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Study of the Engine Bird Ingestion Experience of the Boeing 737 Aircraft
(October 1986 - September 1988)

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Interim Report

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NOTICE

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16. Abstract

The Federal Aviation Administration (FAA) Technical Center initiated a study in October 1986 to determine the numbers, sizes, and types of birds which are being ingested into medium and large inlet area turbofan engines and to determine what damage, if any, results. Bird ingestion data are being collected for the Boeing 737 model aircraft which uses either the Pratt and Whitney JT8D medium inlet area turbofan engine or the CFM International CFM56 large inlet area turbofan engine. This interim report analyzes the first 2 years of data collection for the 3-year study. The first 2 years extended from October 1986 through September 1988.

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FOREWORD

This interim report provides descriptive and statistical analyses of the data collected over a 2-year period on bird ingestion experiences for the B737 aircraft. The data described in this report were collected under a separate contract by the engine manufacturers.

The report was prepared by the University of Dayton under Department of Transportation, Federal Aviation Administration Contract DTFA03-88-C-00024. The technical project monitor for the FAA during the preparation of the report was Mr. Joseph Wilson. The principal investigator at the University of Dayton was Dr. Peter W. Hovey and computer support was provided by Mr. Donald A. Skinn.

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EXECUTIVE SUMMARY

An investigation was initiated by the Federal Aviation Administration Technical Center in September 1986 to determine the numbers, weight and species of birds which are ingested into medium and large inlet area turbofan engines during worldwide service operation and to determine what damage, if any, results. This report summarizes the first 2 of 3 years of Boeing 737 data being collected to support this effort. The first year of data is published under report number DOT/FAA/CT-89/16 (reference 9).

A total of 5.72 million aircraft operations were flown by Boeing 737 commercial aircraft during the first 2 years of this investigation which extended from October 1986 through September 1988. Boeing 737 aircraft equipped with Pratt and Whitney JT8D medium inlet area turbine engines accounted for 76.3 percent of these flights. The remaining 23.7 percent of the flights were made by aircraft having CFM International CFM56 large inlet area turbofan engines.

A total of 521 engine ingestion events were reported during the first 2 years of data collection. There were 11.44 million engine operations during this same period which yields a probability of engine ingestion of 4.55×10^{-5}. A conclusion from these data is that bird ingestion events are rare, but probable events.

When the species of the ingested bird was reliably identified, the most commonly ingested birds were from the order charadriiformes (shorebirds)--primarily gulls, lapwings, and plovers. The majority of ingested birds (87 of 92) weighed 40 ounces or less. The bird weight distribution of ingested birds in the United States was different from the distribution in foreign countries. The median and mode weights of ingested birds in the United States were smaller than abroad; however, the mean United States weight was slightly larger due to the ingestion of one very large bird. The bird ingestion rate within the United States was significantly lower than the foreign bird ingestion rate.

The majority (260 of 328) of aircraft ingestion events, for which the phase of flight was known, occurred within the airport environment during takeoff and landing. There were 81 engine ingestions which resulted in engine damage classified as moderately severe or worse. The majority of bird ingestions resulted in little or no engine damage. The majority of aircraft ingestion events (459 of 504) involved a single bird and a single engine on the aircraft. The remaining 45 aircraft ingestion events involved multiple birds and/or multiple engines.

The following summary shows the most pertinent statistics extracted from the first 2 years of data for the Boeing 737 aircraft:

Total Engine Ingestion Events	521
Total Aircraft Ingestion Events	504
Average Bird Weight (oz)	
United States	17.7
Foreign	16.8
Median Bird Weight (oz)	
United States	6.0
Foreign	9.7
Mode Bird Weight (oz)	
United States	2.0/3.0/6.0/14.0
Foreign	7.0/10.0
Probability of Ingestion Per Aircraft Operation	
Worldwide	0.88×10^{-4}
United States	0.44×10^{-4}
Foreign	1.40×10^{-4}
Most Commonly Ingested Bird	
United States	Dove/Gull
Foreign	Gull/Lapwing
Engines Experiencing Moderate/Severe Damage	81
Multiple Bird, Engine Ingestion Events	34
Multiple Engine Ingestion Events	17
Aircraft Ingestion Events By Phase-of-Flight	
Takeoff and Climb Phase-of-Flight	65.7%
Approach and Landing	31.3%
Airports Reporting Bird Ingestions	205
Ratio of Reported Events to Aircraft Operations	
United States	0.44×10^{-4}
Foreign	1.40×10^{-4}

SECTION 1

INTRODUCTION

1.1 BACKGROUND

Contention for airspace between birds and airplanes has created a serious bird/aircraft strike hazard. A past study [1] has indicated that birdstrikes to engines are statistically rare events. The probability of a birdstrike during any given flight is extremely low; however, when the number of flights is considered, the number of birdstrikes becomes significant.

The windshield and the engines are particularly vulnerable to the birdstrike threat. Although penetration of the windshield by a bird is primarily a concern for military airplanes operating at high speeds in a low-altitude environment, such a penetration has occurred on a civilian airplane resulting in the death of the co-pilot. Ingestion of birds into airplane engines is a problem for commercial as well as military jet airplanes for it can cause significant damage to the engine resulting in degraded engine performance and very possibly failure.

In his study of bird ingestions on commercial flights, Frings [1] indicated that nearly all bird ingestion events have occurred in the vicinity of airports during the non-cruise phases of flight. This is understandable because these phases of flight naturally occur closer to the ground where bird concentrations are higher, resulting in a higher probability of birdstrike.

The solutions to the problem of engine damage resulting from bird ingestion are similar to those for windshield birdstrike, e.g., structural design consideration to withstand impact or bird avoidance. Bird avoidance can be facilitated by either of two approaches: (1) keeping airplanes out of airspaces with large bird concentrations, or (2) removing birds from these regions of airspace. Neither bird avoidance approach is well-suited to commercial air fleets because flight schedules place airplanes in specific areas at specific times and the effectiveness of airport bird control programs (if any) varies from airport to airport and country to country.

Structural design of engines to withstand bird ingestions can be accomplished provided that requirements with respect to bird sizes and numbers can be identified. Bird ingestion data for medium/large inlet area turbofan engines and small inlet area turbine engines are currently being collected by several engine manufacturers. Statistical evaluation of bird ingestion data from these data collection efforts and previous bird ingestion studies will be useful in re-evaluating certification test criteria specified in FAA regulation 14 CFR 33.77. As a result, future jet engines can be designed to withstand more realistic bird threats.

1.2 OBJECTIVES

The objective of this report is to determine the relationship of bird weight, geographic location, season, time of day, phase of flight, and engine type to the frequency of bird ingestion events and the extent of engine damage, if any, resulting from the ingested birds. The statistical analysis of reported bird ingestions experienced by commercial Boeing 737 (B737) airplanes worldwide over a 2-year reporting period is used to summarize the service threat and level of engine damage experienced by these airplanes. The findings of the analysis will be helpful in defining minimum engine design requirements for resistance to damage as a result of bird ingestions. Moreover, this study will provide a comparison between the experiences of a contemporary high-bypass ratio turbofan engine (CFM56) and an older low-bypass ratio turbofan engine with a smaller inlet (JT8D) exposed to similar aircraft-bird ingestion environments.

1.3 ORGANIZATION OF REPORT

Section 2 defines, discusses, and differentiates airport operations and aircraft operations. Section 3 identifies the characteristics of bird species that have been ingested and reliably identified. Section 4 describes bird ingestion rates by location, engine type, and phase of flight. Section 5 provides a geographic placement of bird ingestion events throughout the world. Section 6 summarizes engine damage resulting from bird ingestions. Section 7 examines the probabilities of various bird ingestion events. Section 8 discusses the quality of the data collected in this study by examining the sources of the data and evaluating the consistency of the data from the first year to the second. Section 9 provides a summary of the results obtained during this phase of data analysis.

SECTION 2

AIRCRAFT OPERATIONS AND AIRPORT OPERATIONS

Aircraft operations and airport operations data are used to determine bird ingestion rates. Operations data (and their sources) used to generate bird ingestion rates are discussed in this section. Definitions are provided to aid in understanding these data.

An aircraft operation as defined in the glossary is a nonstop flight from one airport (departure airport) to another airport (arrival airport) and consists of 7 phases of flight which include: (1) taxi-out, (2) takeoff, (3) climb, (4) cruise, (5) approach, (6) landing, and (7) taxi-in. An airport operation is considered either a departure from or an arrival at an airport. When all scheduled flights are considered, the number of airport operations is twice the number of aircraft operations.

The Official Airline Guide (OAG) is the data source for scheduled airport operations. Counts of airport operations involving B737 airplanes were extracted from OAG magnetic tapes and maintained by airport code. The counts were further categorized by month of year and hour of day so that seasonal and time-of-day analyses could be performed.

Table 2.1 presents the OAG airport operations counts by seasonal months for the 2-year period. The counts are also broken down by several geographic regions. Table 2.2 presents the same airport operations counts as table 2.1; however, an adjustment for hemisphere has been made. It should be noted that the number of aircraft operations for each of these categories is one-half the number of airport operations. Frings [1] defines autumn in the Northern Hemisphere and spring in the Southern Hemisphere as the months September, October, and November. The collection period for each year of B 737 data was October through the following September. Consistency with Frings is maintained in table 2.1 and table 2.2 by grouping operations counts for October and November with the operations counts of the following September.

Table 2.3 presents two cross tabulations of airport operations by month and OAG destination-arrival code. The first tabulation includes all airports at which one or more B737 operations were scheduled during the reporting period. The second tabulation is a subset of the first and includes only those airports at which a bird ingestion event was reported during the period. The destination-arrival code is taken directly from the OAG tapes and its values are presented as a footnote in table 2.3.

A tabulation of aircraft operations by engine type and geographic region is required to obtain bird ingestion rates for these parameters. Table 2.4 presents a tabulation of B737 aircraft operations by engine type and geographic region for the reporting period. The OAG operations data identify implicitly the geographic region through the airport code and also identify explicitly whether the airplane is a B737; however, the engine type of the airplane is not reliably identified in the OAG data. The aircraft operations presented in the ALL ENGINES column of table 2.4 are derived by dividing the airport operations in the TOTAL column of table 2.1 by 2. The aircraft operations for the CFM56 engine were provided by the engine manufacturer as actual flights flown during the reporting period and are considered reliable. Similar data were not available for the JT8D engine. The JT8D aircraft operations were therefore derived by subtracting the CFM56 aircraft operations from the total aircraft operation for both engines.

The engine manufacturers provided the FAA with a listing of monthly operations counts for their respective engine types; however, the counts did not agree with the OAG counts. Monthly percentages for each engine type were calculated from the engine manufacturer's data and subsequently applied to the JT8D and CFM56 engine totals in table 2.4 to estimate monthly aircraft operations for the reporting period. Figure 2.1 is a histogram showing the estimated aircraft operations for each engine type.

TABLE 2.1 SCHEDULED OAG AIRPORT OPERATIONS BY SEASONAL MONTH
(OCTOBER 1986 THROUGH SEPTEMBER 1988)

	SEASONAL MONTHS				
Geographic Location	Mar-May	Jun-Aug	Sep-Nov	Dec-Feb	Total
Contiguous US					
Oct'86 - Sep'87	728,180	762,922	685,560	681,306	2,857,968
Oct'87 - Sep'88	758,076	775,265	758,049	756,956	3,048,346
Two Year Total	1,486,256	1,538,187	1,443,609	1,438,262	5,906,314
United States					
Oct'86 - Sep'87	771,231	807,492	726,309	722,461	3,027,493
Oct'87 - Sep'88	801,058	819,890	800,388	798,613	3,219,949
Two Year Total	1,572,289	1,627,382	1,526,697	1,521,074	6,247,442
Foreign					
Oct'86 - Sep'87	619,425	647,640	604,935	591,679	2,463,679
Oct'87 - Sep'88	688,874	722,608	668,398	650,891	2,730,771
Two Year Total	1,308,299	1,370,248	1,273,333	1,242,570	5,194,450
Northern Hemisphere					
Oct'86 - Sep'87	1,235,767	1,296,951	1,181,268	1,166,794	4,880,780
Oct'87 - Sep'88	1,314,164	1,357,068	1,295,982	1,277,954	5,245,168
Two Year Total	2,549,931	2,654,019	2,477,250	2,444,748	10,125,948
Southern Hemisphere					
Oct'86 - Sep'87	154,889	158,181	149,976	147,346	610,392
Oct'87 - Sep'88	175,768	185,430	172,804	171,550	705,552
Two Year Total	330,657	343,611	322,780	318,896	1,315,944
Worldwide					
Oct'86 - Sep'87	1,390,656	1,455,132	1,331,244	1,314,140	5,491,172
Oct'87 - Sep'88	1,489,932	1,542,498	1,468,786	1,449,504	5,950,720
Two Year Total	2,880,588	2,997,630	2,800,030	2,763,644	11,441,892

TABLE 2.2 SCHEDULED OAG AIRPORT OPERATIONS BY SEASON
(OCTOBER 1987 THROUGH SEPTEMBER 1989)

Geographic Location	Spring	Summer	Autumn	Winter	Total
	SEASONS OF THE YEAR				
Contiguous US					
Oct'86 - Sep'87	728,180	762,922	685,560	681,306	2,857,968
Oct'87 - Sep'88	758,076	775,265	758,049	756,956	3,048,346
Two Year Total	1,486,256	1,538,187	1,443,609	1,438,262	5,906,314
United States					
Oct'86 - Sep'87	771,231	807,492	726,309	722,461	3,027,493
Oct'87 - Sep'88	801,058	819,890	800,388	798,613	3,219,949
Two Year Total	1,572,289	1,627,382	1,526,697	1,521,074	6,247,442
Foreign					
Oct'86 - Sep'87	614,512	636,805	609,848	602,514	2,463,679
Oct'87 - Sep'88	685,910	708,728	671,362	664,771	2,730,771
Two Year Total	1,300,422	1,345,533	1,281,210	1,267,285	5,194,450
Northern Hemisphere					
Oct'86 - Sep'87	1,235,767	1,296,951	1,181,268	1,166,794	4,880,780
Oct'87 - Sep'88	1,314,164	1,357,068	1,295,982	1,277,954	5,245,168
Two Year Total	2,549,931	2,654,019	2,477,250	2,444,748	10,125,948
Southern Hemisphere					
Oct'86 - Sep'88	149,976	147,346	154,889	158,181	610,392
Oct'87 - Sep'88	172,804	171,550	175,768	185,430	705,552
Two Year Total	322,780	318,896	330,657	343,611	1,315,944
Worldwide					
Oct'86 - Sep'87	1,385,743	1,444,297	1,336,157	1,324,975	5,491,172
Oct'87 - Sep'88	1,486,968	1,528,618	1,471,750	1,463,384	5,950,720
Two Year Total	2,872,711	2,972,915	2,807,907	2,788,359	11,441,892

TABLE 2.3 OAG AIRPORT OPERATIONS BY MONTH
(OCTOBER 1986 THROUGH SEPTEMBER 1988)

ALL AIRPORTS WITH SCHEDULED B737 OPERATONS

MONTH	OAG DESTINATION-ARRIVAL CODES** (0)	(1)	(2)	(3)	(4)	(Total)
OCT	406,268	499,810	6,652	176	6,072	918,978
NOV	399,060	484,776	6,326	114	6,178	896,454
DEC	416,486	510,834	7,086	74	7,058	941,538
JAN	418,774	512,014	7,620	138	7,006	945,552
FEB	386,386	476,960	7,078	130	6,000	876,554
MAR	425,002	520,222	7,812	122	5,912	959,070
APR	422,122	506,860	7,620	154	5,340	942,096
MAY	440,740	524,302	8,320	194	5,866	917,422
JUN	433,872	519,874	8,532	102	5,864	968,244
JUL	452,944	538,852	8,944	210	6,480	1,007,430
AUG	460,918	545,600	8,764	230	6,444	1,021,956
SEP	448,312	521,930	8,262	198	5,896	941,538
TOTAL	5,110,884	6,162,034	93,016	1,842	74,116	11,441,892

AIRPORTS EXPERIENCING BIRD INGESTIONS DURING REPORTING PERIOD

MONTH	OAG DESTINATION-ARRIVAL CODES** (0)	(1)	(2)	(3)	(4)	(Total)
OCT	126,357	202,912	2,321	176	1,936	333,702
NOV	126,498	199,200	1,855	78	1,996	329,627
DEC	131,345	209,768	2,178	0	2,163	345,454
JAN	131,785	209,849	2,556	0	2,194	346,384
FEB	122,537	195,854	2,370	0	1,981	322,742
MAR	135,399	211,657	2,441	0	2,026	351,523
APR	135,684	206,263	2,296	0	1,911	346,154
MAY	143,077	214,667	2,363	38	2,094	362,239
JUN	141,542	211,709	2,560	14	2,045	357,870
JUL	146,994	218,536	2,724	56	2,247	370,557
AUG	149,175	221,274	2,683	72	2,209	375,413
SEP	147,150	209,719	2,568	54	2,128	361,619
TOTAL	1,637,543	2,511,408	28,915	488	24,930	4,203,284

** =0 Any Carrier. Operation begins and ends out of the US.
=1 Domestic Carrier. Operation begins and ends in the US.
=2 Domestic Carrier. Departure or arrival, but not both, in the US.
=3 Foreign Carrier. Operation begins and ends in the US.
=4 Foreign Carrier. Departure or arrival, but not both, in the US.

TABLE 2.4 SCHEDULED AIRCRAFT OPERATIONS BY ENGINE TYPE

GEOGRAPHIC LOCATION	JT8D	CFM56	ALL ENGINES
United States			
Oct'86 - Sep'87	1,160,091	353,656	1,513,747
Oct'87 - Sep'88	1,082,543	527,431	1,609,974
	---------	---------	---------
Two Year Total	2,242,634	881,087	3,123,721
Foreign			
Oct'86 - Sep'87	1,057,633	174,206	1,231,839
Oct'87 - Sep'88	1,062,971	302,415	1,365,386
	---------	---------	---------
Two Year Total	2,120,604	476,621	2,597,225
Worldwide			
Oct'86 - Sep'87	2,217,724	527,862	2,745,586
Oct'87 - Sep'88	2,145,514	829,846	2,975,360
	---------	---------	---------
Two Year Total	4,363,238	1,357,708	5,720,946

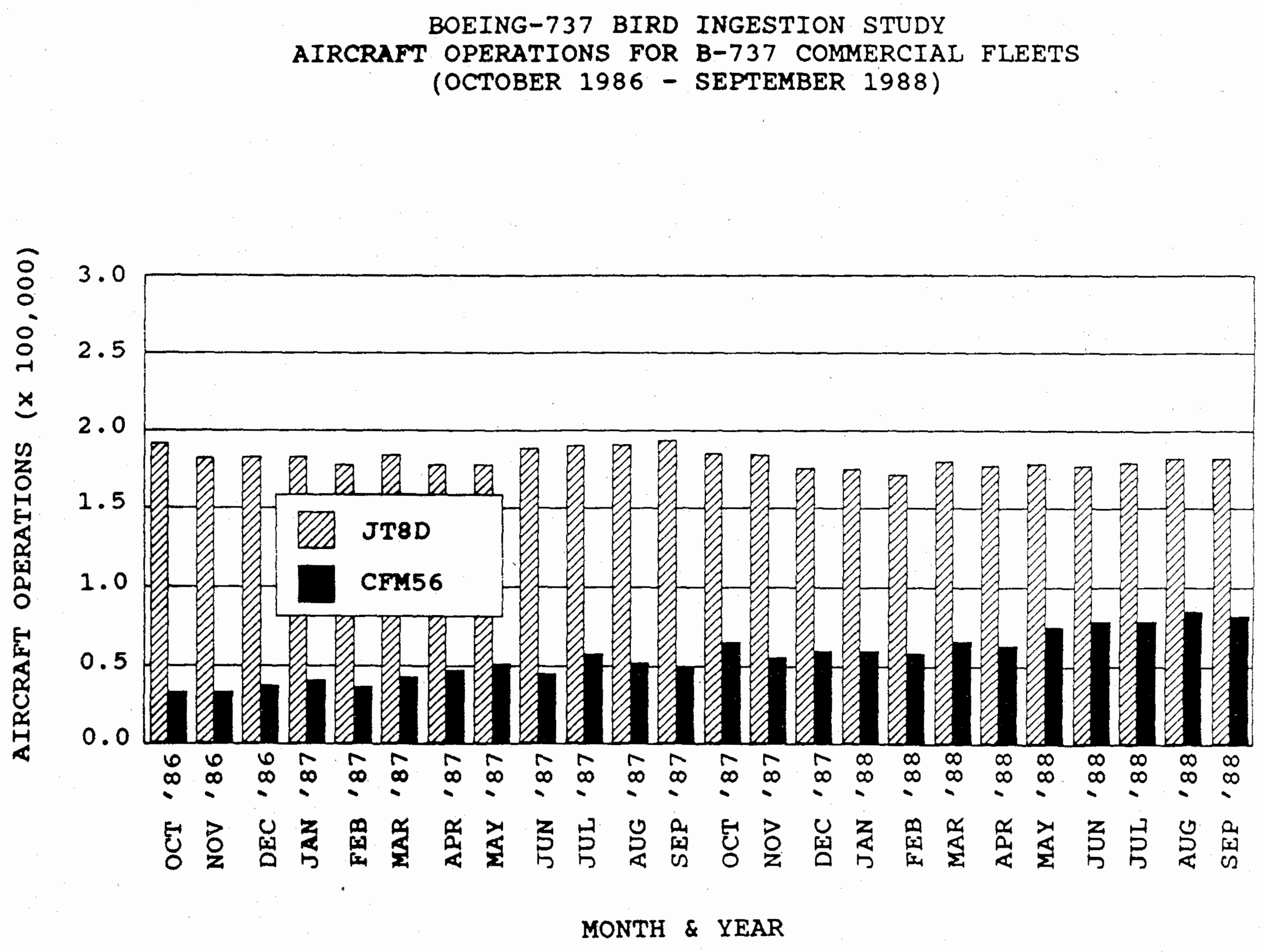

Figure 2.1 Histogram of Monthly Aircraft Operations by Engine Type.

SECTION 3

CHARACTERISTICS OF INGESTED BIRDS

This section provides a description of the birds that were ingested during the data collection period and an analysis of the extent of the bird ingestion threat. The bird related features that are described in this section include species, weight, seasonal trends, time-of-day trends, and geographic location.

A detailed breakdown of aircraft ingestion events in the United States is presented in figures 3.1 and 3.2. Figure 3.1 is a contour map of the contiguous US with the height of the contours being proportional to the number of aircraft ingestion events in each state while figure 3.2 is a bar chart with the same information plus Alaska and Hawaii. Texas and California have the greatest number of ingestions followed by Hawaii and Florida.

Table 3.1 provides a tally of all the species that were positively identified by an ornithologist during the collection period. The counts in the US, Foreign, and Overall columns of table 3.1 indicate the number of aircraft ingestion events in which each bird species was ingested. The species are listed by order and family and it is apparent that the gulls, doves and lapwing/plover families of the charadriiformes order (shorebirds) are the most commonly ingested birds. Doves and gulls were the most commonly ingested bird in the United States while the lapwings appear to be mainly a foreign species.

One of the disappointing features of the B737 bird ingestion data base is the low bird identification rate. The bird species was positively identified in only 61 out of 504 aircraft ingestion events that were recorded giving a 12.1 percent identification rate. The identification rate for engine ingestion events in which an engine sustained damage (19.6 percent) was almost two and one-half times greater than the identification rate for events which caused no engine damage (8.0 percent); which could indicate that the group of identified birds is biased to include more birds in the size and weight ranges that tend to damage engines when ingested. Any conclusions about the population of ingested birds should be viewed with the caution that the sample might be more representative of the population of birds that damage engines than of all birds that are ingested.

The species-related descriptions of ingested birds in this report probably provide a conservative view in that the birds that caused damage are better represented in the sample than birds that did not cause damage. The bird features that influence damage cannot be discerned, however, because of the possible bias in the identifications. That is, the differences between the birds that cause damage and the birds that don't cause damage cannot be readily identified since there is less information about the birds that didn't cause damage.

Table 3.2 is a frequency table of weights for the positively identified birds. The bird weights are derived from the species identification and when possible are adjusted for the age and sex of the ingested bird. The modes in table 3.2 therefore represent the weights of the more commonly identified bird species that were ingested. Figure 3.3 provides the same information in the form of a histogram. Most of the ingested birds (78.3 percent) that were identified in this study weighed less than or equal to 20 ounces; however, only 17.4 percent percent of the identified birds weighed more than 2 pounds.

