ELT in Mount After Impact	8	2	106
Antenna Intact	8	0	108
Antenna Cable Connected	1	5	110
ELT Battery Expired	5	15	96
Search Required	106	10	2

How Did ELT Aid in Search?

Initial Alerting	28
Detection by Airborne SAR	25
Final Homing	74
Voice Communication	0

Activate		ELT Location	
Auto	93	Aft Fuselage	8
Man.	7	Cabin	1
		Cockpit	0

ELT Activated, But Did Not Aid in Search

Search Not Required	7
Battery Went Dead	0
Antenna Disconnected	3
Antenna Shielded	1
Searchers Not Equipped	0
Under Water	0

Why ELT Did Not Activate

Battery Dead	1
Corrosion Damage	1
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	5
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	0

	Fatal	Serious	Minor	None
Pilot	78	16	12	11
Crew	10	1	2	0
Passengers	107	23	8	10
Outsiders	0	0	0	0

TABLE 7.47 B

CRI REPORT 7846-14

DAMAGE DATA

	Involved in Fire (% of total with fires)	Location Data: % of total cases with data in "Location" code box				Deformation Data: % of total cases with data in "Deformation" code box					Final Attitude Data: % of total cases with data in "Attitude" code box		
		1	2	3	4	1	2	3	4	5	1	2	3
COCKPIT	86	-	-	-	-	12	19	43	25	1	43	19	37
CABIN	100	65	0	17	18	15	27	36	22	0	44	19	37
NOSE	57	47	1	31	21	6	15	50	28	1	42	20	38
AFT FUS.	43	60	6	16	17	27	40	30	4	0	46	21	33
TAIL CONE	29	62	19	8	11	67	14	11	8	0	61	22	17
RT INBD WING	57	44	0	16	40	18	23	41	19	0	47	21	32
RT OTBD WING	57	37	22	12	**29**	13	**25**	40	23	0	48	19	33
LT INBD WING	43	46	0	19	35	20	28	37	15	0	48	16	37
LT OTBD WING	43	41	27	9	23	14	32	35	19	0	48	18	33
RT HORIZONTAL	29	51	31	6	12	57	28	10	6	0	44	24	32
LT HORIZONTAL	29	52	31	5	12	58	23	13	7	0	46	24	30
VERTICAL	29	52	33	9	6	61	25	11	3	0	44	25	31
MAIN GEAR	57	51	9	13	27	35	19	24	18	5	-	-	-
NOSE/TAIL GEAR	57	42	5	19	33	32	21	18	27	2	-	-	-
ENG #1	86	41	1	26	31	21	28	32	12	2	37	23	40
ENG #2	-	41	9	18	32	21	26	53	0	0	57	21	21

DATA SET: ALL Files
ELT Aid in Search

No. of Cases: 167

U.S. 76 %

In Flight Breakup
3 ; 2 %

Ground Fire Cases
7 ; 4 %

In Flight Fire Cases
1 ; 1 %

											Bent	Yes	No
PROP #1	-	35	27	5	34	10	24	50	12	4		95	5
PROP #2	-	41	35	0	24	0	47	47	7	0		88	12

TABLE 7.48 A

CRI REPORT 7846-14

ELT DATA SUMMARY

DATA SET: ALL Files, ELT Aid in Search

No. of Cases 167 US: 127 CAN: 40

	Yes	No	Unk
ELT Installed	167	0	0
ELT Armed	156	0	11
ELT Activated	167	0	0
ELT Aid in Search	167	0	0
ELT in Mount After Impact	23	3	141
Antenna Intact	21	0	146
Antenna Cable Connected	1	5	161
ELT Battery Expired	6	16	145
Search Required	150	5	12

ELT Activated, But Did Not Aid in Search

Search Not Required	0
Battery Went Dead	0
Antenna Disconnected	0
Antenna Shielded	0
Searchers Not Equipped	0
Under Water	0

	Fatal	Serious	Minor	None
Pilot	112	25	16	13
Crew	14	5	3	0
Passengers	146	40	15	17
Outsiders	1	0	0	0

How Did ELT Aid in Search?

Initial Alerting	76
Detection by Airborne SAR	33
Final Homing	94
Voice Communication	0

Activate		ELT Location	
Auto	149	Aft Fuselage	41
Man.	12	Cabin	3
		Cockpit	0

Why ELT Did Not Activate

Battery Dead	0
Corrosion Damage	0
Insufficient Force to Activate	0
Destroyed/Damaged by Impact	1
Broke Loose From Mount	0
Internal Malfunction	0
Tested OK After Accident	0

TABLE 7.48 B

CRI REPORT 7846-14

APPENDIX A
REFERENCES

1. Special Study, Emergency Locator Transmitter: An Overview, NTSB-AAS-78-1, National Transportation Safety Board, Washington, DC 20594, 1978.

2. Control of ELT False Alarms, Publication 1362-01-0-2032, ARINC Research Corp., Annapolis, MD 21401, 1979.

3. SARSAT System Summary, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, MD 20771, 1979.

4. Minimum Performance Standards, Emergency Locator Transmitter, DO-147, Radio Technical Commission for Aeronautics, Washington, DC 20006, 1970.

5. Minimum Performance Standards, Emergency Locator Transmitter, DO-168 Radio Technical Commission for Aeronautics, Washington, DC 20006, 1979.

6. Radio Standards Specification, RSS-147, Department of Communications, Canada.

7. Development of Crash Sensor Performance Specifications and Test Procedures, Crash Research Institute, Tempe, AZ 85281, 1977.

8. Harned, M.S., "General Aviation Aircraft in the 90's", Astronautics and Aeronautics, V. 18, N. 1, January 1980.

9. Crash Survival Design Guide, USARTL-TR-79-22E, Prepared for Applied Technology Laboratory, U.S. Army Research & Technical Laboratory, (AVRADCOM) Ft. Eustis, VA 23604, January 1980.