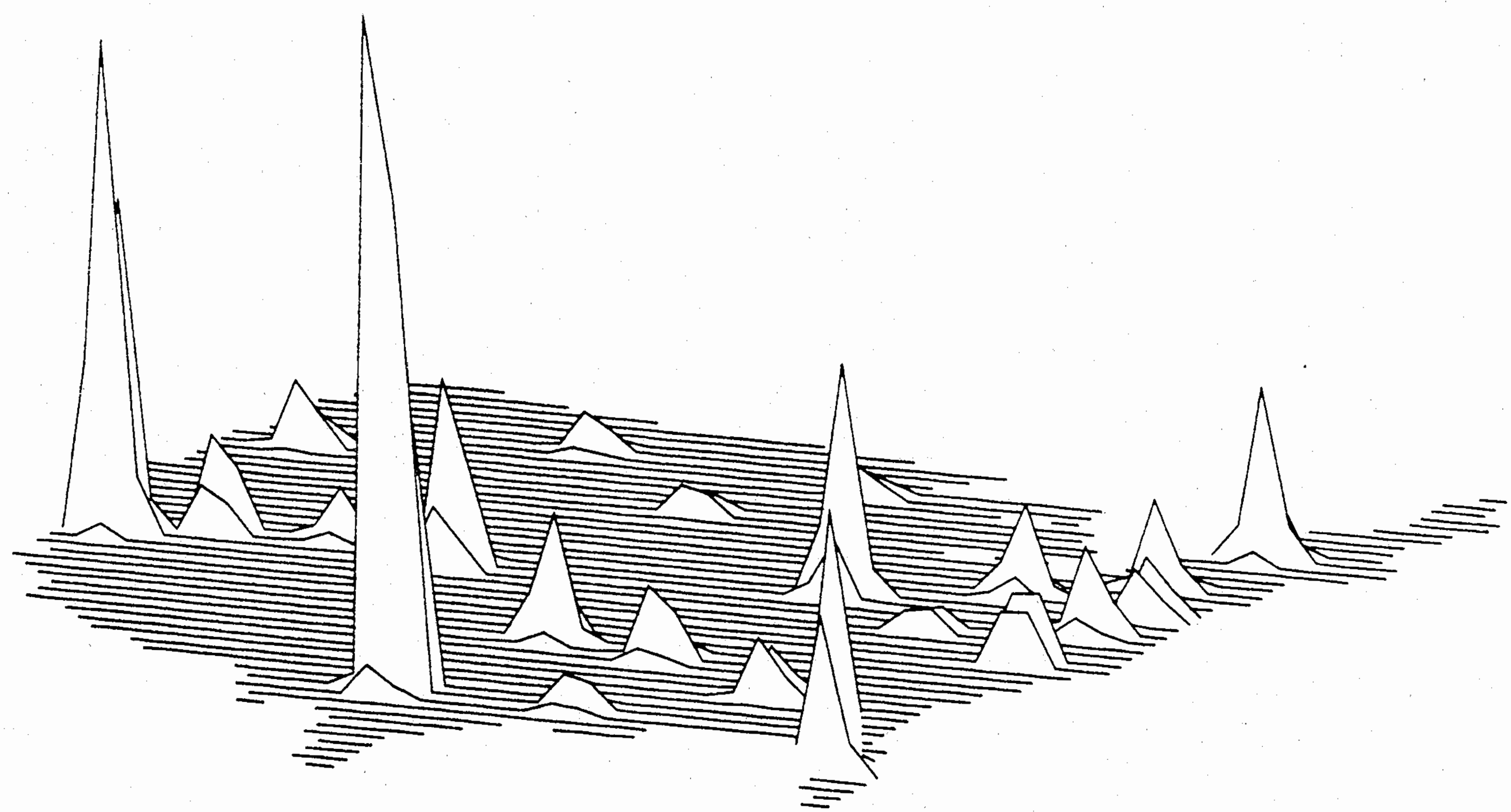

Figure 3.1 Contour Map of Domestic Aircraft Ingestion Events.

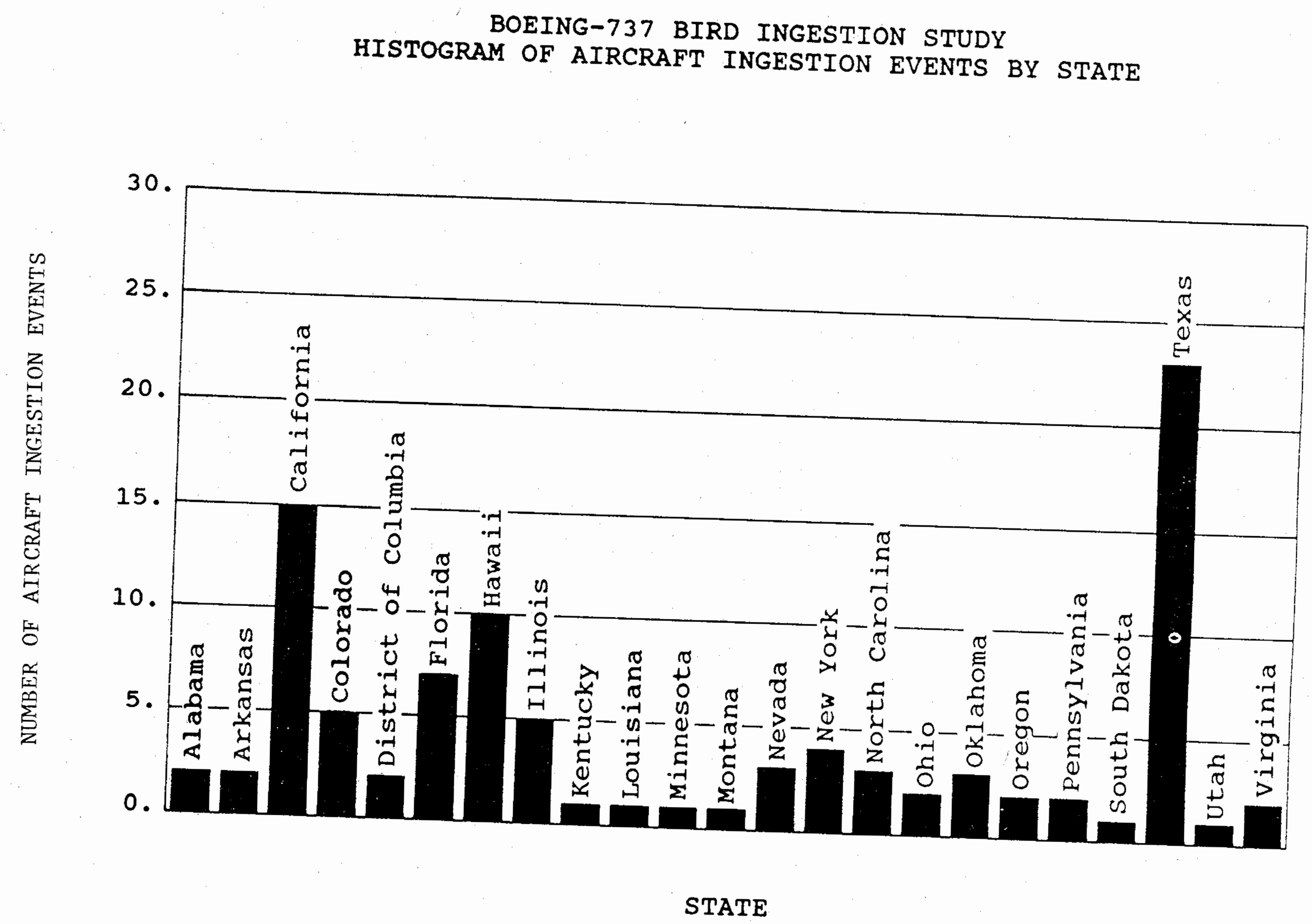

Figure 3.2 Histogram of Aircraft Ingestion Events by State.

TABLE 3.1 TALLY OF POSITIVELY IDENTIFIED BIRD SPECIES BROKEN DOWN BY US, FOREIGN, AND OVERALL (AIRCRAFT INGESTION EVENTS)

Latin Name	Common Name	Species Code	US	Foreign	Overall
Nycticorax nycticorax	Black-crowned night heron	1I24	1	0	1
Bubulcus ibis	Cattle egret	1I35	1	1	2
Egretta alba	Great egret	1I52	1	0	1
Chen caerulescens	Snow goose	2J26	0	1	1
Branta canadensis	Canada goose	2J30	1	0	1
Anas platyrhynchos	Mallard	2J84	1	0	1
Pandion haliaetus	Osprey	2K1	1	0	1
Milvus migrans	Black kite	3K28	0	1	1
Circus cyaneus	Northern marsh harrier	3K78	1	0	1
Accipiter striatus	Sharp-shinned hawk	3K105	1	0	1
Geraonaetus melanoleucus	Gray eagle-buzzard	3K161	0	1	1
Buteo swainsonii	Swainson's hawk	3K171	1	0	1
Falco sparverius	American kestrel	5K26	2	0	2
Falco tinnunculus	Eurasian kestrel	5K27	0	1	1
Perdix perdix	Hungarian partridge	4L85	0	1	1
Vanellus vanellus	Common lapwing	5N1	0	1	1
Vanellus melanopterus	Black-winged plover	5N10	0	1	1
Vanellus vanellus	Gray-headed lapwing	5N20	0	2	2
Pluvialis apricaria	Eurasian golden plover	5N25	2	0	2
Charadrius vociferus	Killdeer	5N33	1	1	2
Numenius americanus	Long-billed curlew	6N12	1	0	1
Bartramia longicauda	Upland sandpiper	6N13	1	0	1
Burhinus capensis	Cape dikkop	9N4	0	1	1
Larus delawarensis	Ring-billed gull	14N12	1	0	1
Larus canus	Common gull	14N13	0	1	1
Larus argentatus	Herring gull	14N14	2	1	3
Larus glaucescens	Glaucous-winged gull	14N22	1	1	2
Larus ridibundus	Common black-headed gull	14N36	0	3	3
Larus philadelphia	Bonaparte's gull	14N38	0	1	1
Columba livia	Common rock dove	2P1	3	1	4
Columba guinea	African Speckled Pigeon	2P4	0	1	1
Streptopelia turtur	Common turtle dove	2P50	0	1	1
Streptopelia chinensis	Spotted dove	2P65	1	0	1
Geopelia striata	Zebra dove	2P102	1	0	1
Geopelia humeralis	Bar-shouldered dove	2P103	1	0	1
Zenaida macroura	American mourning dove	2P105	1	0	1
Coccyzus americanus	Yellow-billed cuckoo	2R51	1	0	1
Tyto alba	Common barn owl	1S2	0	1	1
Chordeiles minor	Nighthawk	5T5	1	0	1
Chaetura pelagica	Chimney swift	1U33	1	0	1
Apus apus	Common swift	1U55	0	1	1
Eremophila alpestris	Horned lark	17Z74	1	1	2
Sturnus vulgaris	Common starling	21Z75	2	0	2
Corvus corone	Carrion crow	22Z94	0	1	1
Catharus ustulatus	Swainson's thrush	41Z246	1	0	1
Sturnella neglecta	Western meadowlark	64Z68	0	1	1
			34	27	61

TABLE 3.2 WEIGHT DISTRIBUTION OF INGESTED BIRDS BY ORIGIN

Weight Range (Oz)	United States			Foreign			Worldwide		
	Multiple Bird Events	Single Bird Events	Total Bird Events	Multiple Bird Events	Single Bird Events	Total Bird Events	Multiple Bird Events	Single Bird Events	Total Bird Events
(0 < x ≤ 4)	2	13	15	1	3	4	3	16	19
(4 < x ≤ 8)	0	5	5	4	3	7	4	8	12
(8 < x ≤ 12)	0	0	0	2	8	10	2	8	10
(12 < x ≤ 16)	2	5	7	0	4	4	2	9	11
(16 < x ≤ 20)	-	1	1	-	1	1	-	2	2
(20 < x ≤ 24)	-	1	1	-	0	0	-	1	1
(24 < x ≤ 28)	-	1	1	-	0	0	-	1	1
(28 < x ≤ 32)	-	0	0	-	1	1	-	1	1
(32 < x ≤ 36)	-	1	1	-	0	0	-	1	1
(36 < x ≤ 40)	-	4	4	-	2	2	-	6	6
. .									
(52 < x ≤ 56)	-	2	2	-	0	0	-	2	2
. .									
(76 < x ≤ 80)	-	0	0	-	1	1	-	1	1
. .									
(84 < x ≤ 88)	-	0	0	-	1	1	-	1	1
. .									
(124 < x ≤ 128)	-	1	1	-	0	0	-	1	1
TOTAL	4	34	38	7	24	31	11	58	69

Summary statistics calculated from the raw data for the US, foreign, and worldwide bird weight distributions are presented in table 3.3. The mean, median, and mode are three different concepts for the typical or average value which measures the central tendency of the distribution. The median and mode are more relevant measures of the average for the bird ingestion problem. The mean weight would be important if damage were related to the cumulative weight of all birds ingested by a single engine since the mean is based on the total weight of the ingested birds.

A pattern suggestive of a sine function is seen in figure 3.4 which is a bar chart of monthly bird ingestions for the data collection period. The cyclic pattern in aircraft ingestion events reflects seasonal bird activity. The start of a cyclic pattern is also seen in the ingestion rate data which indicates that the trends are due to the changing bird population and not changes in air traffic activity. Time trends in bird ingestions are further investigated on a seasonal basis in the following paragraphs.

The seasonal bird ingestion rates for the Northern and Southern Hemispheres, the United States, foreign countries, and the whole world are presented in the bar chart of figure 3.5. Here the ingestion rates are not being compared by engine type so the ingestion rate R is simply calculated as:

$$R = Ing \cdot \frac{10000}{Ops} \qquad 3.1$$

where Ing is the number of ingestions and Ops is the number of aircraft operations in the time period being considered. The rate is expressed as R, ingestions per 10,000 aircraft operations.

Seasonal trends were investigated using a Chi-squared goodness-of-fit (GOF) analysis. The Chi-squared value for testing the hypothesis that the number of aircraft ingestion events does not vary with the seasons is 46.24. The critical value for testing at the 5 percent level of significance is 7.81 while the 0.5 percent level is 12.8; therefore, the high value of the test statistic is a very strong indication that ingestions do vary with the seasons.

The winter data were eliminated in an effort to better identify the nature of the differences between the seasons. Testing for the equality of the ingestions for spring, summer, and autumn also yields a significant difference with a test statistic of 6.05 and a 5 percent critical value of 5.99. After eliminating the data from the next lower season, there is no detectable difference between summer and autumn so the data indicate that there are the fewest ingestions in the winter followed by an increase in ingestions in the spring with the maximum number of ingestions occurring during the summer and carrying through the autumn.

The time-of-day distribution of bird ingestion events is illustrated in figure 3.6 with time-of-day reduced to the four basic segments of morning, mid-day, evening, and night. There is a noticeable drop in the number of ingestions at night and the Chi-squared test for equality of the four time periods indicates that they are not the same. The Chi-squared test statistic is 19.37 while the 99th percentile of the Chi-squared with three degrees of freedom distribution is 11.34.

There are two likely reasons for a drop in ingestions during the night. Birds are not generally nocturnal so bird activity is reduced at night. Also, there are fewer flights scheduled at night. A lessened exposure due to fewer flights and fewer birds results in a reduction in the number of ingestions at night.

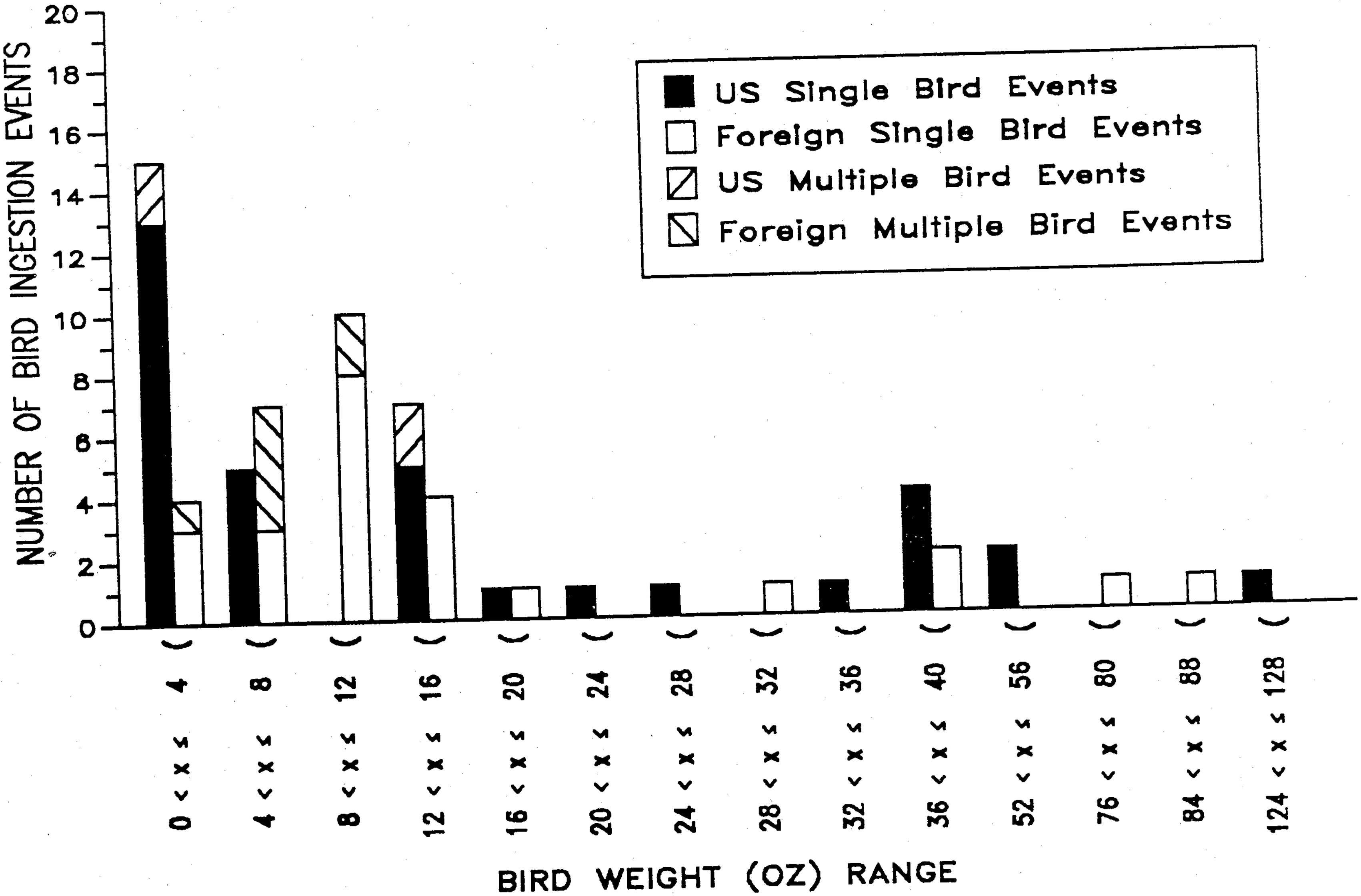

Figure 3.3 Histogram of Number of Birds Ingested by Weight Class.

TABLE 3.3 SUMMARY STATISTICS FOR INGESTED BIRD WEIGHTS (BASED ON ENGINE INGESTION EVENTS)

STATISTIC	United States			Foreign			Worldwide		
	Multiple Bird Events	Single Bird Events	Total Bird Events	Multiple Bird Events	Single Bird Events	Total Bird Events	Multiple Bird Events	Single Bird Events	Total Bird Events
NUMBER OF EVENTS	4	34	38	7	24	31	11	58	69
MODE(S)	3. 14.	2. 6.	2. 3. 6. 14.	7. 11.5	10.	7. 10.	3.	2. 6.	7.
MEDIAN	3.	6.	6.	7.	10.	9.7	7.	10.	9.7
MEAN (AVERAGE)	8.5	18.8	17.7	7.7	19.4	16.8	8.	19.0	17.3
STD DEVIATION	6.35	25.33	24.20	3.03	22.38	20.27	4.21	23.95	22.36

Bird weight given in ounces.

DISTRIBUTION OF WORLDWIDE AIRCRAFT INGESTION EVENTS
(OCTOBER 1986 - SEPTEMBER 1988)

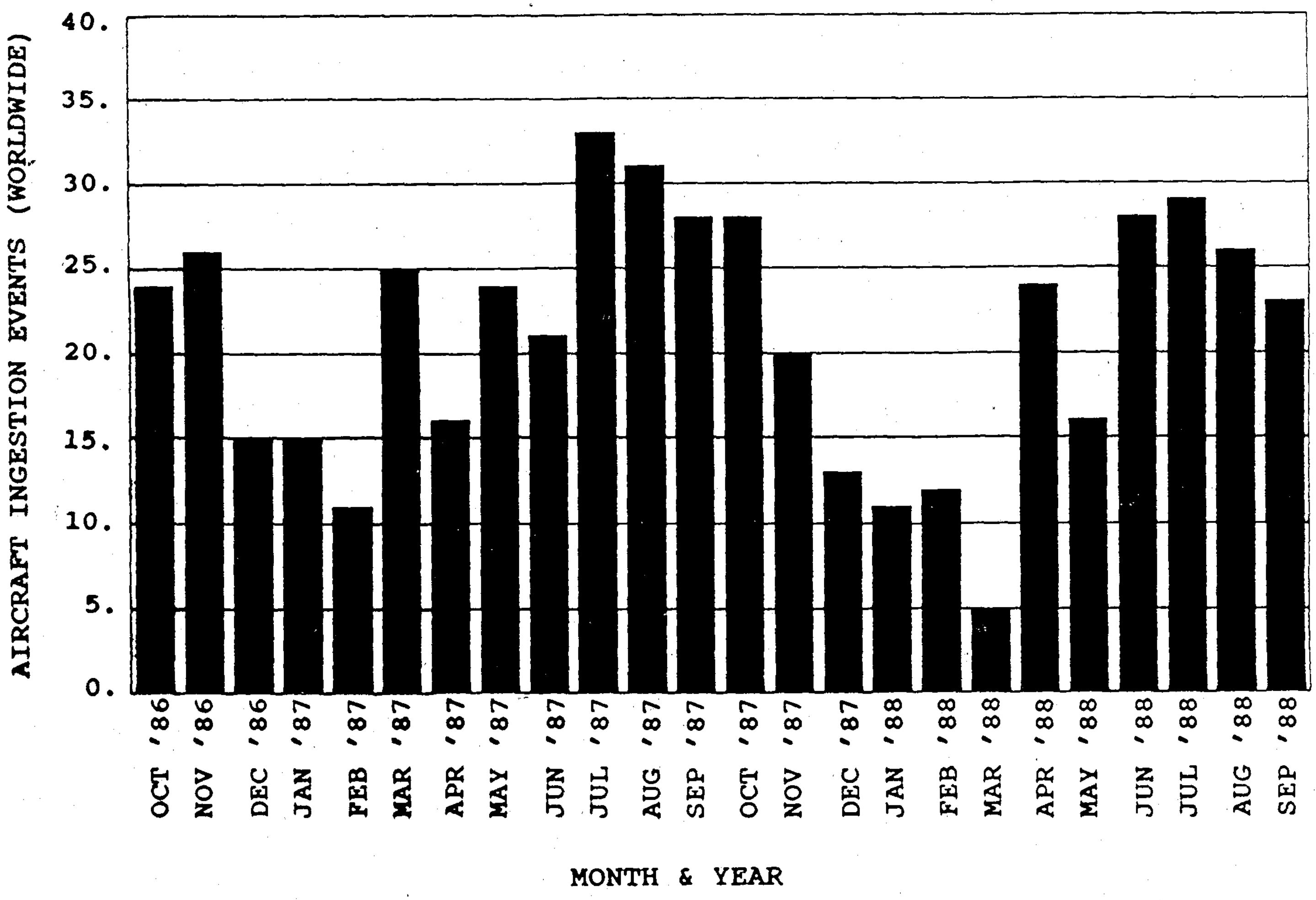

Figure 3.4 **Bar Chart of Worldwide Aircraft Ingestion Events.**

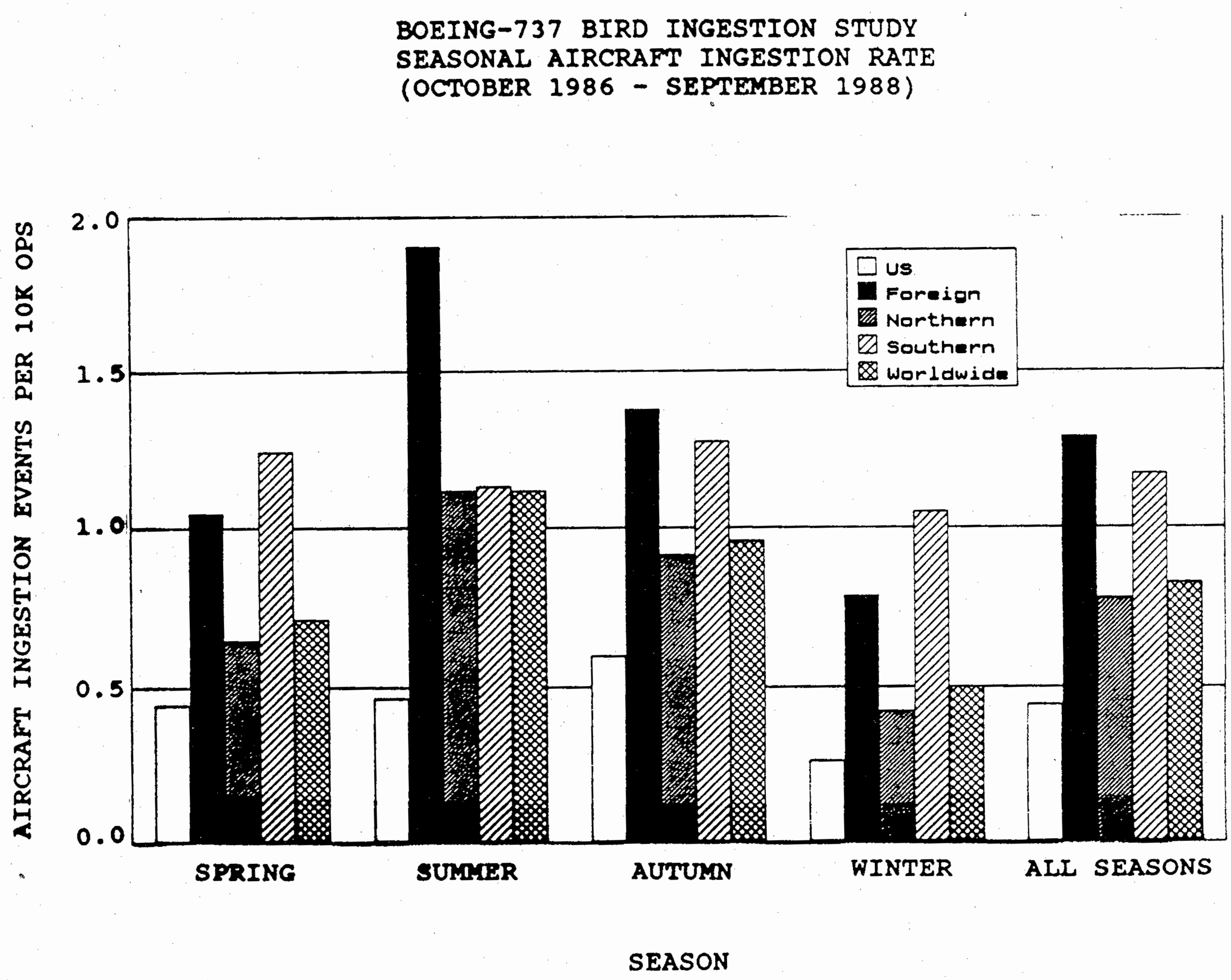

Figure 3.5 Seasonal Aircraft Ingestion Rates.

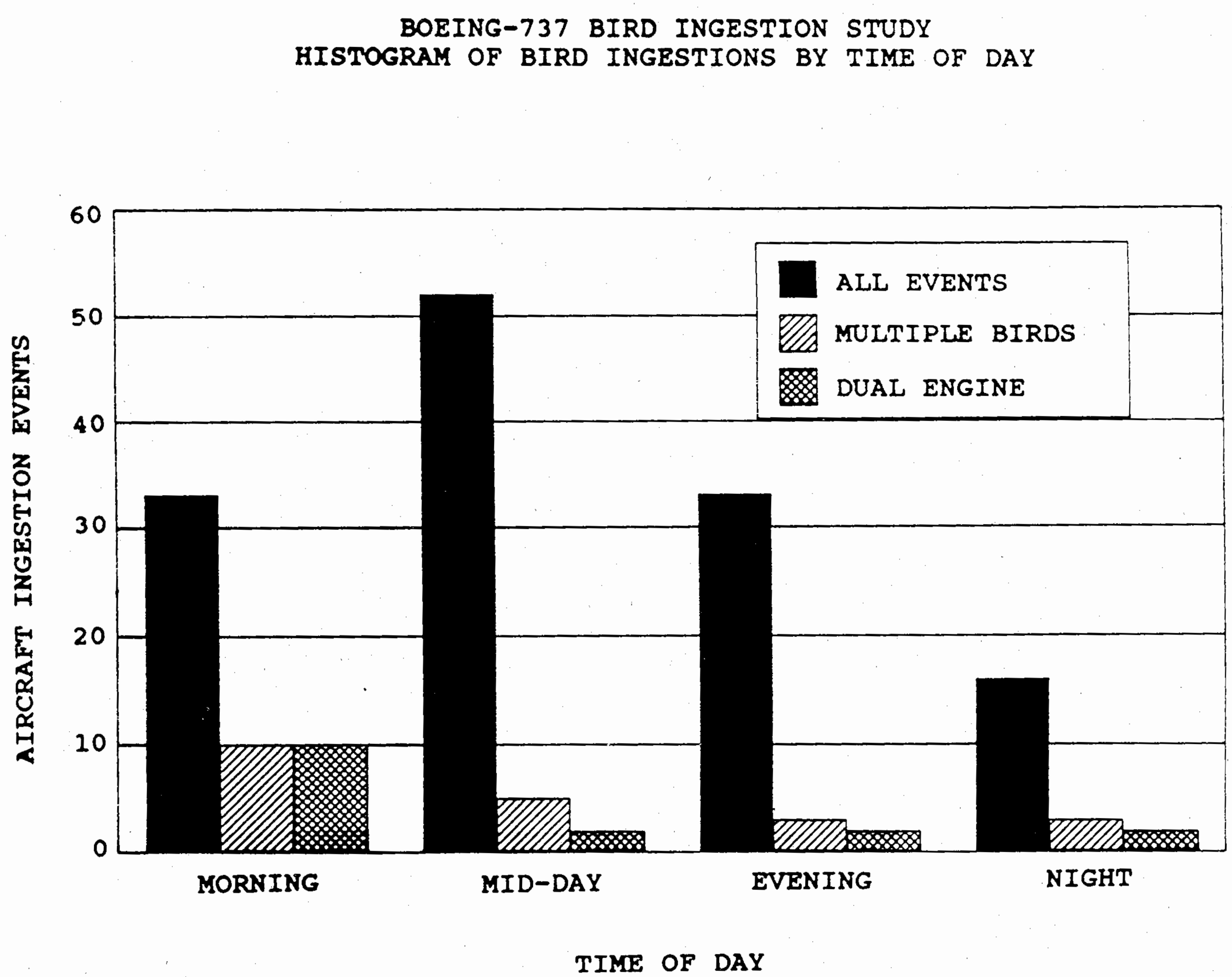

Figure 3.6 Histogram of Aircraft Ingestion Events by Time of Day.

SECTION 4

INGESTION RATES

This section describes the rates at which bird ingestions occurred during the 2-year collection period covered in this report. The Poisson distribution is commonly used to describe how events are randomly scattered in time, and the bird ingestion data are shown to agree with the assumptions of a Poisson process. The first part of this section provides the estimates of the basic ingestion rates. The second part describes the Poisson distribution and how it relates to the bird ingestion events. The final parts discuss statistical analyses based on the assumption that bird ingestions follow a Poisson process.

4.1 INGESTION RATE ESTIMATES

This sub-section provides a general description of ingestion rates broken down by location, engine, and phase of flight. The rates are given in terms of ingestions per 10,000 aircraft operations and have been adjusted to the inlet area of the engine to allow size independent comparisons between engines. The inlet area used throughout this report is called the "fat lip area" and was specified by the Boeing Co. for each type of engine installation. A more detailed statistical analysis of ingestion rates is covered in the next section using statistical techniques for Poisson processes.

Table 4.1A lists the US, foreign, and worldwide ingestion rates for both the JT8D and the CFM56 engines as well as a composite rate for all 737 aircraft. The inlet area adjustment was done using a 10-square-foot unit area on the basis of the total inlet area of both engines to keep the rates in a reasonable range. The composite rates in each geographical region are weighted means of the inlet area adjusted rates for the individual engines and are determined as follows: The number of ingestions per 10 square feet inlet area for each engine is projected by multiplying the rates by the number of aircraft operations. The composite rates are calculated by dividing the total projected ingestions for both engines by the total aircraft operations for the geographical region. Table 4.1B lists engine ingestion rates based on engine operations and normalized for the engine inlet area.

The ingestion rates for the CFM56 engine were calculated using reported aircraft operations for specific geographical regions. The ingestion rates for the JT8D engine were calculated using estimated aircraft operations for specific geographical regions. The details of the calculation were presented in Section 3, equation 3.1.

Figure 4.1 shows monthly ingestion rates subdivided by engine type and adjusted for inlet area so that a comparison between engine types can be made. The adjusted monthly ingestion rate (R_{adj}) for an engine type, expressed as ingestions per 10 ft^2 per 10,000 aircraft operations, is calculated as:

$$R_{adj} = Ing \cdot \frac{1440}{2IA} \cdot\cdot \frac{10000}{Ops} \qquad 4.1$$

where Ing is the number of monthly aircraft ingestion events for an engine type, IA is the inlet area (in^2) of the engine type, and Ops is the number of aircraft

TABLE 4.1A

BREAKDOWN OF BIRD INGESTION RATES BY ENGINE AND LOCATION
(BASED ON AIRCRAFT OPERATIONS)

ENGINE TYPE:	JT8D	CFM56	ALL ENGINES
INLET AREA:*	2234 in^2	4606 in^2	N/A
UNITED STATES			
Aircraft Ingestion Events	62	77	139
OAG Aircraft Operations	2,242,634	881,087	3,123,721
Ingestion Rate (Ing/10K Ops)	0.28	0.87	0.44
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.18	0.27	0.21
FOREIGN			
Aircraft Ingestion Events	260	103	363
OAG Aircraft Operations	2,120,604	476,621	2,597,225
Ingestion Rate (Ing/10K Ops)	1.23	2.16	1.40
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.79	0.68	0.77
WORLDWIDE			
Aircraft Ingestion Events	322	182†	504†
OAG Aircraft Operations	4,363,238	1,357,708	5,720,946
Ingestion Rate (Ing/10K Ops)	0.74	1.34	0.88
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.48	0.42	0.46

*Total Area for 2 Engines

†2 Aircraft Ingestions at Unknown Location

TABLE 4.1B

BREAKDOWN OF BIRD INGESTION RATES BY ENGINE AND LOCATION (BASED ON ENGINE OPERATIONS)

ENGINE TYPE:	JT8D	CFM56	ALL ENGINES
INLET AREA:*	1117 in^2	2303 in^2	N/A
UNITED STATES			
Engine Ingestion Events	64	82	146
OAG Engine Operations	4,485,268	1,762,174	6,247,442
Ingestion Rate (Ing/10K Ops)	0.14	0.47	0.23
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.18	0.29	0.21
FOREIGN			
Engine Ingestion Events	264	109	373
OAG Engine Operations	4,241,208	953,242	5,194,450
Ingestion Rate (Ing/10K Ops)	0.62	1.14	0.72
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.80	0.71	0.79
WORLDWIDE			
Engine Ingestion Events	328	193†	521†
OAG Engine Operations	8,726,476	2,715,416	11,441,892
Ingestion Rate (Ing/10K Ops)	0.38	0.71	0.46
Normalized Ingestion Rate (Ing/10K Ops/10ft^2)	0.48	0.44	0.48

*Total Area for 1 Engine

†Location Unknown for 2 Engine Ingestion Events

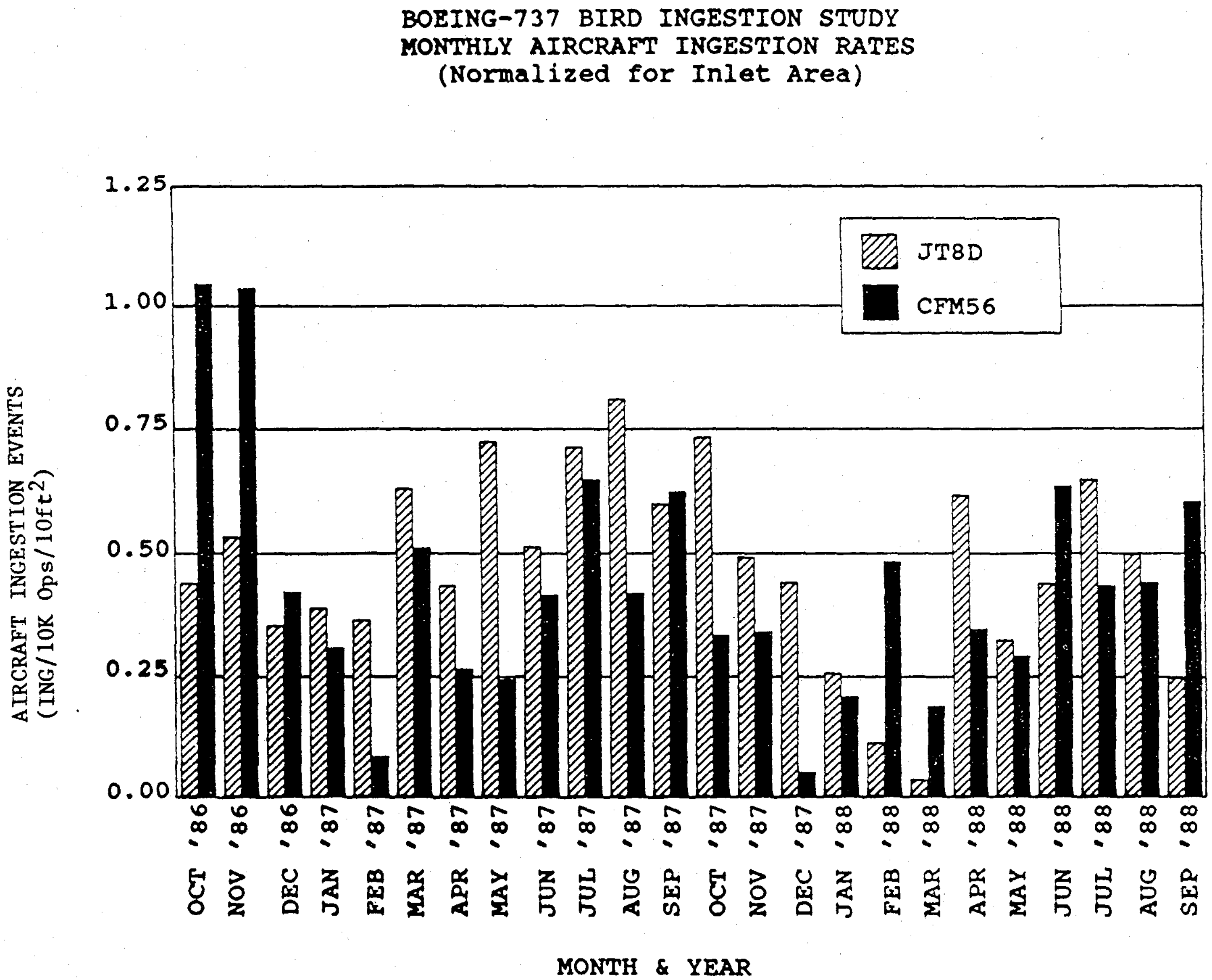

Figure 4.1 Histogram of Monthly Aircraft Ingestion Rates by Engine Type

operations for the month. Twice the engine area is used because there are two engines on each B737 aircraft. The constant 1440 is the factor for converting square inches to units of 10-square-foot areas.

The phase of flight ingestion rate tabulation is presented in table 4.2A. The method used to calculate ingestion rate 1 is expressed in equation 3.1. The area adjustment used for ingestion rate 2 is implemented using equation 4.1. The highest ingestion rates were in the takeoff and landing phases followed by the climb and approach phases. There were very few ingestions during the taxi and cruise phases of flight. This pattern is typically seen in bird strike and bird ingestion studies and is indicative of the fact that airports are often located in desirable bird environs. Since birds congregate around airports there is a greater chance of striking or ingesting a bird during the phases of flight that take place close to the airports. Also, commercial airline cruise routes are well above the altitude in which birds are usually found. Table 4.2B lists engine ingestion rates as a function of phase of flight. The differences in ingestion rates between table 4.2A and 4.2B are due to multiple engine ingestion events.

4.2 THE POISSON PROCESS

The Poisson process is the simplest type of stochastic process which describes how events are distributed in time. The Poisson process is here taken to govern aircraft ingestion events, and the times at which they occur are random. In a Poisson process the events are distributed somewhat evenly in time so that it appears that the times at which the events occurred form a uniform distribution. This section describes some of the properties of Poisson processes that will be useful in describing bird ingestions and in testing hypotheses about bird ingestion rates.

The basis of a Poisson process is a description of the probability distribution of the number of events that occur in a given time interval. The formula for the probability of n events in an interval of length T is:

$$P(X(T)=n) = \frac{e^{-\lambda T}(\lambda T)^n}{n!}. \qquad 4.2$$

The parameter is λ the mean rate at which events occur and the mean number of events in the length T time interval is λT. The time scale that will be used in this study is number of aircraft operations. Ingestion rates are typically reported in events per 10,000 aircraft operations which implies the use of aircraft operations as the time scale in a Poisson process.

One derivation of the formula for the Poisson distribution is the limiting distribution of the binomial distribution for large sample sizes. If we assume that the probability of a bird ingestion is the same from flight to flight then the number of ingestions in a large number of flights has a binomial distribution. If the probability of ingestion is p and the number of flights is N then the probability that n ingestions occur in the N flights is:

$$P(X(N)=n) = \binom{N}{n} p^n(1-p)^{(N-n)}. \qquad 4.3$$

TABLE 4.2A INGESTION RATES FOR ENGINE TYPE BY PHASE OF FLIGHT (BASED ON AIRCRAFT INGESTION EVENTS)

	PRATT-WHITNEY JT8D			CFMI CFM56			ALL ENGINES		
INLET* AREA	$2234\ in^2$			$4606\ in^2$			---		
AIRCRAFT OPERATIONS	4,363,238			1,357,708			5,720,946		
PHASE OF FLIGHT	AIRCRAFT** ING. EVENTS	INGEST† RATE 1	INGEST†† RATE 2	AIRCRAFT ING. EVENTS	INGEST† RATE 1	INGEST†† RATE 2	AIRCRAFT ING. EVENTS	INGEST† RATE 1	INGEST††† RATE 2
Taxi	2	.005	.003	2	.015	.005	4	.007	.003
Takeoff	206	.472	.304	81	.597	.187	287	.502	.276
Climb	17	.039	.025	27	.199	.062	44	.077	.034
Cruise	3	.007	.004	8	.059	.018	11	.019	.008
Approach	25	.057	.037	16	.118	.037	41	.072	.076
Landing	69	.158	.102	48	.354	.111	117	.205	.104
All Phases	322	.738	.476	182	1.340	.419	504	.881	.462

* Total Area of 2 Engines

** Contains Prorated Apportionment of Events with Unknown Phase of Flight

† Ingestion Events Per 10,000 Operations

†† Ingestion Events Per 10,000 Operations Per 10 ft^2

††† Function of JT8D Rate 2, CFM56 Rate 2, and Corresponding Operations

TABLE 4.2B INGESTION RATES FOR ENGINE TYPE BY PHASE OF FLIGHT (BASED ON ENGINE INGESTION EVENTS)

	PRATT-WHITNEY JT8D			CFMI CFM56			ALL ENGINES		
INLET AREA	1117 in^2			2303 in^2			---		
ENGINE OPERATIONS	8,726,476			2,715,416			11,441,892		
PHASE OF FLIGHT	AIRCRAFT* ING. EVENTS	INGEST† RATE 1	INGEST†† RATE 2	AIRCRAFT ING. EVENTS	INGEST† RATE 1	INGEST†† RATE 2	AIRCRAFT ING. EVENTS	INGEST† RATE 1	INGEST††† RATE 2
Taxi	2	.002	.003	2	.007	.005	4	.003	.003
Takeoff	211	.242	.312	87	.320	.200	298	.260	.285
Climb	17	.019	.025	27	.099	.062	44	.038	.034
Cruise	3	.003	.004	8	.029	.018	11	.010	.008
Approach	26	.030	.038	18	.066	.041	44	.038	.039
Landing	69	.079	.102	51	.188	.117	120	.105	.106
All Phases	328	.376	.485	193	.711	.444	521	.455	.475

* Contains Prorated Apportionment of Events with Unknown Phase of Flight

† Ingestion Events Per 10,000 Operations

†† Ingestion Events Per 10,000 Operations Per 10 ft^2

††† Function of JT8D Rate 2, CFM56 Rate 2, and Corresponding Operations

The binomial probabilities in equation 4.3 can be approximated by a Poisson distribution with mean Np for large values of N. That is, the single flight probability of an ingestion, p, replaces λ in equation 4.2.

An important question that can be investigated through the Poisson process model of bird ingestions is the influence of inlet area on the ingestion rates. Past studies [2,3] in bird strikes have used the assumption that the probability of a bird strike is proportional to the cross sectional area of the aircraft. Applying the same concept to engines implies that the bird ingestion rate should be proportional to the inlet area of the engine.

The inlet area effect can be incorporated into the Poisson process model by letting the parameter λ represent the ingestion rate per unit area. The probability of n ingestions in N operations for an engine with inlet area A is:

$$P(X(N)=n) = \frac{e^{-\lambda AN}(\lambda AN)^n}{n!} . \qquad 4.4$$

4.3 VALIDITY OF THE POISSON PROCESS MODEL FOR BIRD INGESTIONS

The applicability of the Poisson process model can be tested by analyzing the times between ingestions. The interarrival times in a Poisson process are random variables that have independent exponential distributions and the mean time between arrivals is the reciprocal of the ingestion rate. The validity of the Poisson process model can be tested by applying a goodness-of-fit (GOF) test for the exponential distribution to the times between ingestions.

The times between ingestions are measured by the number of days between aircraft ingestion events. Normally the number of aircraft operations between aircraft ingestion events would be used; however, it is impossible to measure this directly. The number of days between aircraft ingestion events provides a suitable measure of the time between ingestions since daily aircraft operations are reasonably consistent.

The GOF test for the exponential distribution is a modified Kolmogorov-Smirnov (K-S) test comparing the observed cumulative distribution function (CDF) to the predicted exponential CDF based on the sample mean. The K-S test uses the test statistic D defined as the maximum distance between the observed and predicted cumulative distribution functions. A modification to the critical values for the test statistic is required when the predicted CDF is derived from the mean of the sample. The critical values for the modified K-S test were computed by Liliefors [4]. The critical value for a 0.05 level of significance when the sample size, n, is larger than 30 can be approximated by $1.06/\sqrt{n}$.

The modified K-S test was run on five subgroups of the data broken down by engine and location. The five groups were (1) domestic (United States) JT8D, (2) contiguous US JT8D, (3) foreign JT8D, (4) contiguous CFM56, and (5) foreign CFM56. There were no CFM56 ingestions in Alaska or Hawaii. Figures 4.2 through 4.6 compare the observed and predicted cumulative distributions for each of the five groups, respectively. In each case there is a very close visual agreement between the observed and predicted CDF's.

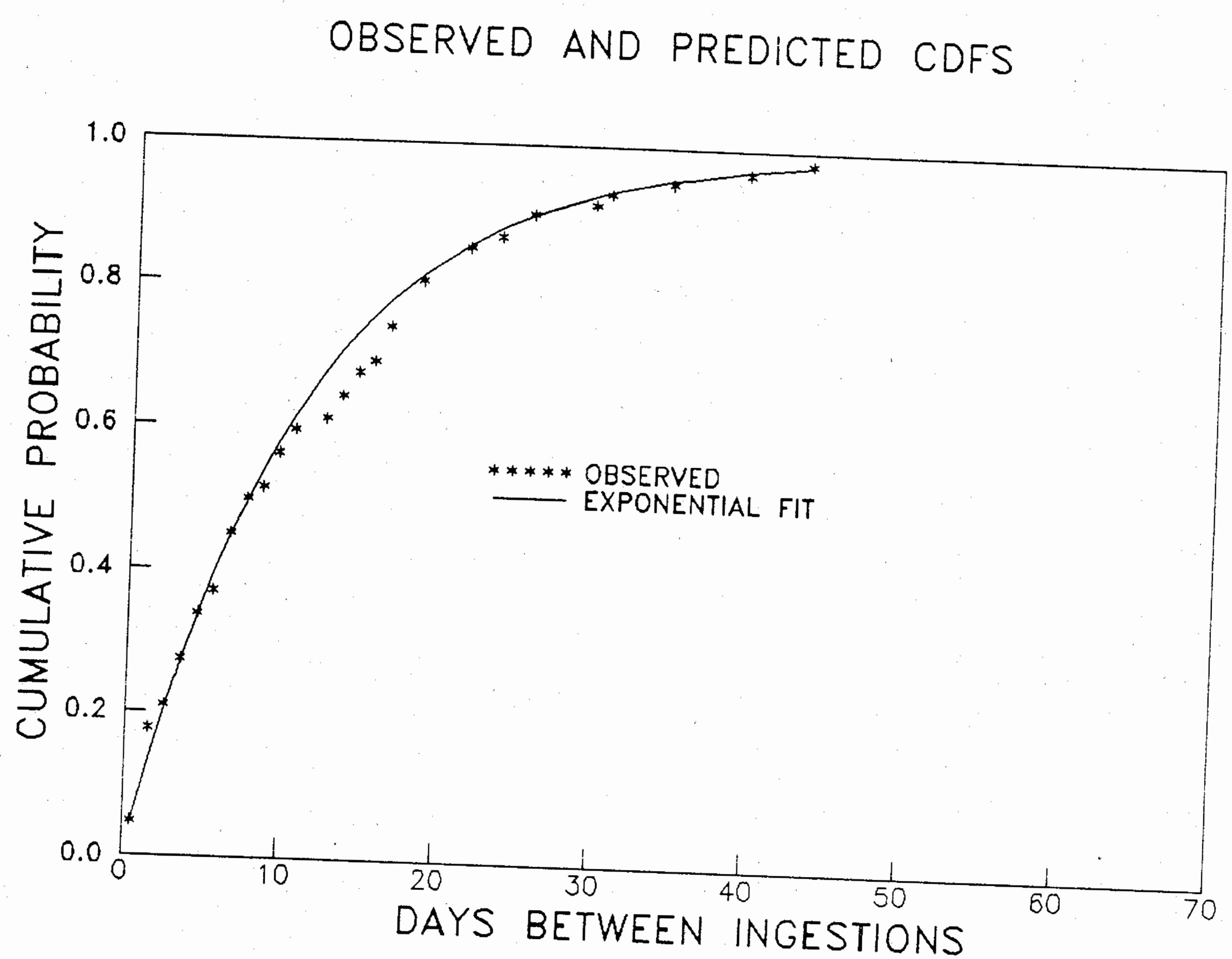

Figure 4.2 Comparison of Observed and Predicted CDFs for United States JT8D Aircraft Ingestion Events.

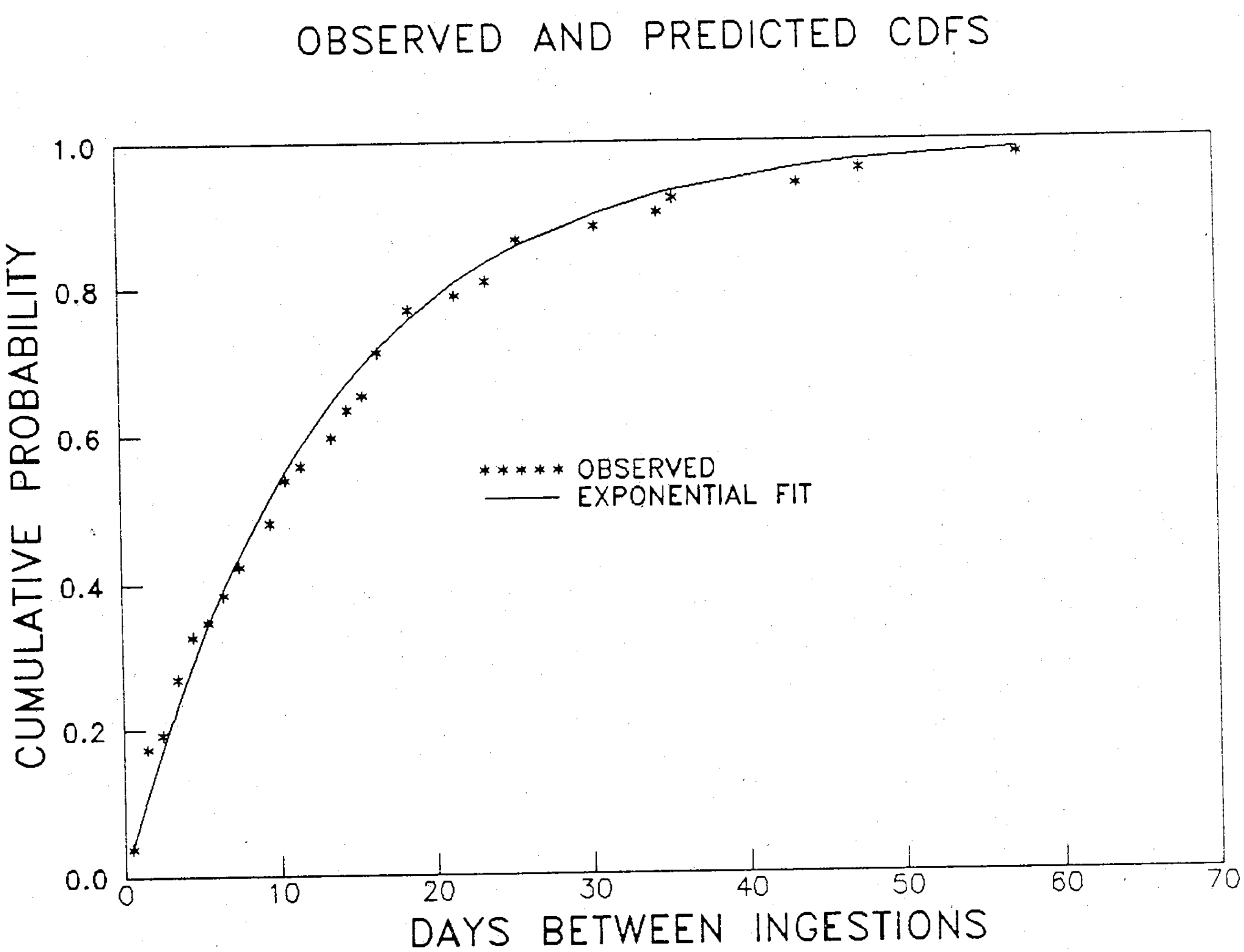

Figure 4.3 Comparison of Observed and Predicted CDFs for Contiguous United States JT8D Aircraft Ingestion Events.