APPENDIX B

ELT MANUFACTURERS DATA

Manufacturer	Model	Description	Battery	Switch
Aircraft Products Div. Pacific Communications P.O. Box 10392 Santa Ana, CA 92705	Alert Model 50 Alert Model 60 Alert Model 70	Mounts inside skin with antenna through hole	Mag Mag Mag	
Avionics Devices	VX2-Bru			
ACR Electronics (Chromalloy, DME Corp.) P.O. Box 2148 Hollywood, FL 33022	RLB-101	Clip on mounting bracket Long axis vertical	Li/Alk	Aerodyne 1898 Gas damped mass
Burton Instrumentation	Adam			
Communication Components Corporation 3000 Airway Ave. Costa Mesa, CA 92626	CIR 10 CIR 11	Cast metal case, exterior or portable antenna. Mounting bracket w/quick release	Mag/Li Mag/Li	Technar Rolamite
Dayton Aircraft Products (Martech) 812 N.W. First St. Fort Lauderdale, FL 33310	Eagle EB-28CD EB-2B EB-1B	Drop in metal bracket exterior or portable antenna Dual freq, single freq, built in antenna	Alk Alk "C" Merc	Technar Rolamite
Dorne & Margden 2950 Veterans Memorial Highway Bohemia, NY 11617	DM ELT 1-3 DM ELT 5-2 DM ELT 6	Metal case, factory mount exterior or portable antenna	Alk Alk Li/Alk	Aerodyne, 3 versions Gas damped mass
Edo-Aire Div. of Edo Corp. 1326 S. Walnut Wichita, KS 67123	ELT 551		Li	

Manufacturer	Model	Description	Battery	Switch
Emergency Beacon Corporation 15 River St. New Rochelle, NY 10801	EBC-102A EBC-202B EBC-302V EBC-302 EBC-302VR	Metal case, potted components integral whip antenna mounting bracket, drop in Claims 1000G shock	Alk Alk Alk Alk Alk	Mechanical, external mass Oil damped pendulum
Garrett Manufacturing, Ltd. 255 Atwell Drive Rexdale, Ontario	Rescu 88 Rescu 88L Rescu 77 Rescu 99 DAL	Avail. in horiz & Vert mounting. 2 piece mounting clips Vert. fin w/ant on each side	Mag/Nicad Li Li Nicad	Aerodyne, 3 versions
Larago Electronics Mfg. Ltd. 3120 44th Ave. N St. Petersburg, FL 33714		Factory mount with latching side, exterior ant. or telescoping		
Leigh Systems, Inc. 6081 Court St. Rd. Syracuse, NY 13206	Sharc 7 Cessna ELT	Rectangular plastic case provided with Velcro attach kit long axis mounts vertical or horizontal	Li	Magnet and Ball Inertia Switch, Inc.
Life Support Technology	Albie I Albie II Albie III		Alk Merc	10 G switch
Merl, Inc.		Same as Larago		
Micro Electronics 911 Commercial Ave. Anacortes, WA 98221	Life-Pak 1800	Steel case, encapsulated, whip antenna, quick disconnect mounting bracket	Li/Alk	Magnet switch with exterior magnet
Narco Avionics Commerce Drive Fort Washington, PA 19034	ELT-10 ELT-10C	Lexan case, factory mount with metal strap over unit exterior or portable antenna	Alk Li	Technar Rolamite
Pathfinder Corp. 4518 Taylorsville Rd. Dayton, OH 45424	2052-AF		Li	

Manufacturer	Model	Description	Battery	Switch
Pacific Avionics	ELT-1	Fixed antenna	Alk	Mechanical, exterior mass
Piper Aircraft Lock Haven, PA 17745	Locator	Same as Garrett		
Pointer, Inc. 1445 W. Alameda Dr. Tempe, AZ 85282	Pointer II Model 3000 Model 3000A Model 2000 Model C4000	Sealed tube, mounts inside skin with attached antenna outside Lexan box with factory mount exterior or portable antenna	Merc/Li Mag Li Mag	Technar Rolamite
Radair Box 13018 Fort Worth, TX 76118	Dart I Dart II			
Specter Systems	Auto Set			

ELT SWITCH MANUFACTURERS

Aerodyne Control Corp.
90 Gazza Blvd.
Farmingdale, NY 11735
(516) 694-3500

Inertia Switch, Inc.
260 N. Route 303
West Nyack, NY 10994
(914) 358-9070

Technar, Inc.
205 N. 2nd Avenue
Arcadia, CA 91006
(213) 445-1143

The following are believed to have their own proprietary desigh

EBC
Larago
Micro Electronics

APPENDIX C

A SUMMARY OF ELT INSTALLATION DATA WHICH
WAS RECEIVED FROM PAUL NEUMANN, FAA, IN
RESPONSE TO HIS REQUEST TO
FAA REGIONAL OFFICES
FOR A COPY OF ELT MOUNTING AND INSTALLATION MANUALS,
IS CONTAINED IN PAGES 2-5.

PAGES 6 AND 7 ARE ADDITIONAL DATA
OBTAINED FROM SALES LITERATURE AND OTHER SOURCES.

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Communication Components Corp. CIR-11 CIR-10	AF AP P	P-In cabin where accessible. AP-Where accessible. Fixed antenna outside within 48 in. of transmitter. AF-Mount in convenient location (not in bilge) as far aft as possible & near inspection panel. Antenna outside on tail assy. within 48 in. of unit with 6 in. service loop in cable. Mount unit on bracket with screws in any position as long as longitudinal axis of unit is parallel to within $\pm 10^0$ of normal direction of flight.	21	March 1978	High
DME Corp. RLB-5(A)	AF AP P	Install by bracket, spring loaded clamps, bungee, elastic straps, or in life raft packs. Secure against rolling, bouncing, etc. Take care not to damage floating styrofoam coating or water-tight seal around unit or antenna.	2	November 5, 1976	Low
Martech EB-2BCD	AF	Bracket is held to aluminum plate or rigid structure by four screws. If 8in. flexible antenna is used, mount transmitter so that antenna is in window envelope. If external antenna is used, position ELT on any fore & aft bulkhead.	2	-	Low
Merl, Inc.	AF	Mount unit to vertical & horizontal aircraft structure with screws making sure antenna connector is up. Locate unit in area away from control cables. Remote control unit mounted in cabin area.	1	-	Very low
Emergency Beacon Corp. ECB-102A	P AP	Attach mounting bracket securely to aircraft, mount unit to left side in vertical position with arrow pointing toward nose of aircraft. As much antenna as possible should be visible through window and should be at least one inch from any metal window parts.	2	-	moderate
Piper Automatic Locator	AF AP P		1	-	None