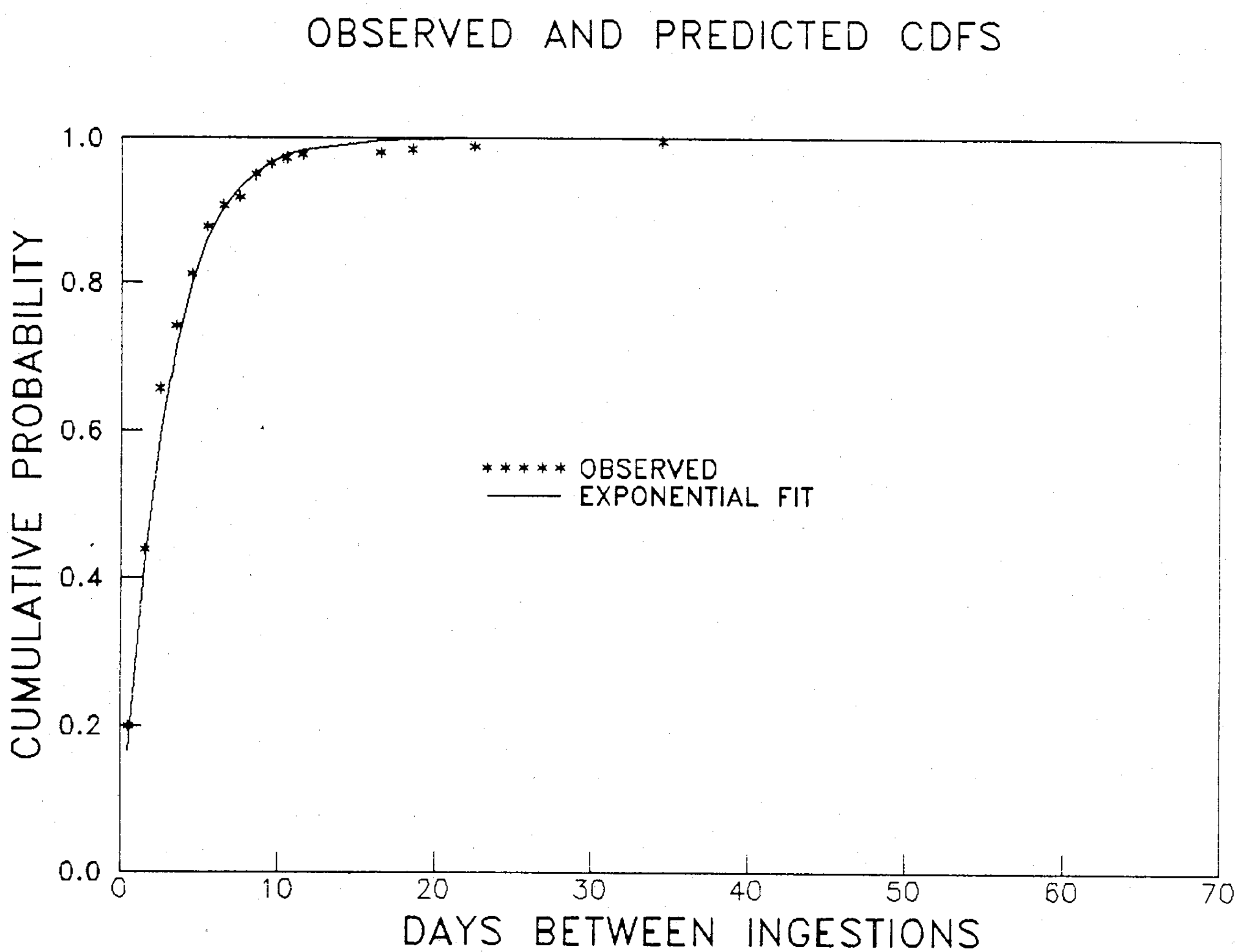

Figure 4.4 **Comparison of** Observed **and Predicted** CDFs for Foreign JT8D Aircraft Ingestion Events.

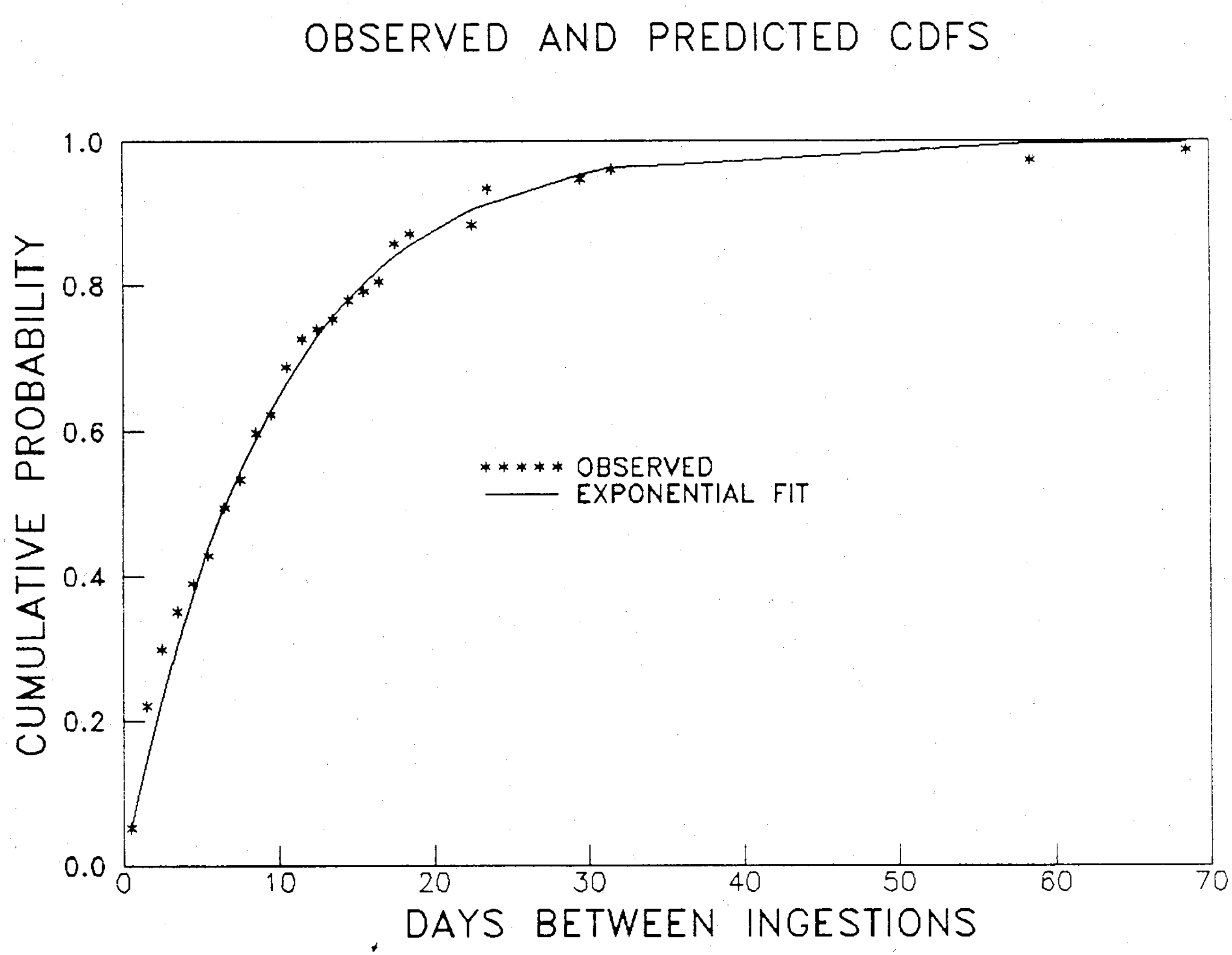

Figure 4.5 Comparison of Observed and Predicted CDFs for Contiguous United States CFM56 Aircraft Ingestion Events.

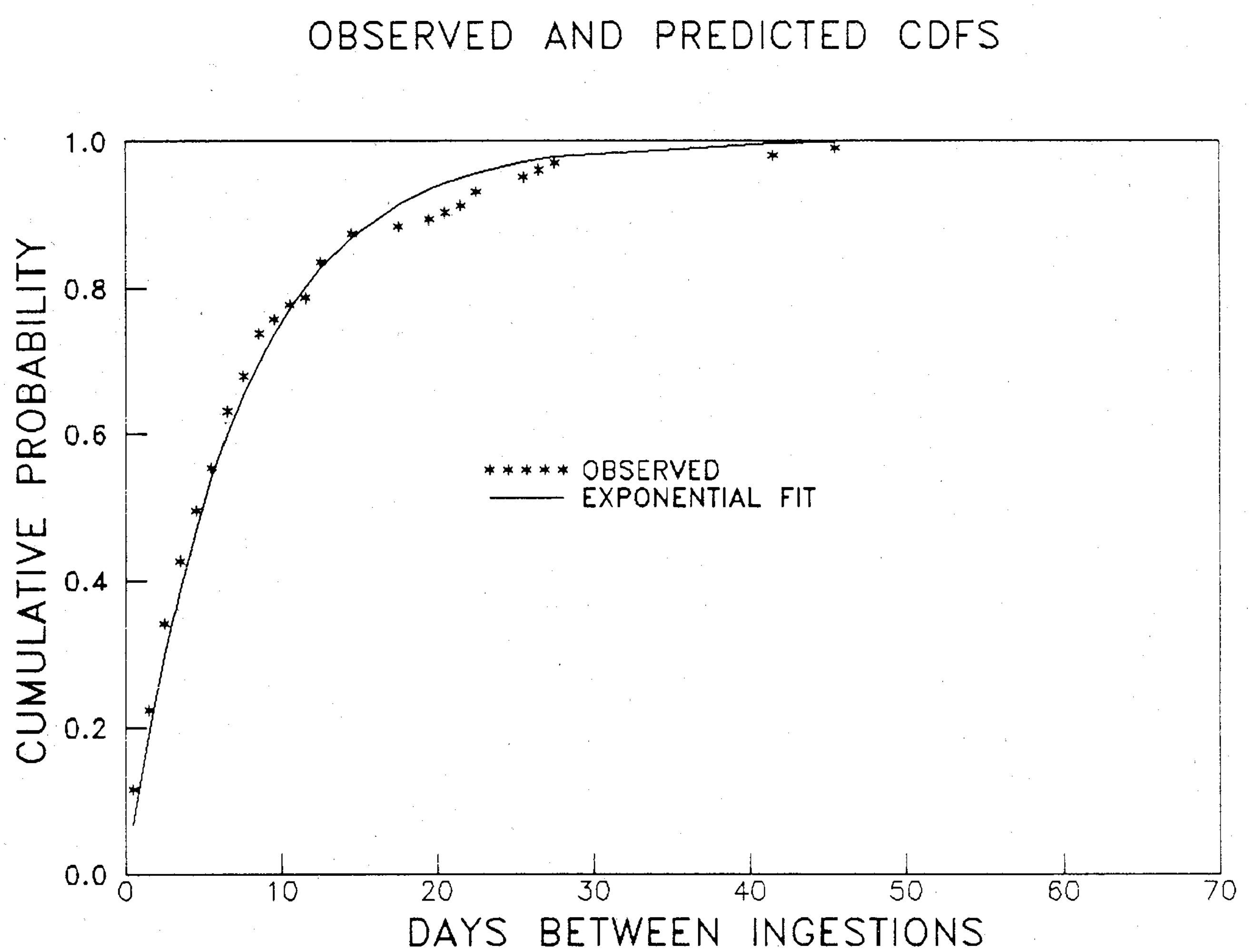

Figure 4.6 Comparison of Observed and Predicted CDFs for Foreign CFM56 Aircraft Ingestion Events.

The visual similarities are verified by the statistical tests which are summarized in table 4.3. The mean time between ingestion events is given in column one. The sample size given in column two is the count of times between ingestions and is one less than the number of aircraft ingestion events. The critical value for a 5 percent significance level (D^*) is in column three and the test statistic (D) is in column four. The assumption that the times between ingestion events come from an exponential distribution cannot be rejected at the 5 percent level in any of the five groups. The use of a Poisson process to model bird ingestions is appropriate based on these test results.

4.4 INLET AREA EFFECT ON INGESTION RATES

One property of the Poisson process model described in Section 4.2 is that ingestion rates should be proportional to the inlet area of the engine. The size effect can be investigated in the B737 bird ingestion data by comparing the number of ingestion events of the JT8D with the number of ingestion events of the CFM56. According to equation 4.4 the total number on ingestion events during the reporting period for a given engine has a Poisson distribution with a mean that is proportional to the number of aircraft operations in the year and to the inlet area of the engine. The number of JT8D ingestion events out of the total number of ingestion events will have a Binomial distribution if the Poisson process model is valid.

The proportion of total ingestion events that occurred in JT8D engines should be:

$$P = \frac{OJ*AJ}{OJ*AJ+OC*AC}, \qquad 4.5$$

where OJ and OC are the numbers of worldwide aircraft operations for, and AJ and AC are the inlet areas of, the JT8D and CFM56 engines, respectively. The relevant values for equation 4.5 can be obtained from table 4.1 giving an expected proportion of JT8D ingestion events of P = 0.61. Out of 504 total ingestion events, there were 322 JT8D ingestion events so that the observed proportion of JT8D ingestion events is 0.64. The test statistic to compare the observed proportion to the predicted is the standard Z statistic for the binomial distribution given by:

$$Z = (\hat{P} - P) \ / \sqrt{(P * (1-P) \ / \ N)}, \qquad 4.6$$

where $\hat{P}$ is the observed proportion of JT8D engines and N is the total number of aircraft ingestion events.

The Z statistic defined in equation 4.6 is used to test the null hypothesis that there is no difference between the two types of engines in ingestion rates after adjusting for area. The test statistic is computed by substituting the value 0.61 for P and 0.64 for $\hat{p}$ in equation 4.6 to give a value of 1.37. The Z value of 1.37 is not significant at the 5 percent level of significance so there is no detectable difference in ingestion rates between the JT8D and the CFM56 after adjustment for the inlet area.

TABLE 4.3

RESULTS OF THE EXPONENTIAL GOF TESTS TO VERIFY THE POISSON PROCESS

		(1)	(2)	(3)	(4)
AREA	ENGINE	MEAN	SAMPLE SIZE	D^*	D
United States	JT8D	10.95	61	0.14	0.07
Contiguous US	JT8D	13.10	51	0.15	0.07
Foreign	JT8D	2.79	259	0.07	0.07
United States	CFM56	9.55	76	0.12	0.08
Contiguous US†	CFM56	9.55	76	0.12	0.08
Foreign	CFM56	7.12	102	0.11	0.05

† All US CFM56 Ingestions Occurred in Contiguous US

A second school of thought suggests that the relationship between engine size and ingestion rate is described better as a linear function of diameter than as a linear function of area. A similar Z test can be computed by substituting diameter for area in equation 4.5. The expected proportion of JT8D ingestion events after an adjustment for diameter is P = 0.69 and the test statistic is Z = -2.72. The null hypothesis is that there is no difference in ingestion rates after adjusting for diameter and the conclusion of the test is that there is a detectable difference at the 5 percent level of significance. The engine size effect on ingestion rates seems to be described better by the inlet area than by the diameter for the 2-year period.

SECTION 5

AIRPORT BIRD INGESTION EXPERIENCE

The objective of the statistics of this section is to identify the frequency and location of bird ingestion events at airports worldwide. An aircraft ingestion event is the simultaneous ingestion of one or more birds by one or more engines of an aircraft. All of the bird ingestion data were provided by the engine manufacturer. Airport ingestion rates are expressed in terms of aircraft ingestion events per 10K airport operations.

The OAG tapes indicate that there are 1,095 airports worldwide for which 11,441,892 B737 airport operations were scheduled during the reporting period. Appendix A lists the airport code, airport location, and the number of scheduled airport operations at these airports (STGFY87-88). Bird ingestion events were reported at only 188 of these airports. The OAG tapes show that there were 4,203,284 scheduled airport operations at these 188 airports. There were also bird ingestion events reported by unscheduled B737 flights at 16 additional airports. These 16 airports are included in appendix A but there are no OAG operations counts for them.

A complete summary of the airports having reported aircraft ingestion events is presented in table 5.1 as a frequency count of worldwide bird ingestion events by phase of flight. The majority of aircraft ingestion events occur during takeoff or landing. This table suggests that the threat of bird ingestion is posed primarily from birds which live near the airport and/or whose migratory path crosses over or near the airport property.

Figure 5.1 is a bar chart showing reported aircraft ingestion events at domestic airports during the reporting period. There are 54 domestic airports at which bird ingestion events have been reported. The largest number of aircraft ingestion events reported in the United States during the period was 7 at both Dallas, Love (DAL) and Houston (HOU). Of the 139 aircraft ingestion events reported in the United States, 40 events occurred at an unknown location and they are assigned to the airport code XUS on the bar chart.

Figure 5.2 is a bar chart showing reported aircraft ingestion events at foreign airports during the reporting period. There are 150 foreign airports at which bird ingestions have been reported. The largest number of aircraft ingestion events reported abroad during the period was 8 at Frankfort, Germany (FRA). Of the 363 aircraft ingestion events reported outside of the United States, 121 events occurred at an unknown location and they are assigned to the airport code XFO on the bar chart.

Table 5.2 lists all airports worldwide which experienced three or more aircraft ingestion events during the reporting period. The table also includes the number of ingestion events, the number of OAG airport operations, and the rate of aircraft ingestion events per 10,000 airport operations. The airports are listed in descending order of airport operations.

The rates of bird ingestion events per aircraft operation summarized previously in table 4.1 are twice the rates of bird ingestion events per airport operation. The number of reported foreign bird ingestion events exceeds the number of reported domestic ingestion events by a factor of 2.6; however, the number of foreign airport operations is less than the number of domestic airport operations. The rate of reported bird ingestions per airport operation is 3.2 times higher at foreign airports than at domestic airports. This implies that either (1) there are far less birds in the environment of domestic airports, possibly due to environmental control programs, or (2) foreign airline operators are much more conscientious and cooperative in reporting bird ingestions.

TABLE 5.1

FREQUENCY COUNT OF AIRCRAFT INGESTION EVENTS BY AIRPORT AND PHASE OF FLIGHT

AIRPORT	AIRPORT DEFINITION	TAXI	TAKEOFF	CLIMB	CRUISE	APPROACH	LANDING	UNKNOWN	TOTAL
ACA	ACAPULCO, MEXICO		1						1
ADD	ADDIS ABABA, ETHIOPIA		1						1
ADL	ADELAIDE, SA, AUSTRALIA		1						1
AJA	AJACCIO, CORSICA, FRANCE						1		1
AJU	ARACAJU, BRAZIL		1						1
AKL	AUCKLAND, NEW ZEALAND		2						2
ALB	ALBANY, NY, USA		1	1					2
ALC	ALICANTE, SPAIN		1						1
ALG	ALGIERS, ALGERIA					1			1
AMS	AMSTERDAM, NETHERLANDS		2	1		2	1	1	7
AOR	ALOR SETAR, MALAYSIA		1						1
ARD	ALOR, INDONESIA					1			1
AUS	AUSTIN, TX, USA		1	1					2
BBI	BHUBANESWAR, INDIA		1						1
BEG	PELGRADE, YUGOSLAVIA			1				1	2
BFS	BELFAST, N. IRELAND		1				1		2
BHM	BIRMINGHAM, AL, USA			1			1		2
BHX	BIRMINGHAM, ENGLAND (UK)		3						3
BJR	BAHAR DAR, ETHIOPIA		1						1
BLR	BANGALORE, INDIA		1				1	1	3
BNE	BRISBANE, QLD, AUSTRALIA						2		2
BOM	BOMBAY, INDIA						1	1	2
BRS	BRISTOL, ENGLAND (UK)		1				1		2
BRU	BRUSSELS, BELGIUM		2	1		1	1		5
CAG	CAGLIARI, ITALY		1						1
CAS	CASABLANCA, MOROCCO						1		1
CCU	CALCUTTA, INDIA		1				1		2
CDG	PARIS DE GAULLE, FRANCE					1	1		2
CGN	COLOGNE BONN, FRG		1						1
CGR	CAMPO GRANDE, BRAZIL		3						3
CHC	CHRISTCHURCH, NEW ZEALAND		5				1		6
CLE	CLEVELAND, OH, USA		1						1
CLT	CHARLOTTE, NC, USA		1				1	1	3
CLV	CALDAS NOVAS, BRAZIL		1						1
CMG	CORUMBA, MATO GROSSO, BRAZIL		1						1
CNS	CAIRNS, QLD, AUSTRALIA							1	1
COS	COLORADO SPRINGS, CO, USA		1						1
CPH	COPENHAGEN, DENMARK		1						1
CPT	CAPE TOWN, SOUTH AFRICA		1						1
CTU	CHENGDU, P.R. CHINA	1							1
CWL	CARDIFF, WALES, UK		1						1
DAB	DAYTONA BEACH, FL, USA		1						1
DAL	LOVE DALLS/FT. WORTH, TX, USA		2	1		2		2	7
DAY	DAYTON, OH, USA		1						1
DEN	STAPLETON INT'L, DENVER, CO, USA		2	1		1			4
DFW	DALLAS/FT WORTH, TX, USA		1						1
DUB	DUBLIN, REPUBLIC OF IRELAND					1	1		2
DUR	DURBAN, SOUTH AFRICA		4						4
DUS	DUESSELDORF, FRG		1	2			1		4
ELS	EAST LONDON, SOUTH AFRICA		2				1		3
EWR	NEWARK, NEW YORK, NY, USA		1						1
EZE	BUENOS AIRES-EZEIZA ARPT, ARGENTINA		1						1
FAO	FARO, PORTUGAL					1			1
FAT	FRESNO, CA, USA		1				1		2
FCO	DA VINCI, ROME, ITALY		1						1

TABLE 5.1 (continued)

FREQUENCY COUNT OF AIRCRAFT INGESTION EVENTS BY AIRPORT AND PHASE OF FLIGHT

AIRPORT	AIRPORT DEFINITION	TAXI	TAKEOFF	CLIMB	CRUISE	APPROACH	LANDING	UNKNOWN	TOTAL
FLL	FT LAUDERDALE, FL, USA		1						1
FRA	FRANKFURT, FRG	1	2	1		1	1	2	8
GAJ	YAMAGATA, HONSHU, JAPAN							1	1
GAU	GAUHATI, INDIA		1						1
GHB	GOVERNORS HARBOUR, BAHAMAS		1						1
GHU	GUALEGUAYCHU, ARGENTINA		1						1
GIG	RIO DE JANEIRO INT'L, BRAZIL		1						1
GOA	GENOA, ITALY		1						1
GRZ	GRAZ, AUSTRIA						1		1
HAC	HACHIJO, JIMA ISLAND, JAPAN						1		1
HAJ	HANOVER, FED REP OF GERMANY						1		1
HAM	HAMBURG, FRG		3						3
HOU	HOUSTON, TX, USA		3	1			3		7
HRL	HARLINGEN, TX, USA						1		1
HYD	HYDERABAD, INDIA		1						1
IAD	DULLES INT'L, WASHINGTON, DC, USA						1	1	2
IAH	HOUSTON INTERCONT, TX, USA		1						1
IBZ	IBIZA, SPAIN						1		1
ISA	MOUNT ISA, QLD, AUSTRALIA						1		1
ISG	ISHIGAKI, JAPAN		2						2
ITO	HILO HAWAII, HA, US		3						3
IVC	INVERCARGILL, NEW ZEALAND		1						1
IXB	BAGDOGRA, INDIA							1	1
JAI	JAIPUR, INDIA						1	1	2
JNB	JOHANNESBURG, SOUTH AFRICA		2						2
JRH	JORMAT, INDIA							1	1
KCH	KUCHING, SARAWAK, MALAYSIA			1					1
KGS	KOS, GREECE		1						1
KHH	KAOHSIUNG, TAIWAN							1	1
KHI	KARACHI, PAKISTAN						1	1	2
KMG	KUNMING, P.R. CHINA		1						1
KOA	KONA, HA, US		1						1
KOJ	KAGOSHIMA, JAPAN							2	2
KST	KOSTI, SUDAN					1			1
KUL	KUALA LUMPUR, MALAYSIA					1			1
LAS	LAS VEGAS, NV, USA		1						1
LAX	LOS ANGELES, CA, USA		1						1
LCA	LARNACA, CYPRUS						1		1
LDE	LOURDES/TARBES, FRANCE		1						1
LGA	NEW YORK LA GUARDIA, NY, USA		1						1
LGW	LONDON-GATWICK, ENGLAND			1					1
LHE	LAHORE, PAKISTAN		1					1	2
LHR	LONDON HEATHROW, ENGLAND, (UK)					2	1		3
LIH	LIHUE, KAUAI, HA, US		4						4
LIN	MILAN LINATE, ITALY		1						1
LIT	LITTLE ROCK, AK, USA		1	1					2
LJU	LJUBLJANA, YUGOSLAVIA		1						1
LLW	LILONGWE, MALAWI		1						1
LNZ	LONZ, AUSTRIA		1						1
LOS	LAGOS, NIGERIA		1					1	2
LST	LAUNCESTON, TASMANIA, AUSTRALIA						1		1
LUT	LAURA STATION, AUSTRALIA		1						1
LXR	LUXOR, ARAB REP OF EGYPT		1						1
MAD	MADRID, SPAIN		1						1
MAF	MIDLAND ODESSA, TX, USA		1						1