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Dorne & Margolin, Inc. DM ELT 5-2A	AF AP P	P-Install at convenient location. Accessible for quick removal. Must be 'hand mounted' to aircraft so may activate automatically. AP-May be mounted in same location as personnel. Install external antenna to aircraft. Recommended cable length not to exceed 10 ft. AF-When mounted for AP with external antenna, unit meets AF category. For maximum protection, unit & antenna should be installed as far aft as possible near an access panel. Mount bracket to aircraft structure with four screws. Unit is mounted with direction of flight arrow facing forward using two quick release fasteners. Install antenna as far aft as possible, no closer than 3 ft. from vertical stabilizer and as far away as possible from other antennas.	4	-	High
Leigh Systems, Inc. SHARC-7K	AF AP	Fixed Wing-Rivet mounting bracket to rigid structure not subject to severe vibration. This should be as far aft as possible and be accessible for manual activation & deactivation, or portable use if equipped with additional antenna. Position transmitter with the direction of flight arrows (shown in figure). Arrows must align with aircraft horizontal axis within $\pm 30^0$. Connect to external antenna avoiding other electrical cables or shielding antenna cable. Helicopters-Rivet mounting bracket to rigid structure not subject to severe vibration. On single rotor aircraft this should be close to the primary structure supporting the rotor drive shaft & transmission, on fuselage aft section, or on the tail boom. Install on multi-rotor helicopters in corresponding areas. The unit should be easily accessible and easily detachable if equipped with antenna for portable use. Position unit with direction of flight arrows (figure). Arrows must point forward & be inclined approximately 45^0 downward in fore & aft plane. Install antenna not more than 2 ft. away & between same bulkheads as transmitter.	23	Dec. 19, 1974	High

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Narco ELT 10	AF AP P	AP-Install where unit is easily accessible for portable deployment. Antenna must be mounted within 60 in. of transmitter. AF-Mount bracket with arrow pointing in direction of flight on any vertical or horizontal surface as far aft as possible. Use screws to secure. Longitudinal axis of unit must be parallel $\pm$ 10° to the longitudinal axis of aircraft. Mount unit into bracket so bracket & unit arrows point in the same direction (only possible to mount this one way). Install antenna aft & away from communication antennas, but within recommended 60 in.	17	August 1978	High
Pacific Avionics ELT-1	AF AP	Attach mounting bracket to an upright rigid structure in cabin area. Place so that arrow on unit points in direction of flight and antenna can be seen through cabin window but is at least one in. from metallic parts of the aircraft.	3	Dec. 11, 1973	Moderate
Micro Electronics Corp. 1800	AF	Mount in cabin area away from obstructions so antenna is visible in a window. Attach bracket to panel material with the correct hardware for that type of material.	1	-	Low
Garrett Rescu/99 DAL	AF	It is recommended that this unit be mounted in the bottom third of the vertical stabilizer or in the rear section of the fuselage. The unit may be mounted flush from the outside, depending on type of aircraft structure. It is recommended to use doublers. This method of mounting is generally used for the vertical stabilizer. Where there is insufficient area for a flush mount, the unit may be installed inside the aircraft to skin or structure. A bracket may be fabricated for the unit and should be attached by riveting or using screws. When this method is used, access must be provided by cutting a door or access hole for switch key. Install unit in any position where arrow on cover is aligned with axis of fuselage and points to nose of aircraft. Drain grooves in unit must be facing down. In some cases, new holes must be made to comply with this.	33	-	High

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Aircraft Products Alert 50	AF	A) Mount unit at least 24 in. forward of vertical fin clear of structure, cables & wiring, by bending mounting flanges to fit flat with inside airframe surface. Control knob must be forward. Fasten with six screws. An access hole & antenna clearance hole must be cut in accordance with template (not provided with FAA info). Install antenna & align with airstream. B) Locate unit near access panel or behind baggage compartment for easy access. Maintain 4 in. clearance on bottom for battery replacement. Unit may be mounted on a bracket held to aircraft skin by six screws. Unit is placed in bracket & held by nylon mounting strap. An L shaped bracket is supplied to align the control knob in the proper direction. The unit may also be mounted directly to an internal structural member. Install antenna as far aft as possible at least 24 in. from vertical fin. Antenna may be mounted around fuselage up to 30^0 from the vertical, within 32 in. of unit due to cable length. C) For non-metal aircraft, locations are the same. In steel tube A/C, install aluminum gusset to fuselage braces with clamps (one at each corner). Wood or plastic A/C, select location at junction of stringers and/or bulkheads. In both cases, follow previous instructions except for section on antenna. Antenna should be mounted near rigid section or must use gusset as above. In fabric, antenna may also be mounted inside away from metal & close to skin, with some sacrifice to transmission. Antenna must have ground plane such as metal foil or tape, forming radials at least as long as antenna. Minimum of 4, optimum 8, must contact antenna metal mounting flange.	12	-	moderate
Alert 60, 70	AF	About the same as above.	7	-	moderate

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Pointer Industrial Model 3000 Model C-4000 (F)	AF AP	Mounting surface must be flat and rigid. The transmitter may be rotated longitudinally to mount, but the mounting bracket and transmitter must be parallel to the longitudinal axis of the aircraft. Do not mount the unit at a downward or negative angle. Mount as far aft as possible, with ease of access.	15	Current	High
Pointer II Model 1002	AF	The mounting bracket is rivetted to the inside of the top of the fuselage. The unit is then bolted to the mounting bracket with the direction-of-flight arrow facing forward. When the unit is installed, the antenna protrudes directly out of the top of the ELT and through the aircraft skin so a hole must be drilled accordingly.		Unk	Moderate
Life Support Technology "Albie III"	AF AP	Permanent units should be mounted near an access hole within the tail-cone of the plane. (10 G switch)			Sales Literature
Garrett Rescue 77	AF	Unit should be securely mounted within the vertical stabilizer of the plane. Two antennas should be mounted, one on each side of the vertical stabilizer. The antenna should be perpendicular to the tail and swept back 45°.	12	1974	High
Piper Automatic Locater a.k.a. Garrett Rescue 88 88L	AF AP	Horizontal Mounting - Ensure that installation location provides rigidity and is not subject to excessive vibration in flight. The metal in mounting area must be 0.114/0.056 inches in thickness. The mounting bracket consists of two parts, one which secures the forward end of the unit and one which secures the rear. Attach forward mount to aircraft so that when unit is installed, i will be parallel to the longitudinal axis of the plane with the on/off switch mechanism facing forward. Place unit securely against forward mount, set rear mount securely against rear of unit and attach rear mount to the aircraft. The rear mount attaches to the aircraft with a snap-locking pin which removes easily so as to remove the unit. The forward mount is permanently attached.	6	1974	High

Make/Model	Type	Summary of Installation Data	Pages of Data	Date Issued	Amount of Detail
Piper Auto-matic Pilot a.k.a. Garrett Rescue 88 (Continued)		Vertical Mounting - (Note: top and bottom mounts are the same, respectively, as the forward and rear mounts in the above example and are installed the same). Ensure that location provides rigidty and is not subject to excessive vibration in flight. Metal in mounting area must be 0.114/0.056 inches in thickness. Attach top mount in such a way that when unit is installed, the direction arrow is pointing forward. Install bottom mount. Unit may be rotated upon its minor axis but must face forward as shown by arrow.			
Chromalloy Electronics RLB-1G1	AP	Mounting bracket must be installed vertically, and in such a way that the units direction-of-flight arrow is pointing forward when installed. As close to pilot as possible.	1	1975	Low

C-7

APPENDIX D

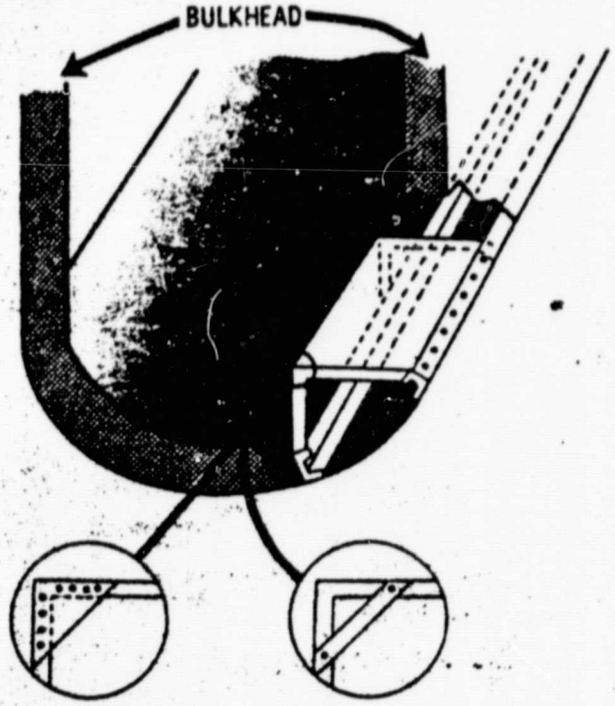
FAA DOCUMENT AC 43.13-2A
(EXTRACTED)

28. EMERGENCY LOCATOR TRANSMITTER (ELT) INSTALLATIONS. The ELT unit should be attached to the airframe or other solid structures. Airframe preparation for either vertical or shelf-type mountings is displayed in figures 2.7 and 2.8. The equipment manufacturer mounting bases that meet load requirements and can be utilized are acceptable.

The installation of the ELT antenna should be located as far as practicable from other installed antennas. Methods for securing whip-type antennas to the structure are shown in figures 3.1 and 3.3. Follow the manufacturer's installation procedures when available.

29.–35. [RESERVED]

Rev. 1977



Use standard aircraft practices and procedures for fabrication and attachment of shelf. Reinforce fore and aft corners with gussets or bulb angle.

FIGURE 2.8.—Typical shelf installation.

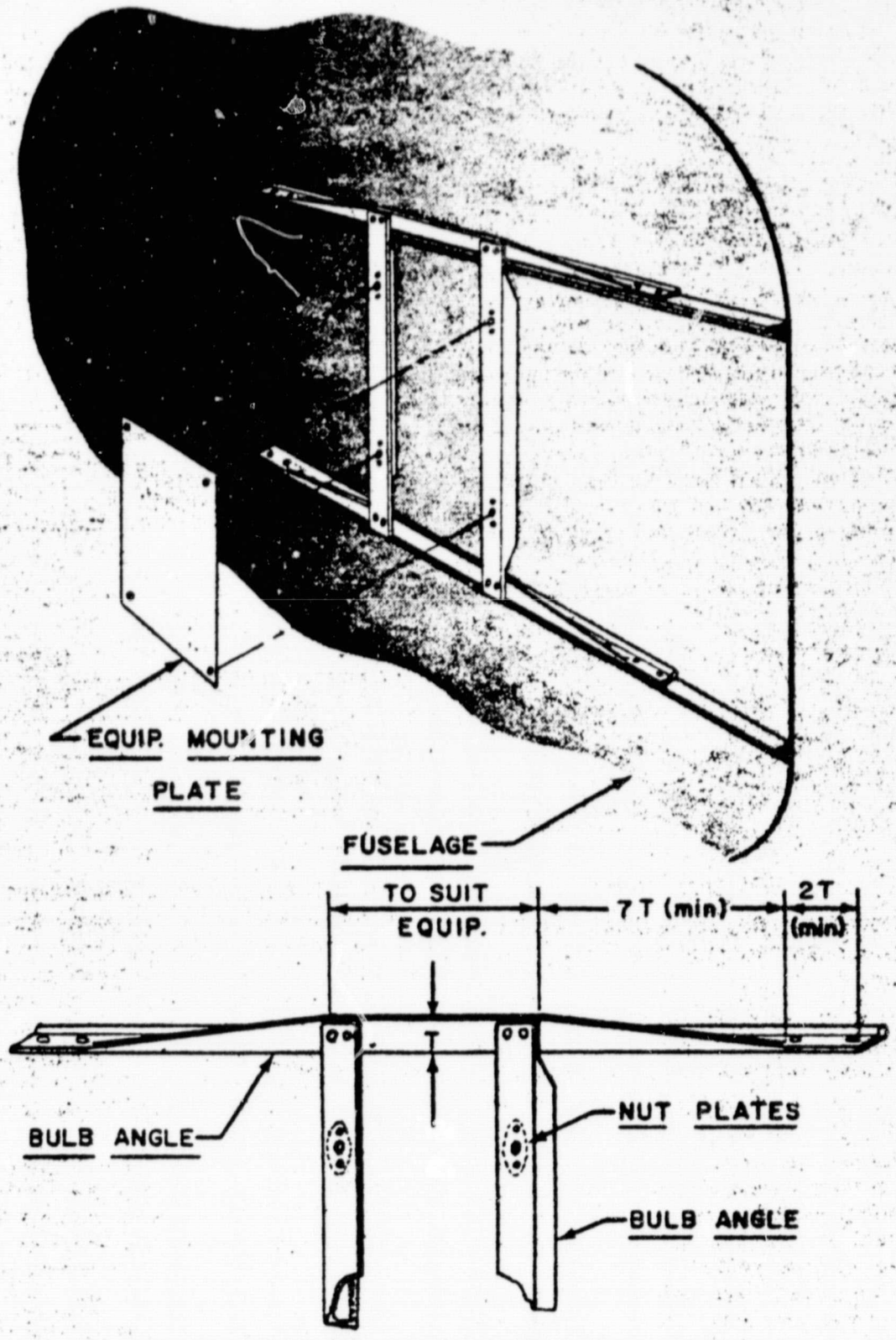


FIGURE 2.7.—Typical remote unit mounting base—vertical or horizontal.