TABLE 5.1 (continued)

FREQUENCY COUNT OF AIRCRAFT INGESTION EVENTS BY AIRPORT AND PHASE OF FLIGHT

AIRPORT	AIRPORT DEFINITION	TAXI	TAKEOFF	CLIMB	CRUISE	APPROACH	LANDING	UNKNOWN	TOTAL
MAN	MANCHESTER, ENGLAND (UK)		2			1			3
MCO	ORLANDO-INT'L, FL, USA						1		1
MDQ	MAR DEL PLATA, ARGENTINA		1						1
MDT	HARRISBURG-OLMSTEAD ST, PA, USA		1						1
MEL	MELBOURNE, VICTORIA, AUSTRALIA		1	1			1		3
MIA	MIAMI, FL, USA						1		1
MIL	MILAN, ITALY		1						1
MMY	MIYAKO JIMA, JAPAN		4				2		6
MSO	MISSOULA, MT, USA						1		1
MSP	MINNEAPOLIS-ST PAUL, MN, USA		1						1
MSY	NEW ORLEANS, LA, USA			1					1
MUC	MUNICH, FRG		2				1		3
MXP	MILAN-MALPENSA, ITALY		1						1
NCE	NICE, FRANCE						1		1
NCL	NEWCASTLE, ENGLAND						1		1
NGO	NAGOYA, JAPAN							1	1
NUE	NUREMBURG, FRG			1					1
OAK	OAKLAND, SAN FRANCISCO, CA, USA		1				2		3
OGG	KAHULUI, MAUI, HA, US		2						2
OKC	OKLAHOMA CITY, OK, USA						1		1
ORD	CHICAGO-O'HARE, IL, USA		3	1			1		5
ORF	NORFOLK-VA. BEACH, VA, USA		1						1
PAT	PATNA, INDIA							1	1
PDX	PORTLAND, OR, USA			1			1		2
PEK	BEIJIN, P. R. CHINA	1					1		2
PEN	PENANG, MALAYSIA		1	1					2
PHL	PHILADELPHIA/WILMINGTON, PA, USA						1		1
PIE	TAMPA-ST. PETERSBURG, FL, USA		2						2
PLZ	PORT ELIZABETH, SOUTH AFRICA		2				1		3
PME	PORTSMOUTH, UK		1				1		2
PMR	PALMERSTON, NEW ZEALAND		1				1		2
PSA	PISA, ITALY			1					1
PVH	PORTO VELHO, BRAZIL		1						1
QTV	TREVISO, ITALY						1		1
RAP	RAPID CITY, SD, USA		1						1
REC	RECIFE, BRAZIL		1						1
RNO	RENO, NV, USA		1	1					2
ROA	ROANOKE, VA, USA					1			1
RUH	RIYADH, SAUDI ARABIA		1						1
SAB	SABA, NETH. ANTILLES						1		1
SAN	SAN DIEGO, CA, USA			1					1
SAO	SAO PAULO, BRAZIL			1					1
SAT	SAN ANTONIO, TX, USA		1	1				1	3
SCN	SAARBRUECKEN, FRG					1			1
SDF	LOUISVILLE, KY, USA		1						1
SDJ	SENDAI, JAPAN							1	1
SFO	SAN FRANCISCO-OAKLAND, CA, USA		3	1				1	5
SHI	SHIMOJISHIMA, JAPAN							1	1
SLC	SALT LAKE CITY, UT, USA				1				1
SLZ	SAO LUIZ, MARANHAO, BRAZIL		1						1
SMF	SACRAMENTO, CA, USA		1						1
SNA	ORANGE COUNTY, CA, USA		1						1
SRQ	SARASOTA/BRADENTON, FL, USA		1						1
STR	STUTTGART, FRG		1				1		2
STV	SURAT, INDIA		1						1

TABLE 5.1 (concluded)

FREQUENCY COUNT OF AIRCRAFT INGESTION EVENTS BY AIRPORT AND PHASE OF FLIGHT

AIRPORT	AIRPORT DEFINITION	TAXI	TAKEOFF	CLIMB	CRUISE	APPROACH	LANDING	UNKNOWN	TOTAL
SXR	SRINAGAR, INDIA						1		1
SYD	SYDNEY, N.S.W., AUSTRALIA			1		1			2
TFS	TENERIFFE-REINASOFIA, CANARY ISLAND		1	1					2
TGD	TITOGRAD, YUGOSLAVIA						1		1
TLV	TEL AVIV-YAFO, ISRAEL		1						1
TNG	TANGIER, MOROCCO		1						1
TRV	TRIVANDRUM, INDIA						2	1	3
TSV	TOWNSVILLE, QLD, AUSTRALIA						1		1
TTJ	TOTTORI, JAPAN							1	1
TUL	TULSA, OK, USA		2						2
TUN	TUNIS, TUNISIA		1				1		2
TVL	LAKE TAHOE, CA, USA			1					1
TXL	WEST BERLIN, GERMANY		1						1
UET	QUETTA, PAKISTAN							1	1
VDM	VIEDMA, ARGENTINA							1	1
VNS	VARANASI, INDIA		1					2	3
WDH	WINDHOEK, NAMIBIA						1		1
WLG	WELLINGTON, NEW ZEALAND		2				1		3
XFO	UNKNOWN FOREIGN AIRPORT		9		5		3	104	121
XMN	XIAMEN, P. R. CHINA		1						1
XRY	JEREZ DE LA FRONTERA, SPAIN					1			1
XUS	UNKNOWN USA AIRPORT	1			2	1		36	40
YAM	SAULT STE MARIE, ONT., CANADA		1			1			2
YHY	HAY RIVER, NWT, CANADA						1		1
YKA	KAMLOOPS, BC, CANADA		1						1
YLW	KELOWNA, BC, CANADA		1			1			2
YMM	FT MCMURRAY, ALTA, CANADA		1						1
YQR	REGINA, SASK, CANADA		1						1
YQT	THUNDER BAY, ONT, CANADA		1						1
YUL	MONTREAL, QUEBEC, CANADA		2				1		3
YVR	VANCOUVER, BC, CANADA					1	1	1	3
YWG	WINNIPEG, MAN, CANADA		2						2
YXD	EDMONTON-MUNICIPAL, ALBERTA, CANADA						1		1
YXJ	FT ST JOHN, BC, CANADA		1						1
YXS	PRINCE GEORGE, BC, CANADA						1		1
YYC	CALGARY, ALBERTA, CANADA						1		1
YYJ	VICTORIA, BC, CANADA		1						1
YYT	ST JOHNS, NFLD, CANADA		1						1
YYZ	TORONTO, ONTARIO, CANADA		1						1
ZRH	ZURICH, SWITZERLAND		1				2		3
ZTH	ZAKINTHOS, GREECE					1			1
-0-	AIRPORT UNKNOWN							2	2
	AIRPORTS WITH KNOWN INGESTIONS	4	184	30	8	26	76	176	504

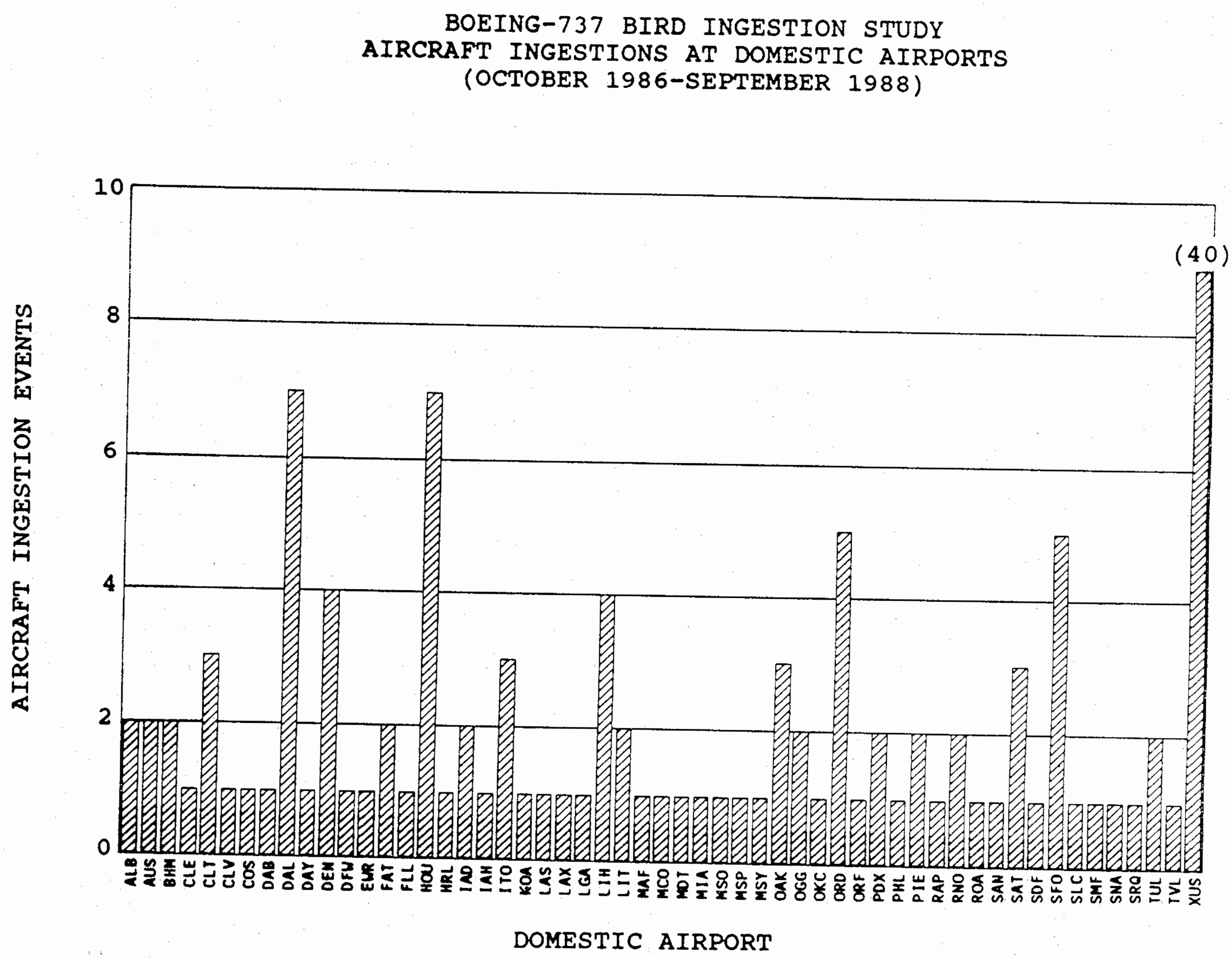

Figure 5.1 Histogram of Aircraft Ingestion Events at Domestic Airports.

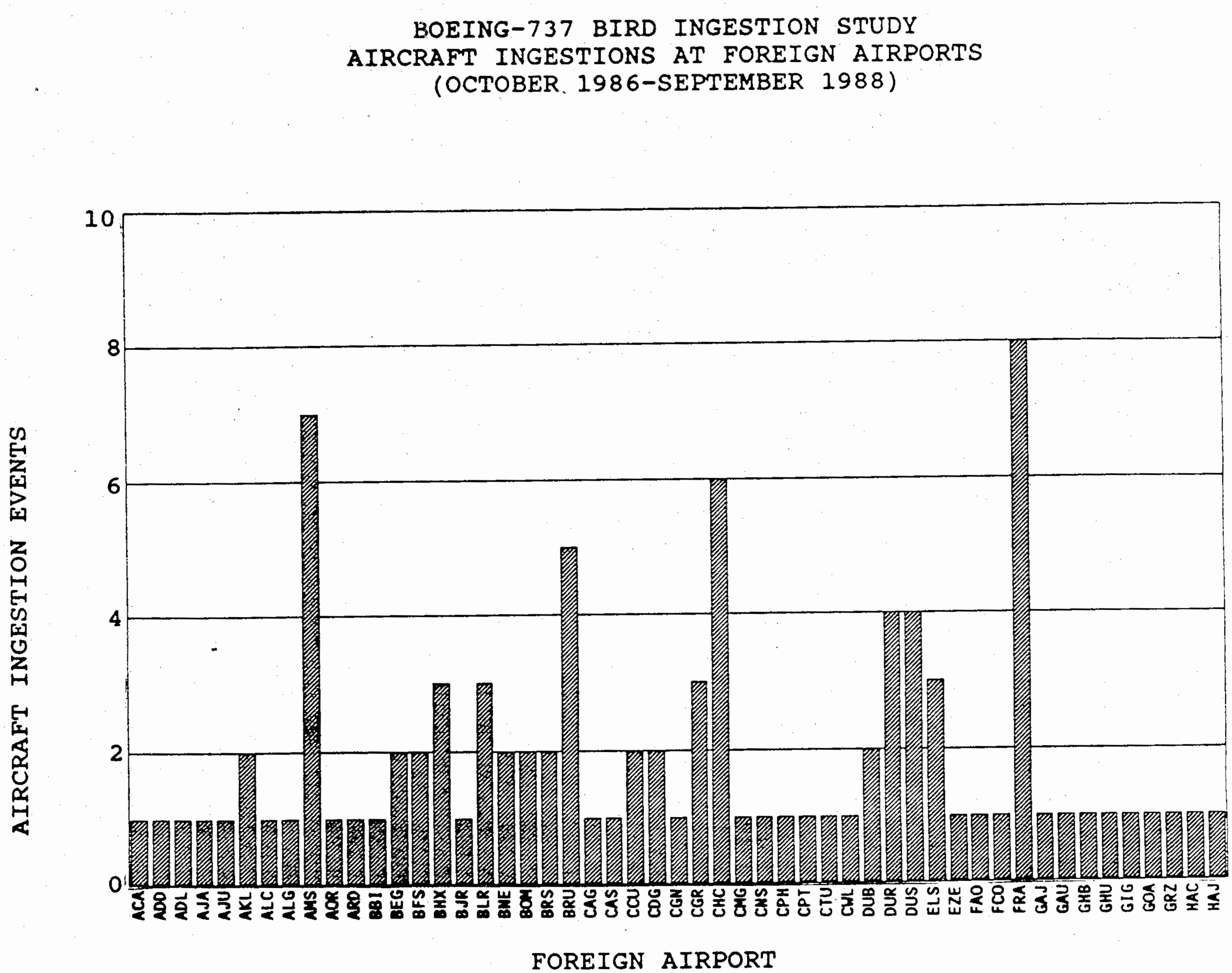

Figure 5.2 Histogram of Aircraft Ingestion Events at Foreign Airports (continued).

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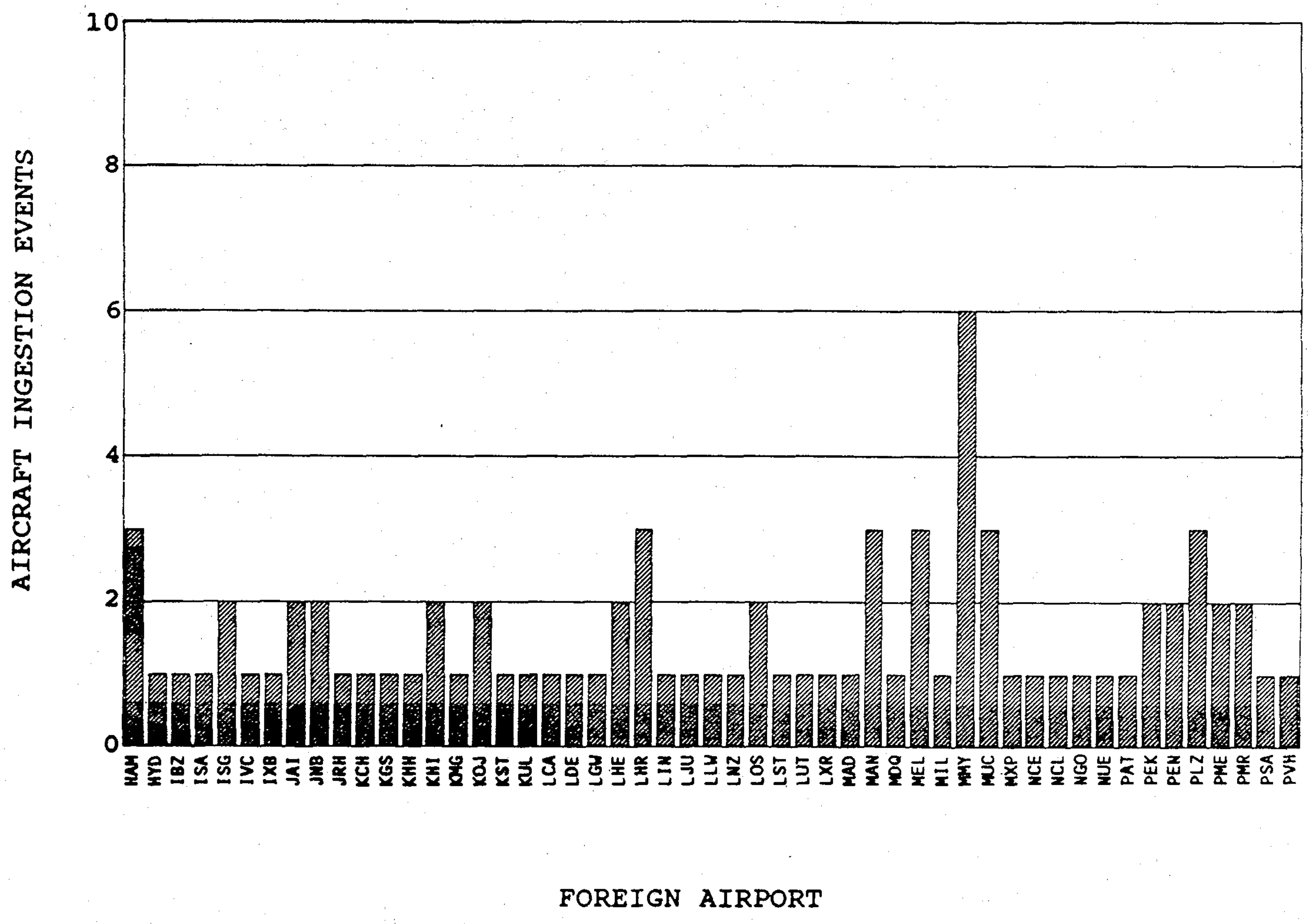

Figure 5.2 Histogram of Aircraft Ingestion Events at Foreign Airports (continued).

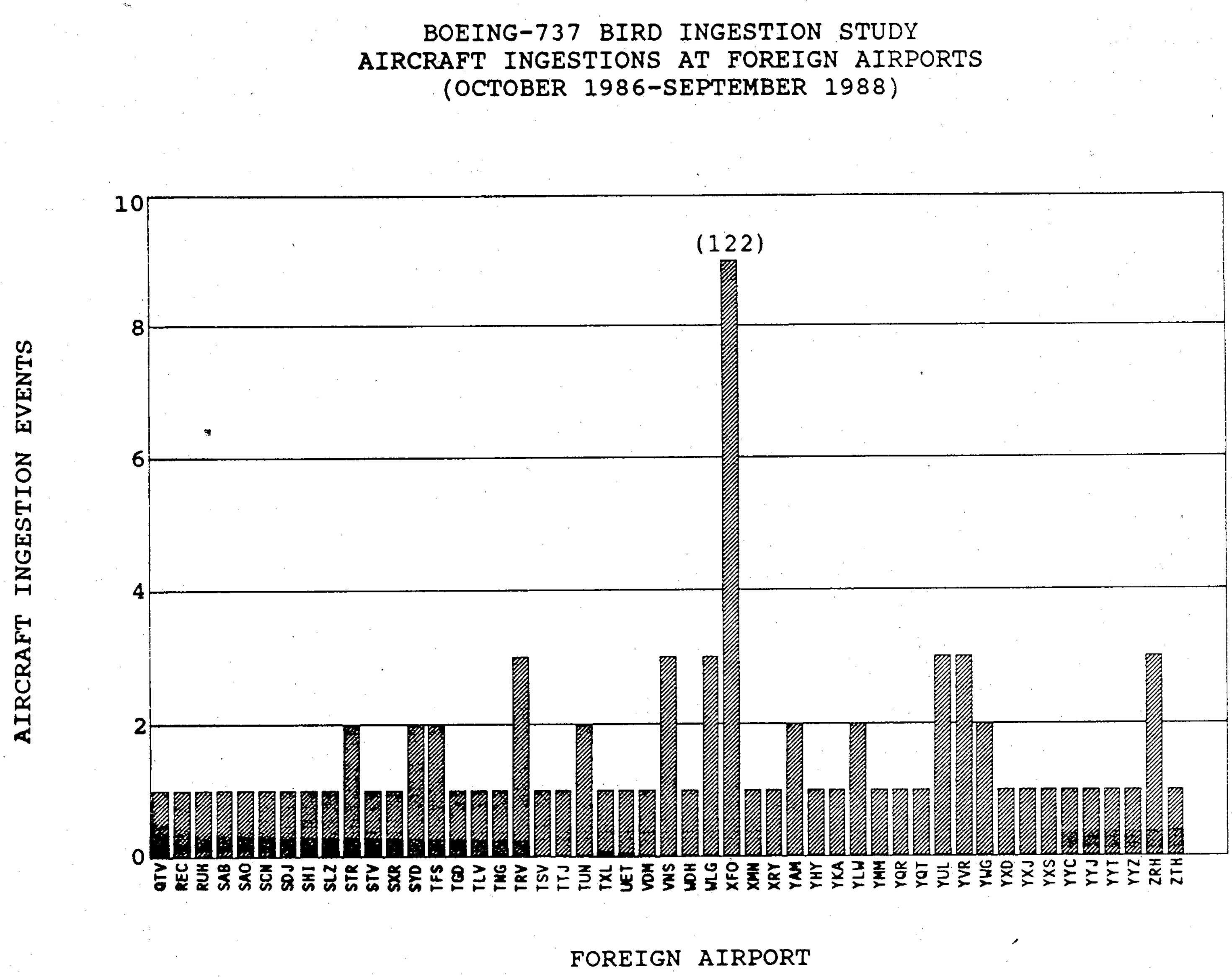

Figure 5.2 Histogram of Aircraft Ingestion Events at Foreign Airports (concluded).

TABLE 5.2 AIRPORT BIRD INGESTION RATES

(3 Or More Aircraft Ingestion Events)

Airport Code	Airport Operations	Ingestion Events	Ingestion Rate Events/10K Ops	Airport Location
DEN	226,307	4	0.35	STAPLETON INT'L, DENVER, CO, USA
CLT	208,553	3	0.29	CHARLOTTE, NC, USA
SFO	160,475	5	0.62	SAN FRANCISCO-OAKLAND, CA, USA
HOU	153,117	7	0.91	HOUSTON, TX, USA
DAL	151,419	7	0.92	LOVE DALLS/FT. WORTH, TX, USA
LHR	145,339	3	0.41	LONDON HEATHROW, ENGLAND, (UK)
ORD	138,943	5	0.72	CHICAGO-O'HARE, IL, USA
FRA	108,530	8	1.47	FRANKFURT, FRG
MUC	80,740	3	0.74	MUNICH, FRG
YVR	76,554	3	0.78	VANCOUVER, BC, CANADA
SAT	68,328	3	0.88	SAN ANTONIO, TX, USA
BRU	64,690	5	1.55	BRUSSELS, BELGIUM
DUS	63,083	4	1.27	DUESSELDORF, FRG
HAM	53,230	3	1.13	HAMBURG, FRG
OAK	52,693	3	1.14	OAKLAND, SAN FRANCISCO, CA, USA
AMS	48,351	7	2.90	AMSTERDAM, NETHERLANDS
WLG	46,198	3	1.30	WELLINGTON, NEW ZEALAND
YUL	42,833	3	1.40	MONTREAL, QUEBEC, CANADA
CHC	41,297	6	2.91	CHRISTCHURCH, NEW ZEALAND
MEL	38,221	3	1.57	MELBOURNE, VICTORIA, AUSTRALIA
LIH	35,073	4	2.28	LIHUE, KAUAI, HA, US
PLZ	26,930	3	2.23	PORT ELIZABETH, SOUTH AFRICA
ZRH	25,977	3	2.31	ZURICH, SWITZERLAND
ELS	21,091	3	2.84	EAST LONDON, SOUTH AFRICA
ITO	17,841	3	3.36	HILO HAWAII, HA, US
DUR	14,664	4	5.46	DURBAN, SOUTH AFRICA
CGR	14,570	3	4.12	CAMPO GRANDE, BRAZIL
BLR	14,046	3	4.27	BANGALORE, INDIA
MAN	13,270	3	4.52	MANCHESTER, ENGLAND (UK)
MMY	8,442	6	14.21	MIYAKO JIMA, JAPAN
VNS	5,836	3	10.28	VARANASI, INDIA
TRV	5,082	3	11.81	TRIVANDRUM, INDIA
BHX	4,937	3	12.15	BIRMINGHAM, ENGLAND (UK)
	2,176,660	132	1.21	

SECTION 6

ENGINE DAMAGE DESCRIPTION

The type of damage incurred by well-defined bird ingestions is useful in refining bird certification test criteria that could lead to improved engine design. In general, three parameters are used to describe engine damage and failure. The first is the type of damage incurred, the second is whether or not the engine failed, and the third is a description of the crew action taken during the ingestion event. The first part of this section provides descriptions of the types of damage incurred during the study and the types of crew actions implemented as a result of the bird ingestion. The second part describes the statistical analysis of the relationship between bird weight and the likelihood of damage occurring in an ingestion. The last part of this section provides estimates of the probabilities of a crew action or an engine shutdown. (The information about engine failures was not available at the time of this report so engine failures are not discussed here.)

6.1 ENGINE DAMAGE AND CREW ACTION DESCRIPTIONS

The types of damage that were identified in the data base were grouped into 14 categories which are defined in table 6.1. Within the first 2 years of data collection 13 of the categories occurred. Tabulations of the occurrences of combinations of damage categories are presented in table 6.2. The triangular top portion of the table provides tallies of co-occurrences for all pairs of damage categories. The number in the top portion represents the number of engine ingestion events in which both the row damage and the column damage occurred. The events in which more than two types of damage occurred were also included in the tallies of the top portion of table 6.2. There were thirteen events in which three types of damage occurred and one event with five types of damage.

There are insufficient data in the top portion of table 6.2 to make any strong statements about correlations between types of damage. There is some indication that bent and dented blades accompany broken and shingled blades and that leading edge blade damage accompany blade shingling; however, these trends cannot be strongly substantiated because of the small amount of data. The observed trends could provide the starting point for further investigations into the damage mechanisms of bird ingestions.

The bottom half of table 6.2 provides tallies of the number of engine ingestion events in which each damage category was the only type of damage and the total number of events that involved each of the damage categories. Fewer than three bent and dented blades, shingled blades, and broken blades seem more likely to occur by themselves than other types of damage. When more than three blades are bent or dented there is a much higher chance that some other type of damage will also occur. As with the trends identified in the top portion of table 6.2, there is insufficient evidence to strongly substantiate these trends.

There were four types of crew action identified in connection with the aircraft ingestion events in the data base. An air turnback was performed in 50 of the events, the takeoff was aborted 27 times, a diversionary maneuver was performed 8 times and in 1 event the crew action was listed as other without specifying the type of action taken. There was no crew action taken in 117 of

TABLE 6.1 DEFINITION OF ENGINE DAMAGE CATEGORIES

DAMAGE CATEGORY	SEVERITY LEVEL	DAMAGE DEFINITION
TRVSFRAC	Severe	Transverse fracture - fan blade broken chordwise (across) and piece liberated (includes secondary hard object damage).
CORE	Severe	Bent/broken compressor blades/vanes, blade/vane clash, blocked/disrupted airflow in low, intermediate, and high pressure compressors.
FLANGE	Severe	Flange separations.
TURBINE	Severe	Turbine damage.
BE/DE>3	Moderate	More than three fan blades bent or dented.
TORN>3	Moderate	More than three torn fan blades.
BROKEN	Moderate	Broken fan blades, leading edge and/or tip pieces missing, other blades also dented.
SPINNER	Moderate	Dented, broken, or cracked spinner (includes spinner cap).
RELEASED	Moderate	Released (walked) fan blades (blade retention mechanism broken).
TORN<3	Mild	Three or fewer torn fan blades.
SHINGLED	Mild	Shingled (twisted) fan blades.
NACELLE	Mild	Dents and/or punctures to the engine enclosure (includes cowl).
LEAD_EDG	Mild	Leading edge distortion/curl.
BEN/DEN	Mild	One to three fan blades bent or dented.

TABLE 6.2 TYPES OF DAMAGE CAUSED BY BIRD INGESTIONS

	LEAD_EDG	BEN/DEN	BE/DE>3	TORN<3	TORN>3	BROKEN	SHINGLED	TRVSFRAC	CORE	RELEASED	TURBINE	NACELLE
BEN/DEN	2											
BE/DE>3	1	0										
TORN<3	2	1	1									
TORN>3	0	0	1	0								
BROKEN	1	8	3	1	1							
SHINGLED	15	9	9	1	0	1						
TRVSFRAC	0	4	4	0	1	4	0					
CORE	0	3	3	0	0	3	1	2				
RELEASED	0	2	4	0	1	1	3	1	0			
TURBINE	0	0	2	0	0	0	0	0	2	0		
NACELLE	0	0	0	0	0	0	0	0	0	0	0	
FLANGE	0	0	0	0	0	0	0	1	0	0	0	0

	LEAD_EDG	BEN/DEN	BE/DE>3	TORN<3	TORN>3	BROKEN	SHINGLED	TRVSFRAC	CORE	RELEASED	TURBINE	NACELLE	FLANGE
ONLY DAMAGE	12	59	11	0	0	20	45	4	3	0	1	2	0
TOTAL	30	82	30	4	1	34	77	14	11	6	3	2	1

the aircraft ingestion events for which a crew action entry was recorded, which is slightly more than half the time. (One airplane crashed on takeoff.) The crew action should correspond to the phase of flight in which the event occurred. No change in the flight is usually required when an ingestion occurs during a landing maneuver. The air turnbacks and aborted takeoffs would most likely occur during takeoff and climb phases since there were practically no ingestions during the cruise phase.

6.2 PROBABILITY OF DAMAGE

One of the key questions that inspired the bird ingestion survey is the issue of what size bird should be simulated in certification testing. Two of the main issues in deciding what the certification bird size should be are (1) the likelihood of ingesting a bird of the certification size or larger and (2) the likelihood that damage will result from ingesting a bird of the certification size. The issue of bird sizes is discussed in Sections 3 and 7 while the probability of damage is the topic of this section.

The problem of relating bird weight to the probability of damage (POD) is similar to bio-assay experiments which try to predict the probability of a response as a function of dose size. The key elements of similarity are that the probability of success for a dichotomous (pass/fail) trial is related to a continuous stimulus variable. In bird ingestions, the dichotomous trial is whether or not damage occurs and the stimulus variable is the weight of the ingested bird.

Linear logistic analysis is the most commonly used method of analyzing the dosage-response type of data and has been used successfully in relating the probability of transparencies breaking as a function of projectile size in dealing with the problem of propwash blown gravel breaking helicopter windshields [5]. The logistic distribution function is assumed to describe the relationship between the probability of damage and the bird weight in a linear logistic analysis. The logistic distribution function is given by:

$$POD(w) = 1/\left|1+\exp[-(\pi/\sqrt{3}(w-\mu)/\sigma]\right| \qquad 6.1$$

where w is the bird weight, μ is the weight with a 50 percent chance of causing damage and σ is a parameter that is related to the steepness of the POD function.

The estimation of the function given in equation 6.1 has been extensively studied and the methods have been described in the literature [6,7]. The method of maximum likelihood provides the best estimates for the type of data in the bird ingestion study since there are only a few ingestions at each weight. The software for estimating the parameters of equation 6.1 has been developed and extensively tested at the UDRI [8] and verified by researchers at other institutions.

The types of damage were categorized as mild, moderate, or severe by the FAA. Table 6.3 itemizes the types of damage that were included in each of the severity categories. Three distinct analyses were conducted based on the severity ratings. The three analyses estimated the probability of any damage, the probability of at least moderate damage, and the probability of severe damage as a function of bias weight. Figures 6.1, 6.2, 6.3 show the estimated POD functions along with confidence bounds on the POD functions for the three analyses.

TABLE 6.3 DAMAGE SEVERITY DEFINITIONS

SEVERITY LEVEL	DAMAGE DEFINITION
SEVERE DAMAGE	Damage classified as severe. Achieved when reported damage category is TRVSFRAC, CORE, FLANGE, or TURBINE.
MODERATE DAMAGE	Damage classified as moderate. Achieved when reported damage category is BE/DE>3, TORN>3, BROKEN, SPINNER, or RELEASED and no SEVERE damage has been reported.
MILD DAMAGE	Damage classified as mild. Achieved when reported damage category is LEAD_EDG, BEN/DEN, TORN<3, SHINGLED, or NACELLE and no SEVERE nor MODERATE damage has been reported.

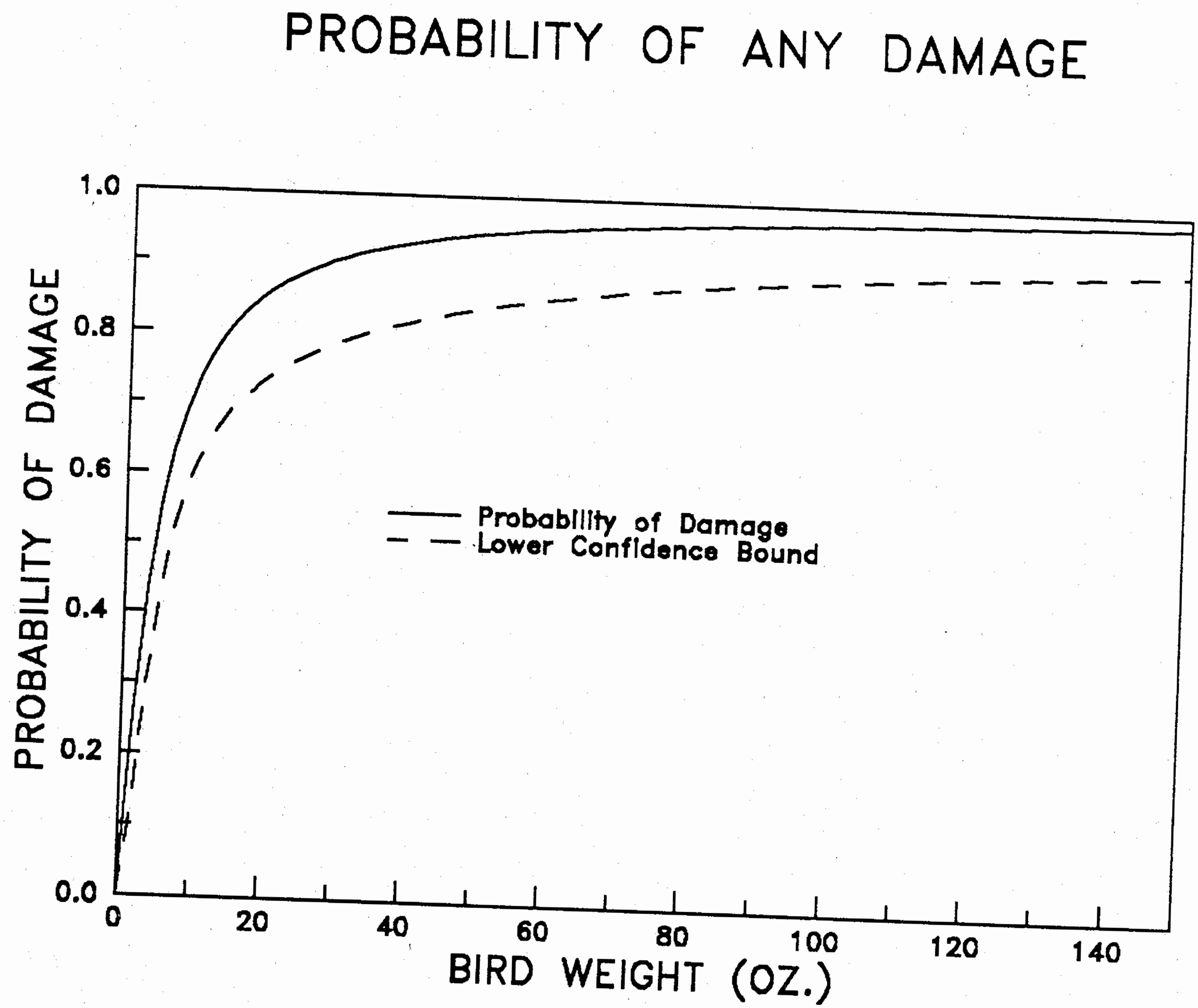

Figure 6.1 Estimated POD Function for Any Damage with the 95 Percent Confidence Bound.

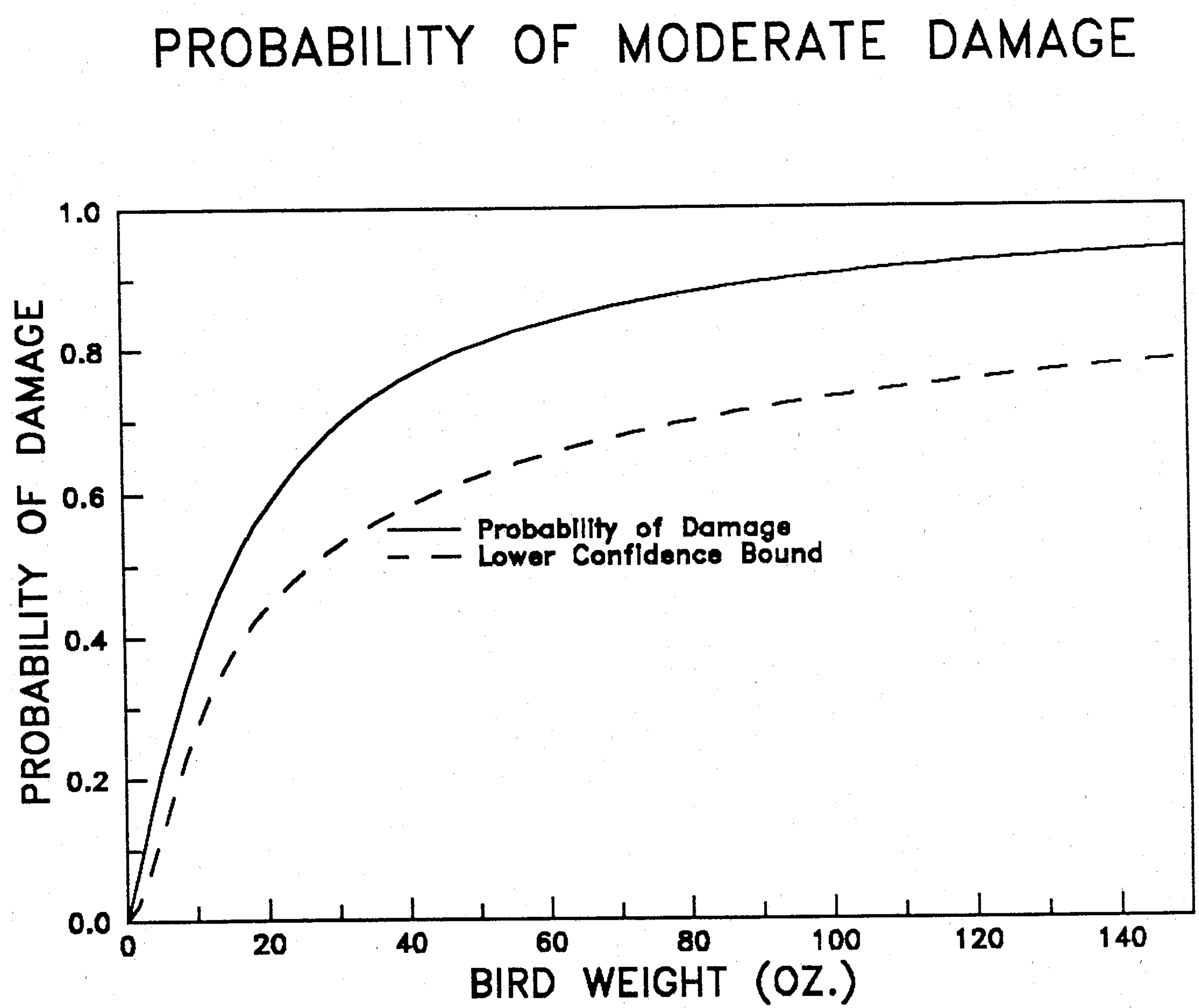

Figure 6.2 Estimated POD Function for Moderate or Worse Damage with the 95 Percent Confidence Bound.

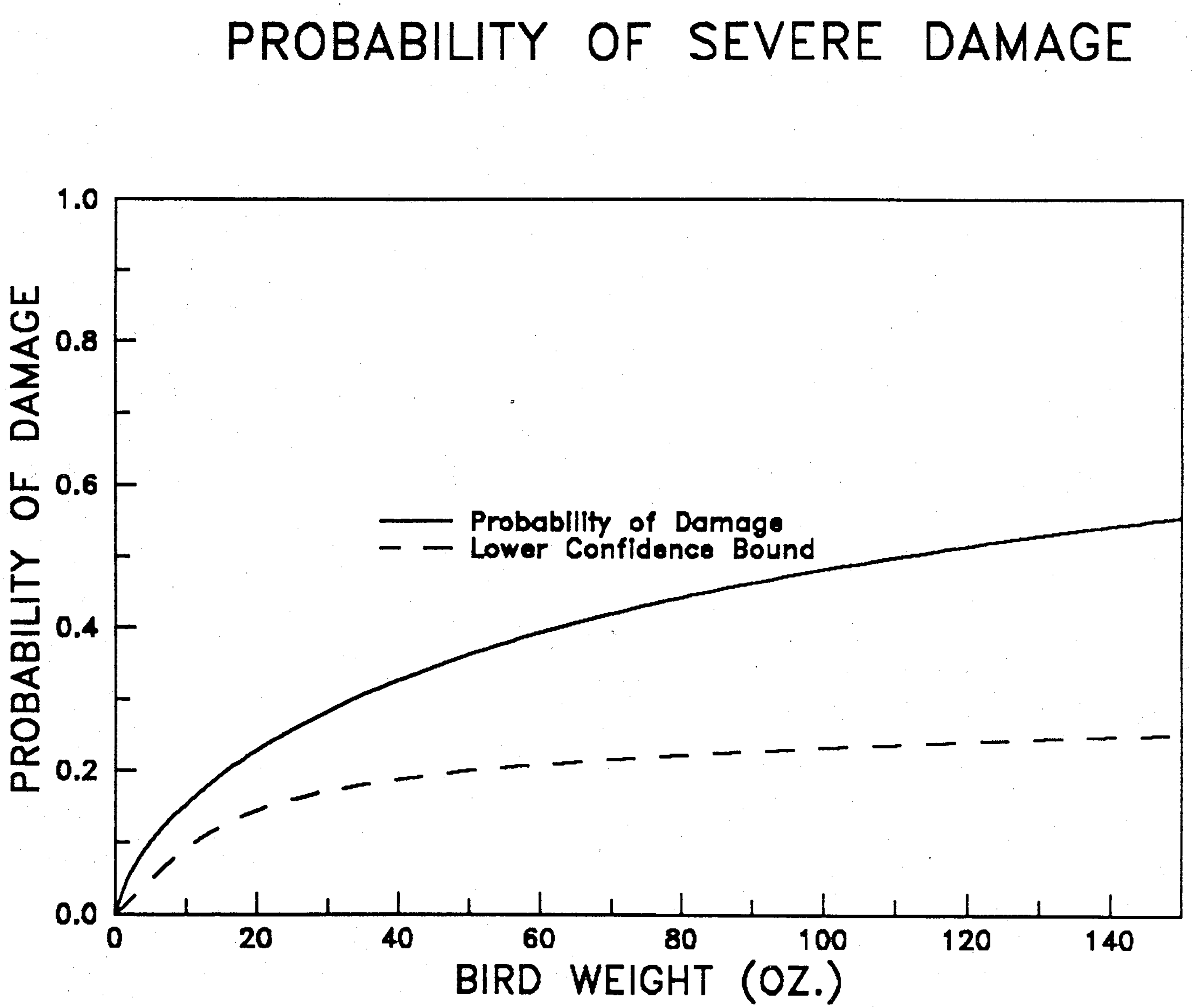

Figure 6.3 Estimated POD Function for Severe Damage with the 95 Percent Confidence Bound.

Figure 6.1 shows the probability of any damage occurring and includes all three severity levels as positive responses. The probability of any damage occurring rises very steeply, reaching 50 percent at about 4.3 ounces and the curve levels off at the 90 percent level at about 30 ounces. The relationship between bird weight and the probability of any damage is very strong and results in the confidence bound being close to the mean trend curve.

The probability of moderate damage does not rise quite so steeply, and a definitive weight cutoff between birds that cause damage and those that do not cause damage cannot be identified. The probability of moderate damage reaches 50 percent at 15 ounces and 90 percent at 95 ounces. The confidence bound shown in figure 6.2 is further from the mean trend than the confidence bound in figure 6.1 because the trend in the probability of moderate damage as a function of bird weight is not as strong as the trend in the probability of any damage.

The probability of severe damage and its confidence bound are plotted in figure 6.3 as functions of bird weight. The probability of severe damage is much lower than the probabilities of any damage or moderate damage. As a result, the curves are much flatter and rise much more slowly than the curves in figures 6.1 and 6.2. The probability of severe damage reaches 50 percent at 110 ounces and increases with bird weight; however, through the weight range collected in this study, the probability of severe damage remains below 60 percent.

The probability of damage analysis is clouded by the poor bird identification rates. The estimated POD functions are likely to be biased toward higher POD values since there was a larger proportion of birds identified when engine damage occurred. The extent of the bias cannot be estimated accurately.

6.3 CREW ACTION AND ENGINE SHUTDOWN PROBABILITIES

Two other factors that relate to the severity of engine damage are whether or not a crew action is required and whether or not an engine was shut down as a result of the ingestion. Table 6.4 lists the conditional probabilities that a crew action is required given the severity of damage that the engine incurs. The probability that a crew action is required increases with the severity of engine damage as expected. The third column of table 6.4 contains the upper 95 percent confidence bound on the conditional probabilities given in column two.

The formulae for the estimates of the conditional probability of a crew action given the engine damage severity are:

$$\hat{P} = \frac{C}{N_S} \qquad 6.2$$

$$P_{CB} = \hat{P} + 1.645\sqrt{\frac{\hat{P}\,(1-\hat{P})}{N_S}} \qquad 6.3$$

In equations 6.2 and 6.3, $\hat{P}$ is the estimated conditional probability of a crew action, C is the number of aircraft ingestion events in which a crew action was taken and an engine sustained the given severity level, N_S is the number of aircraft ingestion events in which an engine sustained the given severity level and P_{CB} is the upper confidence bound on the conditional probability. The constant 1.645 is derived from the cumulative normal distribution function to give a 95 percent level of confidence.

TABLE 6.4

CONDITIONAL PROBABILITY OF CREW ACTION
GIVEN THE ENGINE DAMAGE SEVERITY

ENGINE DAMAGE SEVERITY	PROBABILITY OF CREW ACTION P(CA)	UPPER CONFIDENCE BOUND
NO DAMAGE	.10	.13
DAMAGE	.23	.28
AT LEAST MODERATE DAMAGE	.34	.43
SEVERE DAMAGE	.54	.71

An in-flight engine shutdown occurred in 18 of the 504 aircraft ingestion events, which corresponds to an estimated probability of an in-flight engine shutdown given that an ingestion has occurred of 0.034 with a 95 percent confidence bound of 0.047. The reason for the shutdown was not known in nine of the events. An involuntary shutdown occurred five times; excessive vibration precipitated the shutdown twice; the engine was shut down because of the incorrect engine pressure ratio once and incorrect engine parameter readings once. Inferences about the causes of in-flight shutdowns cannot be drawn because of the large proportion of shutdowns in which the cause was not identified.

SECTION 7

PROBABILITY ESTIMATES

This section provides a summary of the probabilities of various bird ingestion events. The probability of an event is a measure of the likelihood that the event will occur. The probabilities in this section are calculated on a per operation basis and present similar information to the ingestion rates. The ingestion rates that were presented in Section 4 were calculated on the basis of 10,000 aircraft operations; however, it was shown in Section 4.2 that the per operation ingestion rate is equal to the probability of ingestion for a single operation. This section provides more details on the probabilities of various categories of bird ingestion events.

Table 7.1 provides the estimated probabilities and 95 percent confidence bounds for the whole B737 fleet for various aircraft ingestion events. The overall likelihood of an aircraft ingestion event in a single operation is slightly less than one in ten thousand and, although the odds of having a bird ingestion on any one operation are very small, there are millions of B737 operations each year so that hundreds of ingestions are expected each year. Most ingestions occur during the takeoff and landing phases so the probabilities for takeoff and climb and the approach and landing phases are relatively large. Dual engine and multiple bird ingestions are relatively rare, which is reflected in the smaller probabilities for these events.

The inlet area effect on the probabilities is shown in table 7.2 which separates the probabilities by location and engine. The probabilities for the CFMI CFM56 are always larger than the corresponding probabilities for the Pratt and Whitney JT8D. The larger probabilities for the CFM56 are expected since the inlet area of the CFM56 is nearly twice the inlet area of the JT8D.

The effect of bird weight on the probabilities is estimated in tables 7.3 and 7.4. The entries in tables 7.3 and 7.4 were calculated by multiplying the overall probability for each location/engine combination by the relative frequency of each bird weight range. The relative frequencies for bird weight ranges were derived from the weights of positively identified birds and are based on the number of events that involved birds in each weight range, not the total number of birds ingested. The validity of this calculation is dependent on the randomness of bird identifications, as discussed in Section 3. Table 7.3 provides a tabulation of the probability of ingestion (POI) by location and engine while table 7.4 combines the two engine types. The calculations in tables 7.3 and 7.4 were made on both an aircraft operation basis (tables 7.3A and 7.4A) and an engine operation basis (tables 7.3B and 7.4B).