Chapter 3. ANTENNA INSTALLATIONS

36. PERFORMANCE. For proper performance, it is important that the radio equipment manufacturer's instructions be carefully followed in matching and coupling the antenna to the radio equipment.

a. The location of the antenna is of primary importance. When selecting a mounting position, consideration should be given but not limited to the following:

(1) Obstruction to signal reception by aircraft or aircraft components.

(2) Ignition noise (RF radiation pickup).

(3) Vibration.

(4) Flutter.

(5) Instrument static source interference.

b. Attach antenna mounting (masts, base receptacles, and/or supporting brackets) so that the loads imposed (e.g., air, ice, etc.) are transmitted to the aircraft structure.

37. VHF ANTENNA—WHIP.

a. Locate this type antenna so that there is a minimum of structure between it and the ground radio stations. The antenna may be mounted on the top or bottom of the fuselage. It is not advisable to mount the antenna on the cowl forward of the windshield because a lightning strike might possibly blind the pilot.

b. Methods of securing whip antennas to the structure are shown in figures 3.1 and 3.3.

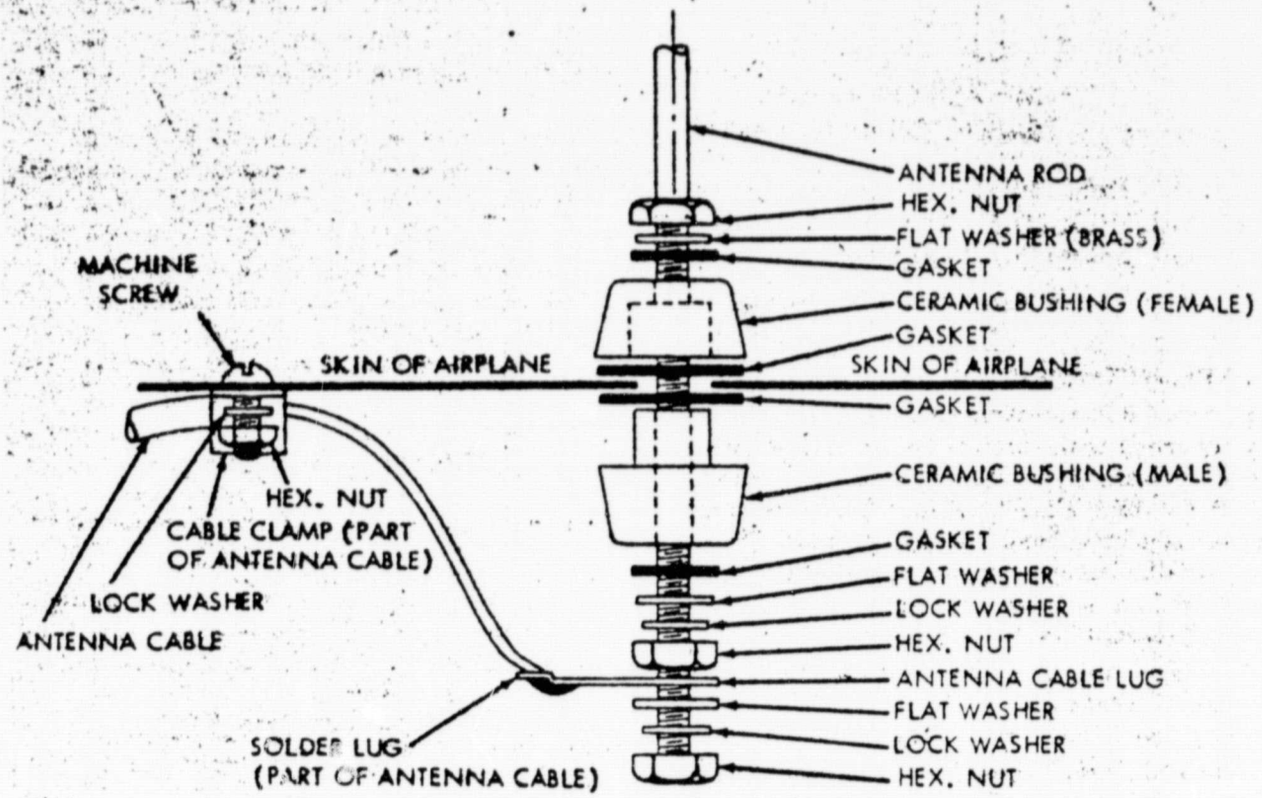
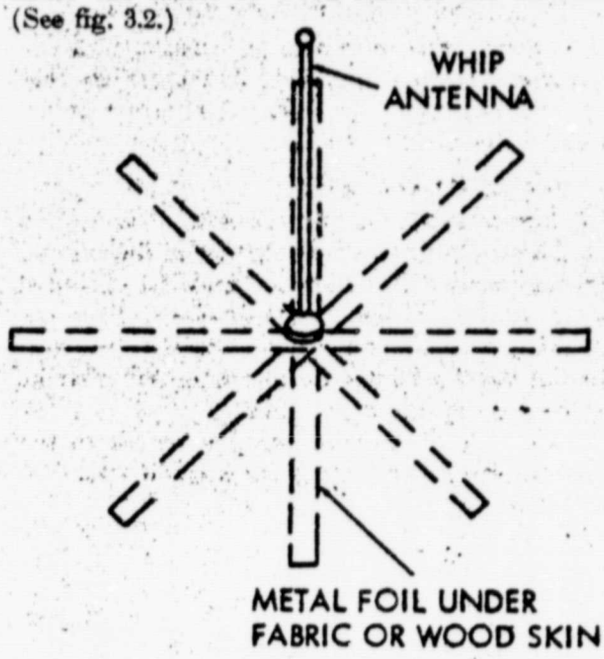


FIGURE 3.1.—Typical whip antenna installation.

c. On fabric-covered aircraft or aircraft with other types of nonmetallic skin, the manufacturer's recommendations should be followed in order to provide the necessary ground plane. An acceptable method of accomplishing this is by providing a number of metal foil strips in a radial position from the antenna base and secured under the fabric or wood skin of the aircraft. (See fig. 3.2.)



NOTE: THE LENGTH OF EACH FOIL RADIAL SHOULD BE AT LEAST EQUAL TO THE ANTENNA LENGTH.

FIGURE 3.2.—Antenna ground plane for nonmetallic aircraft.

38. VHF ANTENNA—RIGID.

a. When it is necessary to cover a broader frequency range than can be covered by a whip antenna, a blade type should be used because it is resonant over a much broader frequency range. However, a broadband antenna is not as efficient as a small diameter whip antenna and, accordingly, should not be used with relatively low output transmitters (under 5 watts).

(1) The antennas shown in figure 3.4 are normally installed at a point on the fuselage directly above the cabin or baggage compartment.

When a rigid antenna is installed on the vertical stabilizer, evaluate the flutter and vibration characteristics of the installation.

(2) The approximate drag load an antenna is required to withstand can be determined by the following formula:

$$D = .000327\ AV^2$$

(The formula includes a 90 percent reduction factor for streamline shape of antenna.)

Where D is the drag load on the antenna in lbs.,
A is the frontal area of the antenna in sq. ft., and
V is the V_{ne} of the aircraft in m.p.h.

The frontal area of typical antennas are approximately as follows:

Antenna (Fig. 3.4)	*Area (sq. ft.)*
a	.073
b	.135
c	.135
d	.025
e	.045

Example: Antenna "b" at 250 m.p.h.

$D = .000327 \times .135 \times (250)^2$
$= .000327 \times .135 \times 62{,}500$
$= 2.75$ lbs.

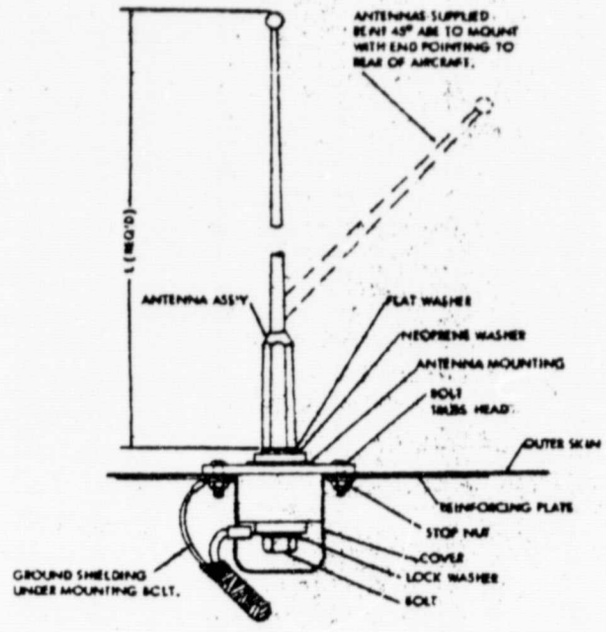


FIGURE 3.3.—Typical shockmounted antenna installation.

APPENDIX E

CRISIS DATA COLLECTION FORM

Analyst _____ Date Form Filled Out _____

Our File Number | | | | | | Government File Number | | | | | | | | | |

A/C Registration Number | | | | | | Date | | | | | | Month Day Year

ELEVATION MSL | TIME (Local)

Location _____ State Code Number | |

AIRCRAFT	MANUFACTURER		MODEL		SERIAL NUMBER	"Type Code			
AIRCRAFT CLASSIFICATION	A	AEROPLANE	I	GYROPLANE	F	DIRIGIBLE	H	HOMEBUILT	
	B	HELICOPTER	O	BALLOON	E	BLIMP	J	ULTRA-LIGHT	
	C	GLIDER	Y	OTHER					
LANDING GEAR 1	H	TRICYCLE FIXED	G	TAILWHEEL RETRACT	D	SKI	Y	OTHER	
	F	TRICYCLE RETRACT	B	HULL/FLOAT	E	SKID			
	I	TAILWHEEL FIXED	C	AMPHIBIOUS					
LANDING GEAR 2	A	HULL	B	FLOAT	C	SKI-WHEEL	O	FLOAT-SKID	
WING/ROTOR	A	LOW WING	C	MID WING	E	TWIN ROTOR	F	BIPLANE	
	B	HIGH WING	O	SINGLE ROTOR	Y	OTHER			

ENGINE(S)	MANUFACTURER		MODEL		NUMBER INSTALLED	POWER	H	HP.	
							T	lbs THRUST	
ENGINE TYPE	A	RECIPROCATING	F	TURBOSHAFT (HELICOPTERS)	B	TURBOJET	E	NONE	
	C	TURBOPROP	O	TURBOFAN	Y	OTHER			
PROPELLER TYPE	A	FIXED METAL	C	VARIABLE PITCH	E	FIXED WOODEN	R	REVERSIBLE	
	B	CONSTANT SPEED	O	CONSTANT SPEED FULLY FEATHERING	O	OTHER			

AIRCRAFT DAMAGE	N	NONE	M	MINOR	S	SUBSTANTIAL	D	DESTROYED	U	UNKNOWN

INJURIES TO PERSONS	FATAL	SERIOUS	MINOR	NONE	UNKNOWN	TOTAL
PILOT IN COMMAND						
OTHER CREW						
PASSENGERS						
PERSONS OUTSIDE AIRCRAFT						

FIRST PHASE OF OPERATION | | FIRST TYPE OF OCCURRENCE | |

SECOND PHASE OF OPERATION | | SECOND TYPE OF OCCURRENCE | |

AERODROME PROXIMITY							
A	ON AIRPORT	F	WITHIN .4 Km 1/4 mi	K	WITHIN 4.8 Km 3 mi		
B	ON SEAPLANE BASE	G	WITHIN .8 Km 1/2 mi	L	WITHIN 6.4 Km 4 mi		
C	ON HELIPORT	H	WITHIN 1.2 Km 3/4 mi	M	WITHIN 8 Km 5 mi		
D	ON BARGE/SHIP/PLATFORM	I	WITHIN 1.6 Km 1 mi	N	BEYOND 8 Km		
E	IN CIRCUIT	J	WITHIN 3.2 Km 2 mi				

☐ Illegal Operation

☐ Search & Rescue Mission

Part G – WEATHER AT TIME AND PLACE OF ACCIDENT

SOURCE OF INFORMATION	SKY COVER	Conf. Level This Page
	☐ CLEAR ☐ CEILING _____ FT. ☐ OTHER _____ _____ FT.	