TABLE 7.1 AIRCRAFT OPERATION INGESTION PROBABILITIES

CONDITION	AIRCRAFT INGESTION EVENTS	PROBABILITY OF INGESTION *
All Flights	502	8.77
Takeoff & Climb†	331	5.79
Approach & Landing†	158	2.76
Dual Engine / Single Bird Per Engine	12	0.21
Dual Engine / Multiple Birds	5	0.09
Multiple Birds / Single Engine	28	0.49
Moderate/Severe Damage	81	1.42

* Scaled by 10^5

† Contains prorated apportionment of events with unknown phase of flight

TABLE 7.2 AIRCRAFT OPERATION INGESTION PROBABILITIES* BY LOCATION AND ENGINE TYPE

	JT8D ENGINE						CFM56 ENGINE					
	UNITED STATES		FOREIGN		WORLDWIDE		UNITED STATES		FOREIGN		WORLDWIDE	
Aircraft Operations:	2,242,634		2,120,604		4,363,238		881,087		476,621		1,357,708	
Condition Under Consideration	Ing Evt	Ingestion Prob'lity	Ing Evt	Ingestion Prob'lity	Ing Evt	Ingestion Prob'lity	Ing Evt	Ingestion Prob'lity	Ing Evt	Ingestion Prob'lity	Ing Evt	Ingestion Prob'lity
All Flights	62	2.76	260	12.26	322	7.38	77	8.74	103	21.61	182†	13.41
Takeoff And Climb Phases	48	2.14	175	8.25	223	5.11	55	6.24	52	10.91	108	7.95
Approach And Landing Phases	13	5.80	81	3.82	94	2.15	18	2.04	35	7.34	64	4.71
Dual Engine - Single Bird Events	0	---	3	0.14	3	0.07	3	0.34	6	1.26	9	0.66
Multiple Birds - Single Engine Events	1	0.04	19	0.90	20	0.46	1	0.11	6	1.26	7	0.52
Multiple Birds - Dual Engine Events	2	0.09	1	0.05	3	0.07	2	0.23	0	---	2	0.15
Moderate Or Severe Damage	19	0.85	40	1.89	59	1.35	8	0.91	14	2.94	22	1.62

*Ingestion probabilities scaled by 10^5

†Geographic region and phase of flight unknown for 2 CFM56 aircraft ingestion events

TABLE 7.3A

PROBABILITY OF INGESTION* AS A FUNCTION OF BIRD WEIGHT BY LOCATION AND ENGINE TYPE
(BASED ON AIRCRAFT OPERATIONS)

	JT8D ENGINE			CFM56 ENGINE		
	US	FOREIGN	WORLDWIDE	US	FOREIGN	WORLDWIDE
Aircraft Ops:	2,242,634	2,120,604	4,363,238	881,087	476,621	1,357,708
Bird Wt Range (Oz.)	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion
(0 < X ≤ 4)	0.768	1.362	1.435	4.370	4.802	5.362
(4 < X ≤ 8)	0.614	3.406	1.845	0.546	4.802	1.609
(8 < X ≤ 12)	---	2.043	0.615	---	7.203	1.609
(12 < X ≤ 16)	0.461	2.043	1.230	1.092	2.401	1.609
(16 < X ≤ 20)	0.154	---	0.205	---	2.401	0.536
(20 < X ≤ 24)	---	---	---	0.546	---	0.536
(24 < X ≤ 28)	---	---	---	0.546	---	0.536
(28 < X ≤ 32)	---	0.681	0.205	---	---	---
(32 < X ≤ 36)	---	---	---	0.546	---	0.536
(36 < X ≤ 40)	0.307	1.362	0.820	1.092	---	1.072
⋮						
(52 < X ≤ 56)	0.307	---	0.410	---	---	---
⋮						
(76 < X ≤ 80)	---	0.681	0.205	---	---	---
⋮						
(84 < X ≤ 88)	---	0.681	0.205	---	---	---
⋮						
(124 < X ≤ 128)	0.154	---	0.205	---	---	---
(All Events)	2.765	12.261	7.380	8.739	21.610	13.405

* Probability that either engine will ingest 1 or more birds of a given weight class per aircraft operation. Probabilities have been scaled up by 10^5.

TABLE 7.3B

PROBABILITY OF INGESTION* AS A FUNCTION OF BIRD WEIGHT BY LOCATION AND ENGINE TYPE
(BASED ON ENGINE OPERATIONS)

	JT8D ENGINE			CFM56 ENGINE		
	US	FOREIGN	WORLDWIDE	US	FOREIGN	WORLDWIDE
Engine Ops:	4,485,268	4,241,208	8,726,476	1,762,174	953,242	2,715,416
Bird Wt Range (Oz.)	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion	Prob. of Ingestion
(0 < X ≤ 4)	0.357	0.622	0.658	2.585	2.079	2.941
(4 < X ≤ 8)	0.285	1.556	0.846	0.259	2.079	0.735
(8 < X ≤ 12)	---	1.556	0.470	---	5.198	1.225
(12 < X ≤ 16)	0.214	0.934	0.564	0.517	1.040	0.735
(16 < X ≤ 20)	0.214	---	0.282	---	1.040	0.245
(20 < X ≤ 24)	---	---	---	0.259	---	0.245
(24 < X ≤ 28)	---	---	---	0.259	---	0.245
(28 < X ≤ 32)	---	0.311	0.094	---	---	---
(32 < X ≤ 36)	---	---	---	0.259	---	0.245
(36 < X ≤ 40)	0.143	0.622	0.376	0.517	---	0.490
⋮						
(52 < X ≤ 56)	0.143	---	0.188	---	---	---
⋮						
(76 < X ≤ 80)	---	0.311	0.094	---	---	---
⋮						
(84 < X ≤ 88)	---	0.311	0.094	---	---	---
⋮						
(124 < X ≤ 128)	0.071	---	0.094	---	---	---
(All Events)	1.427	6.225	3.759	4.653	11.435	7.108

* Probability that an engine will ingest 1 or more birds of a given weight class per engine operation. Probabilities have been scaled up by 10^5.

TABLE 7.4A

PROBABILITY OF INGESTION* AS A FUNCTION OF BIRD WEIGHT BY LOCATION
(BASED ON AIRCRAFT OPERATIONS)

	BOEING-737 COMMERCIAL FLEET		
	UNITED STATES	FOREIGN	WORLDWIDE
Aircraft Operations:	3,123,721	2,597,225	5,720,946
Bird Weight Range (Ounces)	Probability Of Ingestion	Probability Of Ingestion	Probability Of Ingestion
(0 < X ≤ 4)	1.701	2.071	2.455
(4 < X ≤ 8)	0.654	3.623	1.733
(8 < X ≤ 12)	---	3.106	0.867
(12 < X ≤ 16)	0.654	2.071	1.300
(16 < X ≤ 20)	0.131	0.518	0.289
(20 < X ≤ 24)	0.131	---	0.144
(24 < X ≤ 28)	0.131	---	0.144
(28 < X ≤ 32)	---	0.518	0.144
(32 < X ≤ 36)	0.131	---	0.144
(36 < X ≤ 40)	0.524	1.035	0.867
⋮			
(52 < X ≤ 56)	0.262	---	0.289
⋮			
(76 < X ≤ 80)	---	0.518	0.144
⋮			
(84 < X ≤ 88)	---	0.518	0.144
⋮			
(124 < X ≤ 128)	0.131	---	0.144
(All Events)	4.450	13.976	8.810

*Probability that either engine will ingest 1 or more birds of a given weight class per aircraft operation. Probabilities have been scaled by 10^5.

TABLE 7.4B

PROBABILITY OF INGESTION* AS A FUNCTION OF BIRD WEIGHT BY LOCATION (BASED ON ENGINE OPERATIONS)

BOEING-737 COMMERCIAL FLEET

	UNITED STATES	FOREIGN	WORLDWIDE
Engine Operations:	6,247,442	5,194,450	11,441,892
Bird Weight Range (Ounces)	Probability Of Ingestion	Probability Of Ingestion	Probability Of Ingestion
(0 < X ≤ 4)	0.922	0.927	1.254
(4 < X ≤ 8)	0.307	1.621	0.792
(8 < X ≤ 12)	---	2.316	0.660
(12 < X ≤ 16)	0.307	0.927	0.594
(16 < X ≤ 20)	0.184	0.232	0.264
(20 < X ≤ 24)	0.061	---	0.066
(24 < X ≤ 28)	0.061	---	0.066
(28 < X ≤ 32)	---	0.232	0.066
(32 < X ≤ 36)	0.061	---	0.066
(36 < X ≤ 40)	0.246	0.463	0.396
⋮			
(52 < X ≤ 56)	0.123	---	0.132
⋮			
(76 < X ≤ 80)	---	0.232	0.066
⋮			
(84 < X ≤ 88)	---	0.232	0.066
⋮			
(124 < X ≤ 128)	0.061	---	0.066
(All Events)	2.337	7.181	4.554

*Probability that an engine will ingest 1 or more birds of a given weight class per engine operation. Probabilities have been scaled by 10^5.

SECTION 8

DATA QUALITY

The interpretations derived from any large set of data are only as good as the data. The use of poor data can lead to invalid and misleading conclusions. The conclusions reached in this report should be interpreted in the context of the sources of the data and the quality of the data. The following paragraphs discuss the sources of data for the first 2 years and the quality of the data as measured by the consistency of the data collected in the first and second years.

8.1 DATA SOURCES

The main body of data was collected by the manufacturers of the two engines used on B737 aircraft under separate contracts with the FAA. The method of data collection was a census rather than a survey sample; i.e., the goal was to collect information on every B737 bird ingestion event in the 2-year period. A complete census is nearly impossible to achieve under any circumstances; therefore, estimates involving the total number of ingestions, such as ingestion rates, should be viewed as lower bounds.

One specific factor that may have hindered collecting ingestion data for all B737 bird ingestion events was that the International Civil Aviation Organization (ICAO) was also collecting bird ingestion data. Data from sources other than the engine manufacturers are also available for part of the 2-year period and have been included in the data listing in appendix B. The other sources include ICAO, the FAA Voluntary Bird Strike/Incident Report (FAA Form 5200-7), and reports received from FAA Field Inspectors (see FAA Action Notice A8300.39) and the FAA Service Difficulty Report (SDR). These data were not used in the analysis.

One method of improving the collection percentage for the B737 bird ingestion data is to include the data collected by the ICAO and the other sources; however, two problems prevent including the data at this time. The first problem is the collection and reporting cycles of the FAA and the ICAO are not synchronous; therefore, data from the ICAO are not yet available for the full 2-year period. The second problem is that the manner in which bird ingestion reports for individual events were prepared may differ from the way the engine manufacturers collected bird ingestion event information. The differences could affect interpretations made from the combined data sets.

At some future date, when complete data are available from all sources and potential conflicts in data collection procedures have been analyzed, all the sources of data could be combined to provide a more complete description of B737 bird ingestions. The descriptions in this report are based only on the data collected by the engine manufacturers for the FAA.

8.2 INTERNAL CONSISTENCY

The data collected over the second year of the program appear to be consistent with the data collected in the first year. Most of the tables, graphs, and statistical tests presented in this report for the 2-year period are very similar to the corresponding data presented in the report [9] for the data collected in the first year. This section provides statistical verification of the similarities and discusses some of the differences.

The first feature for comparing the 2 years is the total number of aircraft ingestion events collected in each year. Section 4 provided evidence that aircraft ingestion events occur according to a Poisson process so that the same Z test used to study the size effect on ingestion rates can be used to compare the yearly ingestion rates. According to the properties of a Poisson process, the proportion of events that were recorded in the first year should be equal to the proportion of operations conducted in the first year.

The same formulas used in Section 4 can be used here except that the area factor is no longer required since comparisons are made between years for the same engine. The formula for the expected proportion of events in the first year becomes:

$$P = O1 / (O1 + O2) \qquad 8.1$$

where O1 and O2 represent the number of operations for the specific engine and geographic location for the first and second years, respectively. The proportion of aircraft ingestion events in the first year is used as $\hat{P}$ in equation 4.6 along with P as defined in equation 8.1 to test the null hypothesis that the ingestion event collection rates were the same for both years.

The data for performing the test are presented in table 8.1 and table 8.2. The number of events and number of operations for each year are broken down by engine type and geographic location in table 8.1. The calculated Z values for the test are given in Table 8.2 for each engine and location combination. Any type of change, either an increase or a decrease, is important so that a two-sided test (with critical values of ± 1.96 for a 5 percent level of significance) should be used. The only significant change is in the collection rate for foreign JT8D data.

The large positive value of the test statistic for foreign JT8D ingestion rates indicates a reduction in the amount of data collected. One possible explanation is that the efforts of the ICAO to collect bird ingestion data may have hindered the collection of data for the JT8D. The outside agency has not yet published their data for the entire second year however, so there is insufficient data to test for a corresponding increase in their foreign JT8D collection rates.

The change in collection rates for the JT8D could affect the test for size effect that was described in Section 4. In the first year report [9] both area and diameter provided adequate adjustments for the differences in ingestion rates between the two engines. In this report, area provides an adequate adjustment but diameter does not. It is possible that there were insufficient data in the first report to rule out using the diameter adjustment or that the change in collection rates for foreign JT8D operations has affected the results of the size effect test. The test of a relationship between diameter and ingestion rate should be considered inconclusive since there is confusion about the reason for the result.

Another check on the consistency of the data collection is to compare the birds that were identified in the 2 years. There were too many different species and locations of ingestions to allow comparisons of these features; however, if the species identifications are reduced to bird weights, the cumulative weight distributions for the first and second years can be compared.

TABLE 8.1

COUNTS FOR UNITED STATES AND FOREIGN
EVENTS AND OPERATIONS BY YEAR AND ENGINE

		YEAR 1		YEAR 2	
		EVENTS	OPERATIONS	EVENTS	OPERATIONS
JT8D	UNITED STATES	27	1160091	35	1082543
	FOREIGN	160	1057633	100	1062971
CFM56	UNITED STATES	39	353656	38	527431
	FOREIGN	43	174206	60	302415

TABLE 8.2

COMPARISONS OF THE COLLECTION RATES OF THE FIRST AND SECOND YEARS
USING Z TESTS FOR POISSON PROCESSES

	UNITED STATES	FOREIGN
JT8D	-1.29	3.76
CFM56	1.88	1.10

Table 8.3 provides a table of the cumulative weight distributions for both the first and second years for birds ingested in the United States and for birds ingested in foreign countries. The data in table 8.3 are plotted in figures 8.1 and 8.2 to provide visual comparisons of the first and second-year bird weight distributions for United States and foreign ingested birds. The distributions for the United States ingestions are moderately close and the distributions for the foreign ingestions are very close.

A statistical measure of the closeness of the cumulative distributions plotted in figures 8.1 and 8.2 is provide by the Kolmogorov-Smirnov D test. The D statistic is the maximum vertical distance between two observed cumulative distribution functions. The D statistic is compared to a test value based on the sizes of the two samples. When the D statistic is smaller than the test value, the distributions are considered to be similar at a given significance level.

The maximum difference in both figure 8.1 and figure 8.2 occurs at 4 ounces. The maximum differences in cumulative probability, or the D statistics, are 0.24 and 0.20 for the United States and foreign bird weight distributions, respectively. For the sample sizes in this study, the D statistics should be below 0.42 and 0.45 for the United States and foreign distributions, respectively, when there is no change in the bird weight distributions between the 2 years. Both the United States and foreign test statistics are well within the acceptance range indicating consistent bird weights over the 2 years.

The overall quality of the data collected for the FAA seems to be adequate. There is some confusion about the influence of the efforts of other agencies to collect bird ingestion data on the completeness of the FAA data. A better set of bird ingestion data might be created by combining data from different sources; however, the compatibility of the sources should be verified before analyzing the combined set of data.

TABLE 8.3

COMPARISON OF WEIGHT DISTRIBUTIONS BETWEEN BIRDS INGESTED IN THE FIRST AND SECOND YEARS

CUMULATIVE RELATIVE FREQUENCY

WEIGHT (OZ)	UNITED STATES		FOREIGN	
	YEAR 1	YEAR 2	YEAR 1	YEAR 2
4	0.32	0.56	0.25	0.05
8	0.44	0.67	0.42	0.32
12	0.44	0.67	0.67	0.84
16	0.72	0.78	0.92	0.86
20	0.76	0.78	0.92	0.89
24	0.76	0.83	0.92	0.89
28	0.76	0.89	0.92	0.89
32	0.76	0.89	0.92	0.92
36	0.76	0.94	0.92	0.92
40	0.88	1.00	1.00	0.95
56	0.96	1.00	1.00	0.95
80	0.96	1.00	1.00	0.97
88	0.96	1.00	1.00	1.00
128	1.00	1.00	1.00	1.00

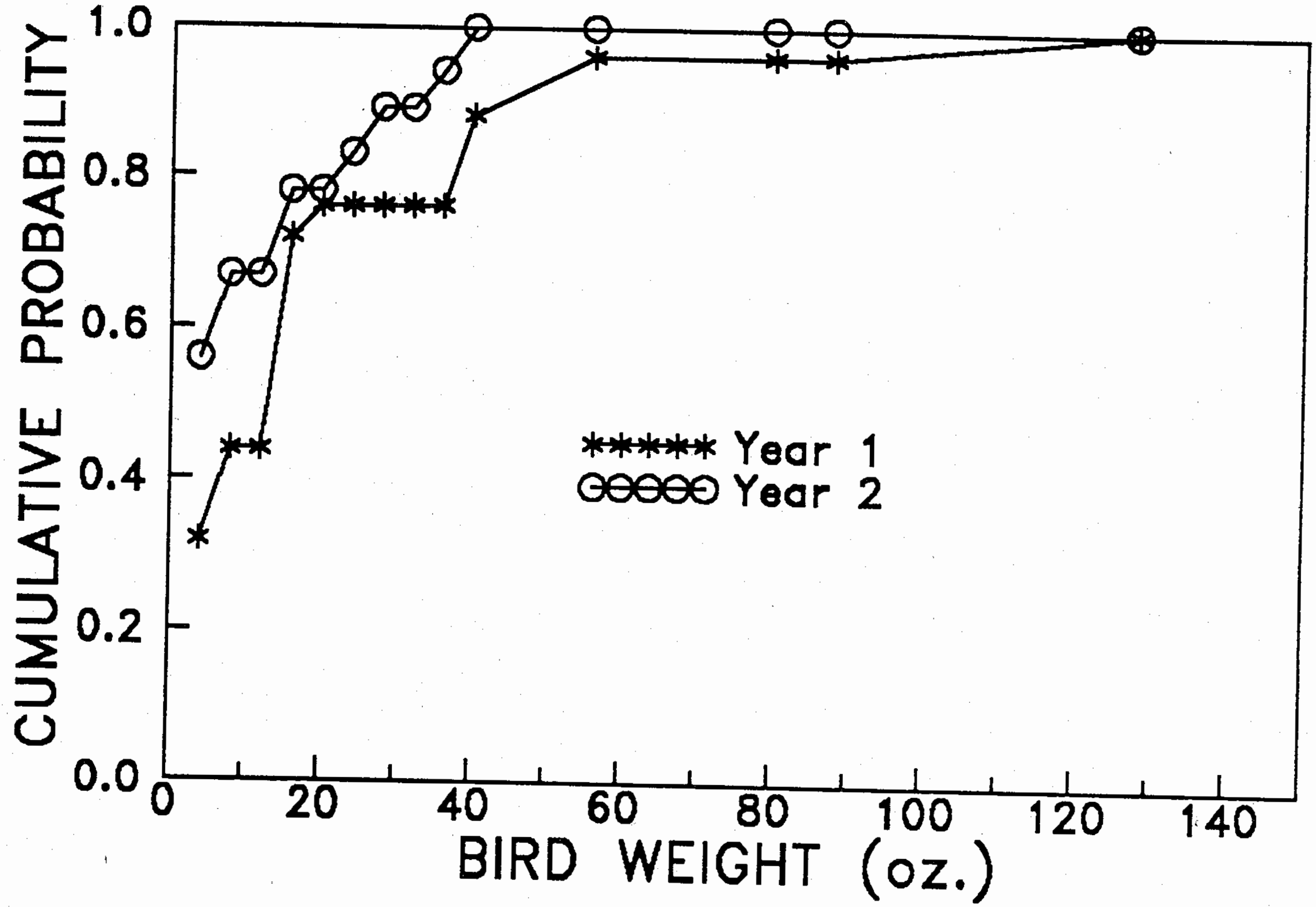

Figure 8.1 Comparison of the U.S. Bird Weight Distributions for the First and Second Years.

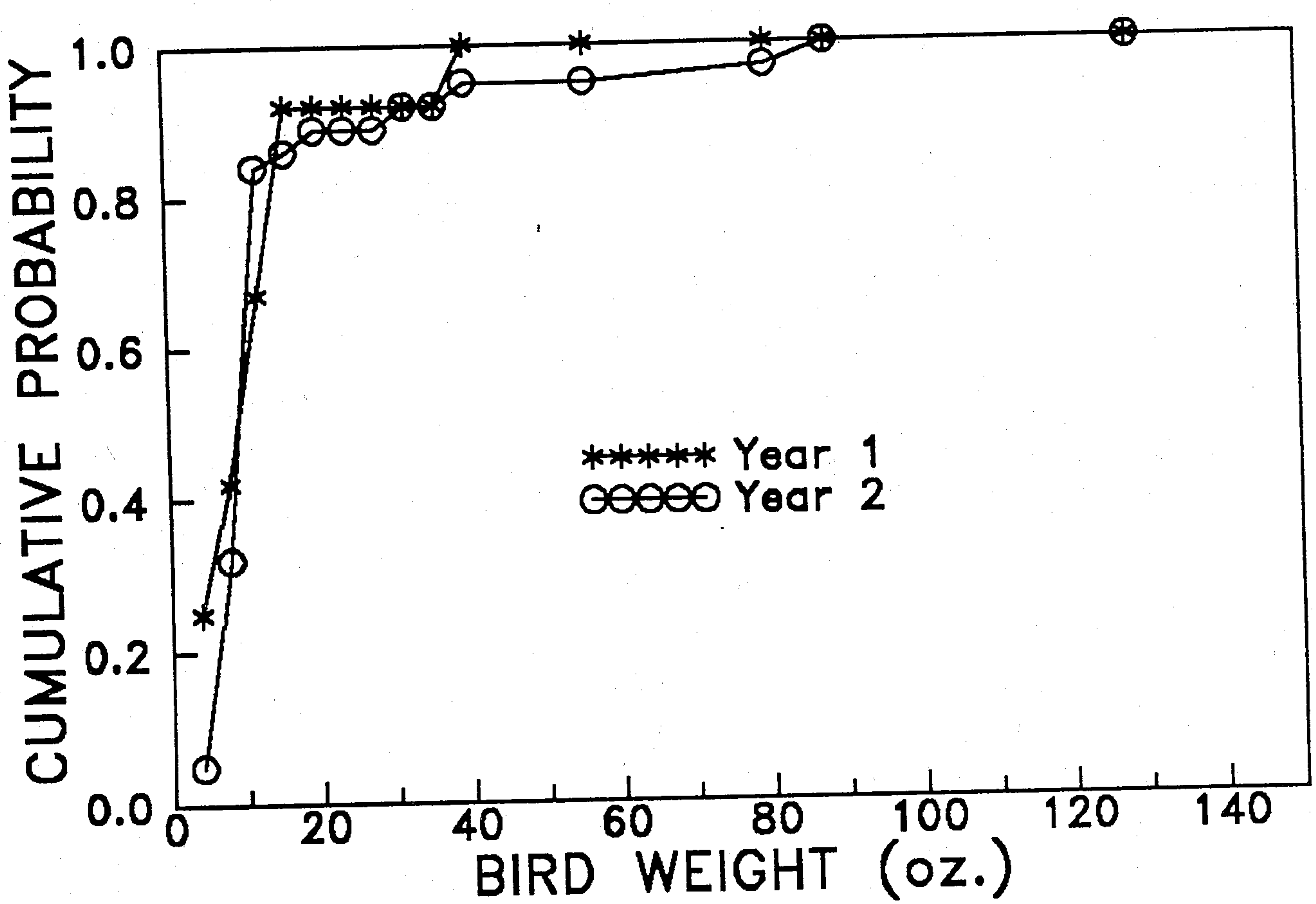

Figure 8.2 Comparison of the Foreign Bird Weight Distributions for the First and Second Years.

SECTION 9

CONCLUSIONS

The main goal of this bird ingestion investigation is to provide data to better define the nature and extent of the bird ingestion threat. The job of collecting information on bird ingestions is extremely difficult because of the large number of organizations that must cooperate to collect complete and accurate bird ingestion data. The sparsity of information that was collected makes it very difficult to draw strong inferences about the nature of the bird ingestion threat. This section summarizes conclusions from the first 2 years of data for the B737 aircraft.

Bird Descriptions

Gulls, doves, and lapwings are most often ingested.

There is a better identification rate when the engine is damaged.

Ingestions are seasonal and less likely at night.

Ingestion Rates

Ingestion events can be modeled as a Poisson process.

It appears that ingestion rates are proportional to the inlet area of the engine (i.e., there is no statistically significant difference between the ingestion rates of the JT8D and the CFM56 after adjusting for inlet area).

Airport Experiences

More bird ingestions were reported at foreign airports than at United States airports, and the ingestion rates for foreign operations were higher than for United States operations.

The 33 airports that reported three or more ingestions represented 13 percent of the airports that experienced ingestions and accounted for 26 percent of all ingestion events.

Engine Damage

Some types of engine damage are correlated with other types of damage.

There is some evidence that the probability of any damage increases with the weight of the bird that is ingested; however, there is insufficient data to establish a weight relationship to severe damage.

Unusual crew actions are more likely when more severe damage is inflicted on an engine.

Required in-flight engine shutdowns occur in less than 4 percent of all ingestion events.

Probabilities of Ingestion

Bird ingestions are more likely during the takeoff and landing phases of an aircraft operation.

SECTION 10

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SECTION II

GLOSSARY

Term	Definition of Term
Engine Ingestion Event	Process whereby one or more birds pass through the engine inlet during engine operation.
Ingested Bird	A bird having experienced the process of engine ingestion event.
Aircraft Ingestion Event	Simultaneous ingestion of one or more birds into one or more engines of an aircraft.
Airport Operation	Takeoff (departure) from an airport or a landing (arrival) at an airport.
Aircraft Operation	A nonstop aircraft flight from one airport to another. (Includes time from taxi-out from departure airport through taxi-in at arrival airport.)
Engine Operation	The participation of each engine of an aircraft in an aircraft operation (e.g., a twin engine aircraft would, ideally, experience two engine operations for each aircraft operation).
Ingestion Rate	The number of aircraft or engine ingestion events per flight event. Flight event refers to aircraft, engine or airport operation. The components of ingestion rate are specified when used in the report. The influence of engine inlet area is not considered.
Normalized Ingestion Rate	Ingestion rate adjusted to a given nominal area. Allows statistical comparison of ingestion rates of engines with different inlet areas.