TURBULENCE	LIGHT CONDITIONS	VISIBILITY
N ☐ NONE L ☐ LIGHT M ☐ MODERATE S ☐ SEVERE E ☐ EXTREME	A ☐ DAWN / DUSK B ☐ BRIGHT NIGHT S ☐ DAYLIGHT D ☐ DARK NIGHT	MILES

WEATHER CONDITIONS AND VISIBILITY RESTRICTIONS	TEMPERATURE
A ☐ FOG B ☐ RAIN C ☐ SNOW D ☐ SLEET E ☐ FREEZING RAIN F ☐ THUNDERSTORMS H ☐ HAZE H ☐ HAIL S ☐ SMOKE D ☐ DUST I ☐ ICING CONDITIONS	°C °F

102 TYPE OF TERRAIN	A	MOUNTAINOUS	C	ROLLING	
	B	HILLY	D	LEVEL/FLAT	

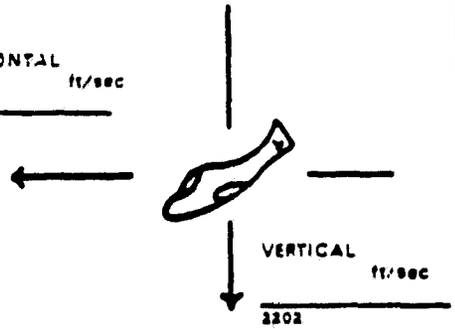
103 SURFACE CONDITION GENERAL	3	HARD	H	TREE COVERED	K	WATER
	F	ROCKY	I	BUILT-UP (CITY-DENSE)	N	SWAMP
	G	SANDY	M	BUILT-UP (SUBURBAN-COUNTRY-SPARSE)	Y	OTHER
104 SURFACE CONDITION SPECIFIC	O	PAVED	S	MUD, WET SOIL	1	SNOW
	P	LOOSE	T	HIGH WAVES	2	ICE
	Q	COMPACT	U	SWELLS	Y	OTHER
	J	CULTIVATED	V	CALM/GLASSY WATER		
	R	LOW VEGETATION/GRASS	E	FROZEN GROUND		

1015 SKY CONDITION	A	CLEAR	E	BROKEN LOWER SCATTERED	I	OBSCURED
	B	SCATTERED ABOVE 1000'	G	OVERCAST LOWER SCATTERED	H	PARTIALLY OBSCURED
	C	SCATTERED BELOW 1000'	F	OVERCAST		
	D	BROKEN				
1019 RESTRICTING PHENOMENA	A	DUST	F	SMOKE	K	PRECIPITATION
	B	FOG	G	BLOWING DUST	J	NONE
	C	SHALLOW FOG	H	SANDSTORM	Y	OTHER
	E	FREEZING FOG	I	BLOWING SNOW		
1017 TYPE OF PRECIPITATION (Select up to 2)	C	DRIZZLE	F	SNOW	I	THUNDERSHOWERS
	D	RAIN	G	SNOW GRAINS/ICE PELLETS	L	NONE
	E	RAIN SHOWERS	H	SNOW SHOWERS	Y	OTHER
	A	HAIL	J	FREEZING DRIZZLE		
	B	SLEET	K	FREEZING RAIN		
1018 SIGNIFICANT WEATHER (Select up to 3)	A	TURBULENCE IN CLOUD	H	VARIABLE CLOUD BASE	C	TORNADO
	B	CLEAR AIR TURBULENCE	M	LIGHT PRECIPITATION	D	HURRICANE, TYPHOON
	G	SEVERE LINE SQUALL	L	HEAVY PRECIPITATION	E	MOUNTAIN WAVE
	J	WIND VARIABLE	T	THUNDERSTORM	S	NOT SIGNIFICANT
	I	WIND GUSTY	Q	SEVERE ICING	Y	OTHER
	K	WIND GUSTY & VARIABLE	N	TEMPERATURE BELOW 0°C		

Our File Number _____ Regis. No. _____ Conf. Level This Page ____

VELOCITY COMPONENTS AT IMPACT

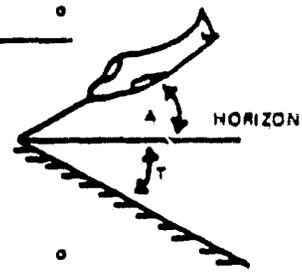
HORIZONTAL ft/sec
2201



☐ VERIFIED ☐ ESTIMATED
2203

FLIGHT PATH ANGLE & TERRAIN ANGLE

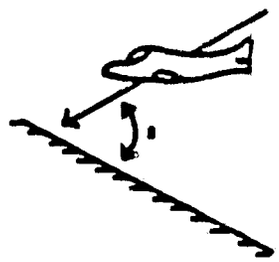
A ° 2204



T ° 2205

☐ VERIFIED ☐ ESTIMATED
2206

IMPACT ANGLE



B ° 2207

2208 OPEN TERRAIN (Select up to two)

A	CONCRETE	G	FRESH LOOSE SNOW
B	ASPHALT	H	DRY CULTIVATED SOIL
C	DRY PACKED CLAY	K	WET CULTIVATED SOIL
D	DRY SOD	L	BOGGY
E	WET SOD	M	WATER
F	PACKED SNOW	N	ICE
V	OTHER		

2209 OBSTACLES (Select up to three)

A	ROCK FACE	M	TREES 6" TO 9" DIA.
B	RIGID STRUCTURE	K	TREES 9" TO 12" DIA.
C	WOOD FRAME STRUCTURE	L	TREES 12" DIA. +
D	BOULDERS 0.5 TO 1.0 FT DIA.	M	SCRUB TREES
E	BOULDERS 1 TO 2 FT DIA.	N	WIRES
F	BOULDERS 2 TO 3 FT DIA.	P	POLES
G	TREES 3" TO 6" DIA.	V	OTHER

TOTAL STOPPING DISTANCE FROM FIRST IMPACT

ft
2212

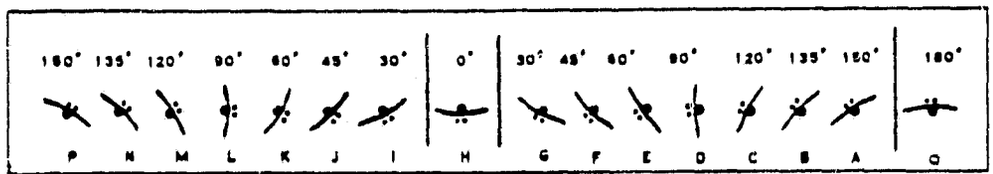
LATERAL VELOCITY

ft/sec
2213/2214

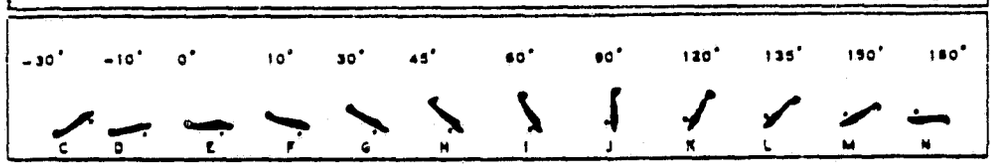
DIRECTION	
L	LEFT
R	RIGHT

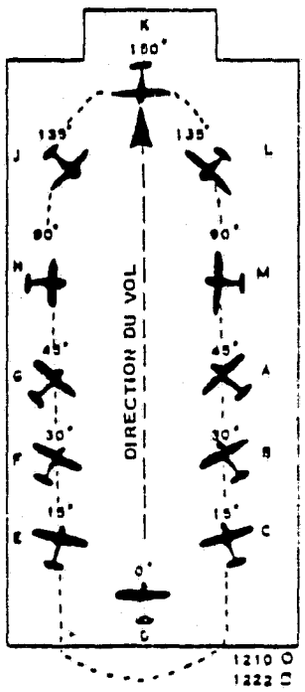
	Rear	Stbd.	Plan
Ground Contact			
Final Rest			

REAR ELEVATION 1108

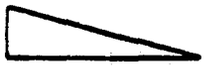


STARBOARD ELEVATION 1109

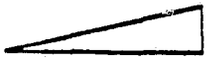
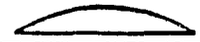




MOST SEVERE IMPACT

PULSE TYPE 2215	INITIAL VELOCITY Vo (2216) ft/sec	COEFFICIENT OF FRICTION μ (2218)	WEIGHT AT IMPACT (2221) lb
A ☐ 			
B ☐ 	FINAL VELOCITY Vf (2217) ft/sec		
C ☐ 		DISTANCE OF PULSE Ve to Vf S (2220) ft	DECELERATION LEVEL (2222) G
D ☐ 	VELOCITY CHANGE Vo-Vf (2219) ft/sec		
E ☐ 			

SECOND MOST SEVERE IMPACT

PULSE TYPE	INITIAL VELOCITY Vo (2224) ft/sec	COEFFICIENT OF FRICTION μ (2227)	WEIGHT AT IMPACT (2229) lbs
A ☐ 			
B ☐ 	FINAL VELOCITY Vf (2225) ft/sec		
C ☐ 		DISTANCE OF PULSE Ve to Vf (2228) ft	DECELERATION LEVEL (2230) G
D ☐ 	VELOCITY CHANGE Vo-Vf (2226) ft/sec		
E ☐ (2231) 			

SEARCH & RESCUE 1601			P	PERTINENT	N	No search req.
AIRCRAFT FOUND BY 1602	A	SAR ORGANISATION	D	RCMP	G	MOT
	B	PRIVATE AGENCY	E	PROVINCIAL POLICE	H	NOT FOUND
	C	COMMERCIAL AGENCY	F	MUNICIPAL POLICE	V	OTHER
SEARCH BY 1603	A	GROUND	C	BOAT	E	GROUND/AIR
	B	AIR	D	AIR/BOAT	F	ALL MODES
LOCATING METHOD 1604	A	L/F RADIO	D	VISUAL-MIRROR	G	VISUAL-PYROTECHNICS
	B	AUTOMATIC C*I	E	VISUAL-SMOKE/FIRE	H	VISUAL-OTHER
	C	VHF/UHF HOMING	F	VISUAL/WRECKAGE	V	OTHER

ELAPSED TIME	ACCIDENT TO NOTIFICATION (1605) _____ Days _____ hours	ACCIDENT TO SEARCH SUCCESS (1606) _____ Days _____ hours

DAMAGE/DEFORMATION/LOCATION

Our File Number _____

Registration Number _____

Gov't file number _____

Number of Photos _____

Inflight breakup	Yes	No
Fire inflight	Yes	No
Fire on ground	Yes	No
Wreckage not rec'd	Land	Water

Section	Burned	Location	Deform	Attitude @ rest	Confidence Level	Position @ impact	
A - Cockpit							
B - Cabin							
N - Nose							
C - Aft Fus							
T - Tail Cone							
R - Rt inbd wing							
S - Rt otbd wing							
L - Lt inbd wing							
M - Lt otbd wing							
H - Rt horiz							
G - Lt horiz							
V - Vertical							
W Main ldg gear						UP	DN
X Nose/tail gear						UP	DN

							Inst. Loc
Eng #1							
2							
3							
4							

	Blades Bent yes	no				
Prop #1						
2						
3						
4						

2201 _____
2202 _____
2203 _____
2204 _____
2205 _____
2206 _____
2207 _____
2208 _____
2209 _____
2210 _____
2211 _____
2212 _____
2213 _____
2214 _____
2215 _____
2216 _____
2217 _____
2218 _____
2219 _____
2220 _____
2221 _____
2222 _____
2223 _____
2224 _____
2225 _____
2226 _____
2227 _____
2228 _____
2229 _____
2230 _____

Was ELT required [yes | no | undetermined]

Was ELT installed [yes | no | Unk] No ELT data [0] Confidence Level ELT Data [ ]

ELT manufacturer _____

ELT model _____ [ ][ ]

ELT location [ ] (use zone code) Still in mount [yes | no]

ELT antenna location [ ] (use zone code) Still intact [yes | no]

Length of antenna cables [ ][ ] in. Battery exp. date [ ][ ] months after accident [-][+] (use neg if before)

Battery Installation date mo ___ yr ___

Slack in cable [yes | no] Connected after accident [yes | no] Attitude @ rest [ ]

ELT type [A] Automatic Ejectable [F] Automatic Fixed [P] Personal [W] Water Activated

Second ELT Unit [ ]

Was it armed? [yes | no | unk]

Unit But No Mounting [X]
ELT Mounting provision but no unit found [Y]

Did it activate? [yes | no | unk]

[Auto activation A | Manual activation M]

Any use of febric or non-metallic material in ELT installation [Yes | No]

Did it aid in search? [yes | no | unk]

Why not?

- [A] Initial alerting
- [B] Detected by airborne SAR
- [C] Final homing
- [D] Voice comm.

- [A] Batt. went dead
- [B] Antenna Disconn.
- [C] Antenna Shielded
- [D] Searchers not Equipped
- [E] Not Required
- [F] Underwater

- [A] Unknown
- [B] Battery dead
- [C] Corrosion damage
- [D] Insufficient forces to activate
- [E] Destroyed/ damaged by impact
- [F] Broke loose from mounting
- [G] Internal Malfunction
- [H] Tested OK After Accident

Detailed desc. of antenna inst. _____

Detailed desc. of mounting _____