APPENDIX A

AIRPORTS WITH SCHEDULED BOEING-737 FLIGHTS
AND/OR REPORTED BIRD INGESTION EVENTS

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
AAE	ANNABA, ALGERIA	N	FGN	2393	2237
AAY	AL GHAYDAH, YEMEN	N	FGN	210	314
ABE	ALLENTOWN, PA, USA	N	YES	370	1573
ABJ	ABIDJAN, COTE D'IVORE (IVORY COAST)	N	FGN	1620	1806
ABQ	ALBUQUERQUE, NM, USA	N	YES	41942	43562
ABS	ABU SIMBEL, ARAB REP OF EGYPT	N	FGN	3366	5028
ABT	AL BAHA, SAUDI ARABIA	N	FGN	1148	642
ABV	ABUJA, NIGERIA	N	FGN	1240	1178
ABZ	ABERDEEN, SCOTLAND	N	FGN	1519	1636
ACA	ACAPULCO, MEXICO	N	FGN	126	322
ACC	ACCRA, GHANA	N	FGN	486	0
ACE	LANZAROTE, CANARY ISLANDS	N	FGN	76	688
ACK	NANTUCKET, MA, USA	N	YES	0	7
ACV	EUREKA ARCATA, CA, USA	N	YES	2616	739
ADB	IZMIR, TURKEY	N	FGN	0	236
ADD	ADDIS ABABA, ETHIOPIA	N	FGN	148	1538
ADE	ADEN, YEMEN	N	FGN	1346	1022
ADK	ADAK ISLAND, AS, USA	N	NO	0	16
ADL	ADELAIDE, SA, AUSTRALIA	S	FGN	4738	5568
ADQ	KODIAK, AS, US	N	NO	2290	2500
ADZ	SAN ANDRES ISLAND, COLOMBIA	N	FGN	526	624
AEP	BUENOS AIRES - NEWBERY, ARGENTINA	S	FGN	23291	22170
AES	AALESUND, NORWAY	N	FGN	8988	8364
AGA	AGADOR, MOROCCO	N	FGN	601	684
AGP	MALAGA, SPAIN	N	FGN	2434	3226
AGR	AGRA, INDIA	N	FGN	1980	2074
AGS	AUGUSTA, GA, USA	N	YES	1579	1881
AHB	ABHA, SAUDI ARABIA	N	FGN	2026	5425
AHU	AL HOCEIMA, MOROCCO	N	FGN	292	338
AJA	AJACCIO, CORSICA, FRANCE	N	FGN	59	87
AJF	JOUF, SAUDI ARABIA	N	FGN	1128	1258
AJU	ARACAJU, BRAZIL	S	FGN	1460	2592
AKL	AUCKLAND, NEW ZEALAND	S	FGN	16985	26503
AKN	KING SALMON, AS, US	N	NO	1444	1832
AKR	AKURE, NIGERIA	N	FGN	238	354
ALB	ALBANY, NY, USA	N	YES	4461	6510
ALC	ALICANTE, SPAIN	N	FGN	148	1070
ALG	ALGIERS, ALGERIA	N	FGN	14258	13443
ALY	ALEXANDRIA, ARA REP OF EGYPT	N	FGN	2104	1507
AMA	AMARILLO, TX, USA	N	YES	12811	11122
AMD	AHMEDABAD, INDIA	N	FGN	5932	6180
AMM	AMMAN, JORDAN	N	FGN	2131	1859
AMS	AMSTERDAM, NETHERLANDS	N	FGN	19047	29304
ANC	ANCHORAGE, AS, US	N	NO	18977	17295
ANF	ANTOFAGASTA, CHILE	S	FGN	1434	1635
ANI	ANIAK, AS, US	N	NO	460	714
ANR	ANTWERP, BELGIUM	N	FGN	540	0
ANU	ANTIGUA, WEST INDIES	N	FGN	18	0
AOR	ALOR SETAR, MALAYSIA	N	FGN	1886	1884
APL	NAMPULA, MOZAMBIQUE	S	FGN	1144	1156
APW	APIA, WESTERN SAMOA	S	FGN	858	264
AQI	QAISUMAH, SAUDI ARABIA	N	FGN	494	552
ARD	ALOR, INDONESIA	N	FGN	0	0
ARI	ARICA, CHILE	S	FGN	970	1308
ARN	STOCKHOLM ARLANDA, SWEDEN	N	FGN	7556	8439
ASM	ASMARA, ETHIOPIA	N	FGN	0	769
ASP	ALICE SPRINGS, N.T., AUSTRALIA	S	FGN	1816	3728
ASU	ASUNCION, PARAGUAY	S	FGN	498	234
ASW	ASWAN, ARAB REP OF EGYPT	N	FGN	4968	7042
ATH	ATHENS, GREECE	N	FGN	24758	25267
ATL	ATLANTA, GA, USA	N	YES	42143	43773
ATM	ALTAMIRA, BRAZIL	S	FGN	416	420
ATQ	AMRITSAR, INDIA	N	FGN	1846	1838
AUA	ARUBA, ARUBA	N	FGN	50	9
AUH	ABU DHABI, U. A. EMIRATES	N	FGN	4023	4381
AUS	AUSTIN, TX, USA	N	YES	33326	31454
AUX	ARAGUAINA, BRAZIL	S	FGN	244	420
AVL	ASHEVILLE, NC, USA	N	YES	1298	1594
AVP	WILKES-BARRE/SCRANTON, PA, USA	N	YES	114	555
AXD	ALEXANDROUPOLIS, GREECE	N	FGN	908	1028
AXT	AKITA, JAPAN	N	FGN	591	609
AYT	ANTALYA, TURKEY	N	FGN	52	62
AZD	YAZD, ISLAMIC REP OF IRAN	N	FGN	0	522
AZO	KALAMAZOO, MI, USA	N	YES	2800	2802
AZR	ADRAR, ALGERIA	N	FGN	818	718

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
BAH	BAHRAIN, BAHRAIN	N	FGN	11933	10623
BAQ	BARRANQUILLA, COLOMBIA	N	FGN	105	104
BBI	BHUBANESWAR, INDIA	N	FGN	2086	2160
BCN	BARCELONA, SPAIN	N	FGN	4166	4707
BDH	BANDAR LENGEH, IRAN	N	FGN	1460	1464
BDL	HARTFORD, CN, USA	N	YES	15001	14757
BDQ	VADODARA, INDIA	N	FGN	1925	1866
BDT	BADO LITE, ZAIRE	N	FGN	208	278
BEG	BELGRADE, YUGOSLAVIA	N	FGN	10759	13303
BEL	BELEM, BRAZIL	S	FGN	5505	9161
BEN	BENGHAZI, LIBYAN A JAMAHIRIYA	N	FGN	0	62
BET	BETHEL, AS, US	N	NO	3190	3238
BEW	BEIRA, MOZAMBIQUE	S	FGN	1304	1112
BFL	BAKESFIELD, CA, USA	N	YES	2742	1037
BFN	BLOEMFONTEIN, SOUTH AFRICA	S	FGN	3954	4710
BFS	BELFAST, N. IRELAND	N	FGN	1570	2915
BFX	BAFOUSSAM, CAMEROON	N	FGN	0	14
BGF	BANGUI, CEN. AFRICAN REPUBLIC	N	FGN	272	340
BGI	BARBADOS, BARBADOS	N	FGN	52	52
BGM	BINGHAMTOM, NY, USA	N	YES	0	130
BGO	BERGEN, NORWAY	N	FGN	12038	14288
BGW	BAGHDAD, IRAQ	N	FGN	0	31
BHH	BISHA, SAUDI ARABIA	N	FGN	1740	1779
BHI	BAHIA BLANCA, ARGENTINA	S	FGN	2162	2412
BHJ	BHUJ, INDIA	N	FGN	730	732
BHM	BIRMINGHAM, AL, USA	N	YES	6048	11193
BHO	BHOPAL, INDIA	N	FGN	1828	2462
BHU	BHAVNAGAR, INDIA	N	FGN	730	732
BHX	BIRMINGHAM, ENGLAND (UK)	N	FGN	2307	2630
BIA	BASTIA, CORSICA, FRANCE	N	FGN	234	300
BIL	BILLINGS, MT, USA	N	YES	7285	4583
BIO	BILBAO, SPAIN	N	FGN	622	628
BIQ	BIARRITZ, FRANCE	N	FGN	52	52
BIS	BISMARCK, ND, USA	N	YES	3396	3760
BJL	BANJUL, GAMBIA	N	FGN	472	420
BJM	BUJUMBURA, BURUNDI	S	FGN	245	245
BJR	BAHAR DAR, ETHIOPIA	N	FGN	0	572
BKI	KOTA KINABALU, SABAH, MALAYSIA	N	FGN	8699	9134
BKK	BANGKOK, THAILAND	N	FGN	7329	7596
BKO	BAMAKO, MALI	N	FGN	50	54
BKY	BUKAVU, ZAIRE	S	FGN	104	106
BLI	BELLINGHAM, WA, USA	N	YES	0	2
BLL	BILLUND, DENMARK	N	FGN	2177	2178
BLQ	BOLOGNA, ITALY	N	FGN	310	374
BLR	BANGALORE, INDIA	N	FGN	5886	8160
BNA	NASHVILLE, TN, USA	N	YES	17920	22380
BND	BANDAR ABBAS, IRAN	N	FGN	1460	1922
BNE	BRISBANE, QLD, AUSTRALIA	S	FGN	12830	15610
BNI	BENIN CITY, NIGERIA	N	FGN	2127	1875
BNJ	BONN, FRG	N	FGN	0	0
BOD	BORDEAUX, FRANCE	N	FGN	688	790
BOI	BOISE, ID, USA	N	YES	5399	5655
BOM	BOMBAY, INDIA	N	FGN	16848	15854
BOO	BODO, NORWAY	N	FGN	2868	3254
BOS	BOSTON, MA, USA	N	YES	30820	34903
BRC	SAN CARLOS DE BARILOCHE, ARGENTINA	S	FGN	1663	1656
BRE	BREMEN, FED REP OF GERMANY	N	FGN	4526	5729
BRS	BRISTOL, ENGLAND (UK)	N	FGN	2	0
BRU	BRUSSELS, BELGIUM	N	FGN	31942	32748
BRW	BARROW, AS, US	N	NO	1897	1960
BSB	BRASILIA, BRAZIL	S	FGN	22788	30251
BSL	BASEL/MULHOUSE, SWITZERLAND	N	FGN	554	538
BTM	BUTTE, MT, USA	N	YES	1460	1464
BTR	BATON ROUGE, LA, USA	N	YES	2944	2065
BTV	BURLINGTON, VT, USA	N	YES	2544	2678
BUD	BUDAPEST, HUNGARY	N	FGN	1660	1468
BUF	BUFFALO, NY, USA	N	YES	17704	16940
BUQ	BULAWAYO, ZIMBABWE	S	FGN	1834	2870
BUR	BURBANK, CA, USA	N	YES	11187	14262
BUX	BUNA, ZAIRE	N	FGN	210	208
BUZ	BUSHEHR, IRAN	N	FGN	88	24
BVB	BOA VISTA, BRAZIL	N	FGN	1314	1426
BVH	VITHENA, BRAZIL	S	FGN	0	62
BWI	BALTIMORE, MD, USA	N	YES	54435	60614
BWN	BASERI BEGAWAN, BRUNEI DARUSSALAM	N	FGN	2951	2782

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
BXO	BISSAU, GUINEA BISSAU	N	FGN	20	80
BZE	BELIZE CITY, BELIZE	N	FGN	3647	4416
BZN	BOZEMAN, MT, USA	N	YES	5200	4588
BZV	BRAZZAVILE, PEOP REP OF CONGO	S	FGN	1406	1321
CAB	CABINDA, ANGOLA	S	FGN	1042	966
CAE	COLUMBIA, SC, USA	N	YES	8213	8051
CAG	CAGLIARI, ITALY	N	FGN	0	0
CAI	CAIRO, ARAB REP OF EGYPT	N	FGN	8057	8970
CAK	AKRON/CANTON, OH, USA	N	YES	2241	2582
CAN	GUANGZHOU, P. R. CHINA	N	FGN	13955	16177
CAS	CASABLANCA, MOROCCO	N	FGN	0	8
CAY	CAYENNE, FRENCH GUIANA	N	FGN	208	367
CBD	CAR NICOBAR, INDIA	N	FGN	40	106
CBH	BECHAR, ALGERIA	N	FGN	1455	1258
CBQ	CALABAR, NIGERIA	N	FGN	1935	1783
CBR	CANBERRA, A.C.T, AUTSTRALIA	S	FGN	5600	5064
CCJ	CALICUT, INDIA	N	FGN	0	174
CCP	CONCEPCION, CHILE	S	FGN	1184	1484
CCS	CARACAS, VENEZUELA	N	FGN	0	52
CCU	CALCUTTA, INDIA	N	FGN	10798	11583
CDG	PARIS DE GAULLE, FRANCE	N	FGN	25514	28834
CDV	CORDOVA, AS, US	N	NO	1514	1516
CEO	WACO KUNGO, ANGOLA	S	FGN	10	4
CFU	CORFU, GREECE	N	FGN	746	1152
CGB	CUIABA MATO GROSSO, BRAZIL	S	FGN	9184	8652
CGH	SAO PAULO-CONGONHAS, BRAZIL	S	FGN	1082	2410
CGK	JAKARTA-SOEKARNO, INDONESIA	S	FGN	626	630
CGN	COLOGNE BONN, FRG	N	FGN	18161	19445
CGO	ZHENGZHOU, P. R. CHINA	N	FGN	208	394
CGQ	CHANGCHUN, P. R. CHINA	N	FGN	62	70
CGR	CAMPO GRANDE, BRAZIL	S	FGN	6770	7800
CHA	CHATTANOOGA, TN, USA	N	YES	1618	1704
CHC	CHRISTCHURCH, NEW ZEALAND	S	FGN	17095	24202
CHO	CHARLOTTESVILLE, VA, USA	N	YES	1814	808
CHQ	CHANIA, CRETE, GREECE	N	FGN	856	793
CHS	CHARLESTON, SC, USA	N	YES	7219	8528
CID	CEDAR RAPIDS/IOWA CITY, IO, USA	N	YES	3800	2995
CIX	CHICLAYO, PERU	S	FGN	286	450
CJB	COIMBATORE, INDIA	N	FGN	1528	1674
CJC	CALAMA, CHILE	S	FGN	626	420
CKG	CHONGQING, P. R. CHINA	N	FGN	714	787
CKS	CARAJAS, BRAZIL	S	FGN	417	417
CKY	CONAKRY, GUINEA	N	FGN	550	707
CLE	CLEVELAND, OH, USA	N	YES	24028	40166
CLT	CHARLOTTE, NC, USA	N	YES	95251	113302
CLV	CALDAS NOVAS, BRAZIL	S	FGN	0	0
CMB	COLOMBO, SRI LANKA	N	FGN	3021	3078
CMG	CORUMBA, MATO GROSSO, BRAZIL	S	FGN	1460	1464
CMH	COLUMBUS, OH, USA	N	YES	8004	9329
CMI	CHAMPAIGN, IL, USA	N	YES	2186	2195
CMN	MOHAMEDV, CASABLANCA, MOROCCO	N	FGN	4767	6241
CNF	BELO HORIZONTE-CONFINS, BRAZIL	S	FGN	19683	19554
CNQ	CORRIENTES, ARGENTINA	S	FGN	1100	544
CNS	CAIRNS, QLD, AUSTRALIA	S	FGN	4850	6049
CNX	CHIANG MAI, THAILAND	N	FGN	728	435
COK	COCHIN, INDIA	N	FGN	5457	4646
COO	COTONOU, BENIN	N	FGN	1120	1038
COR	CORDOBA, ARGENTINA	S	FGN	6772	6194
COS	COLORADO SPRINGS, CO, USA	N	YES	8004	8313
CPH	COPENHAGEN, DENMARK	N	FGN	11419	14184
CPO	CUPIATO, CHILE	S	FGN	0	320
CPQ	CAMPINAS, BRAZIL	S	FGN	1056	1207
CPR	CASPER, WY, USA	N	YES	4230	2902
CPT	CAPE TOWN, SOUTH AFRICA	S	FGN	8545	10490
CPV	CAMPINA GRANDE, BRAZIL	S	FGN	626	628
CRD	COMODORO RIVADAVIA, ARGENTINA	S	FGN	2553	2041
CRP	CORPUS CHRISTI, TX, USA	N	YES	5584	5292
CRW	CHARLESTON, WV, USA	N	YES	4478	5070
CTA	CATANIA, ITALY	N	FGN	252	665
CTC	CATAMARCA, ARGENTINA	S	FGN	778	782
CTG	CARTAGENA, COLOMBIA	N	FGN	105	104
CTS	SAPPORO-CHITOSE, JAPAN	N	FGN	1398	2908
CTU	CHENGDU, P.R. CHINA	N	FGN	2138	1728
CUN	CANCUN, MEXICO	N	FGN	634	1212
CUR	CURACAO, NETH ANTILLES	N	FGN	20	0

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
CUT	CUTRAL-CO, ARGENTINA	S	FGN	0	18
CVG	CINCINNATI, OH, USA	N	YES	14496	18777
CWB	CURITIBA, PARANA, BRAZIL	S	FGN	6532	8720
CWL	CARDIFF, WALES, UK	N	FGN	0	0
CXI	CHRISTMAS ISLAND, REP OF KIRIBATI	N	FGN	106	104
CYI	CHIAYI, TAIWAN	N	FGN	730	732
CZL	CONSTANTINE, ALGERIA	N	FGN	3352	3129
CZS	CRUZEIRO DO SUL, ACRE, BRAZIL	S	FGN	344	436
CZX	CHANGZHOU, P. R. CHINA	N	FGN	208	227
DAB	DAYTONA BEACH, FL, USA	N	YES	3532	4032
DAC	DHAKA, BANGLADESH	N	FGN	934	734
DAL	LOVE DALLS/FT. WORTH, TX, USA	N	YES	75124	76295
DAM	DAMASCUS, SYRIA	N	FGN	523	883
DAR	DAR ES SALAAM, TANZANIA	S	FGN	3407	2968
DAY	DAYTON, OH, USA	N	YES	37652	43020
DBV	DUBROVNIK, YUGOSLAVIA	N	FGN	1806	2366
DCA	NATIONAL, WASHINGTON, DC, USA	N	YES	22108	26412
DEC	DECATUR, IL, USA	N	YES	0	0
DEL	DELHI, INDIA	N	FGN	15987	16401
DEN	STAPLETON INT'L, DENVER, CO, USA	N	YES	112673	113634
DET	DETROIT CITY, MI, USA	N	YES	0	2064
DEU	SOMEWHERE OVER GERMANY	N	FGN	0	0
DFW	DALLAS/FT WORTH, TX, USA	N	YES	51130	48254
DHA	DHAHRAN, SAUDI ARABIA	N	FGN	7902	6474
DIB	DIBRUGARH, INDIA	N	FGN	816	864
DIE	ANTSIRANANA, MADAGASCAR	S	FGN	610	610
DIR	DIRE DAWA, ETHIOPIA	N	FGN	38	628
DJE	DJERBA, TUNISIA	N	FGN	547	267
DJG	DJANET, ALGERIA	N	FGN	466	532
DKR	DAKAR, SENEGAL	N	FGN	467	580
DLA	DOUALA, REP OF CAMEROON	N	FGN	5262	4691
DLC	DALIAN, P. R. CHINA	N	FGN	0	44
DLG	DILLINGHAM, AS,US	N	NO	1444	1622
DOD	DODOMA, TANZANIA	S	FGN	16	0
DOH	DOHA, QATAR	N	FGN	8859	9310
DPS	DENPASAR, INDONESIA	S	FGN	104	104
DRO	DURANGO, CO, USA	N	YES	2233	1462
DRW	DARWIN, N.T., AUSTRALIA	S	FGN	1107	2092
DSM	DES MOINES, IO, USA	N	YES	7748	9329
DTW	WAYNE CO, DETROIT, MI, USA	N	YES	16765	24028
DUB	DUBLIN, REPUBLIC OF IRELAND	N	FGN	19308	23823
DUD	DUNEDIN, NEW ZEALAND	S	FGN	4145	4379
DUR	DURBAN, SOUTH AFRICA	S	FGN	6925	7739
DUS	DUESSELDORF, FRG	N	FGN	30119	32964
DUT	DUTCH HARBOR, AS, US	N	NO	828	1116
DXB	DUBAI, U. A. EMIRATES	N	FGN	3134	2234
EAM	NEJRAN, SAUDI ARABIA	N	FGN	2392	2412
EBB	ENTEBBE KAMPALA, UGANDA	N	FGN	39	167
EBD	EL OBEID, SUDAN	N	FGN	632	968
EBJ	ESBJERG, DENMARK	N	FGN	482	284
EDI	EDINBURGH, SCOTLAND	N	FGN	1040	1988
EFL	KEFALONIA, GREECE	N	FGN	780	786
EJH	WEDJH, SAUDI ARABIA	N	FGN	784	736
ELF	EL FASHER, SUDAN	N	FGN	0	8
ELG	EL GOLEA, ALGERIA	N	FGN	416	416
ELM	ELMIRA, NY, USA	N	YES	0	260
ELP	EL PASO, TX, USA	N	YES	38902	39117
ELQ	GASSIM, SAUDI ARABIA	N	FGN	4652	4072
ELS	EAST LONDON, SOUTH AFRICA	S	FGN	9987	11104
ELU	EL OUED, ALGERIA	N	FGN	288	312
EMA	EAST MIDLANDS, ENGLAND	N	FGN	291	269
ENU	ENUGU, NIGERIA	N	FGN	3138	2980
EQS	ESQUEL, ARGENTINA	S	FGN	1116	1066
ERI	ERIE, PA, USA	N	YES	1772	1618
ESB	ANKARA-ESENBOGA, TURKEY	N	FGN	0	695
ESR	EL SALVADOR, CHILE	S	FGN	836	772
ETH	ELAT, ISRAEL	N	FGN	4	14
EUG	EUGENE, OR, USA	N	YES	3493	2908
EUN	LAAYOUNE, MOROCCO	N	FGN	244	503
EVE	EVENES, NORWAY	N	FGN	1520	1874
EVV	EVANSVILLE, IN, USA	N	YES	2468	2519
EWR	NEWARK, NEW YORK, NY, USA	N	YES	78323	85323
EZE	BUENOS AIRES-EZEIZA ARPT, ARGENTINA	S	FGN	424	838
FAE	FAROE ISLANDS, DENMARK	N	FGN	756	837
FAI	FAIRBANKS, AS, US	N	NO	3674	3816

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
FAO	FARO, PORTUGAL	N	FGN	1069	1712
FAR	FARGO, ND, USA	N	YES	1561	383
FAT	FRESNO, CA, USA	N	YES	9993	6833
FAY	FAYETTEVILLE, NC, USA	N	YES	3260	3643
FBM	LUBUMBASHI, ZAIRE	S	FGN	262	378
FBU	FORNEBU, OSLO, NORWAY	N	FGN	11420	29599
FCA	KALISPELL GLACIER NAT'L OK, MT, USA	N	YES	1460	1460
FCO	DA VINCI, ROME, ITALY	N	FGN	4538	6614
FEZ	FEZ, MOROCCO	N	FGN	146	408
FIH	KINSHASA, ZAIRE	S	FGN	2324	2776
FJR	AL FUJAIRAH, U.A.E.	N	FGN	0	208
FKI	KISANGANI, ZAIRE	N	FGN	1170	1596
FLL	FT LAUDERDALE, FL, USA	N	YES	12566	12687
FLN	FLORIANOPOLIS, BRAZIL	S	FGN	4180	5040
FMA	FORMOSA, ARGENTINA	S	FGN	682	696
FMI	KALEMIE, ZAIRE	S	FGN	524	440
FNA	FREETOWN, SIERRA LEONE	N	FGN	112	0
FNC	FUNCHAL - MADEIRA, PORTUGAL	N	FGN	3737	4944
FNT	FLINT, MI, USA	N	YES	2186	2300
FOC	FUZHOU, P. R. CHINA	N	FGN	534	1116
FOE	FORBES, TOPEKA, KA, USA	N	YES	1407	62
FOR	FORTALEZA, CEARA, BRAZIL	S	FGN	4798	6068
FPO	FREEPORT, BAHAMAS	N	FGN	2666	5156
FRA	FRANKFURT, FRG	N	FGN	52274	56256
FSD	SIOUX FALLS, SD, USA	N	YES	6410	2897
FTU	FT DAUPHIN, MADAGASCAR	S	FGN	332	328
FUE	FUERTEVENTURA, CANARY IS.	N	FGN	0	216
FUK	FUKUOKA, JAPAN	N	FGN	730	410
FWA	FT WAYNE, IN, USA	N	YES	2580	2344
GAJ	YAMAGATA, HONSHU, JAPAN	N	FGN	1154	1426
GAL	GALENA, AS, USA	N	NO	0	270
GAU	GAUHATI, INDIA	N	FGN	3934	5832
GBE	GABORONE, BOTSWANA	S	FGN	527	500
GDL	GUADALAJARA, MEXICO	N	FGN	0	38
GEG	SPOKANE, WA, USA	N	YES	8549	5588
GEO	GEORGETOWN, GUYANA	N	FGN	0	8
GHA	GHARDAIA, ALGERIA	N	FGN	1014	858
GHB	GOVERNORS HARBOUR, BAHAMAS	N	FGN	36	0
GHU	GUALEGUAYCHU, ARGENTINA	S	FGN	0	0
GIB	GIBRALTAR, GIBRALTAR	N	FGN	1788	2904
GIG	RIO DE JANEIRO INT'L, BRAZIL	S	FGN	27048	33116
GIZ	GIZAN, SAUDI ARABIA	N	FGN	5781	6019
GJT	GRAND JUNCTION, CO, USA	N	YES	2416	3572
GLA	GLASGLOW, SCOTLAND	N	FGN	687	1605
GMA	GEMENA, ZAIRE	N	FGN	312	332
GOA	GENOA, ITALY	N	FGN	292	267
GOI	GOA, INDIA	N	FGN	1798	1554
GOM	GOMA, ZAIRE	S	FGN	104	446
GOP	GORAKHPUR, INDIA	N	FGN	486	328
GOT	GOTHENBURG, SWEDEN	N	FGN	3846	4517
GOU	GAROUA, REP OF CAMEROON	N	FGN	1954	1822
GOV	GOVE, N.T., AUSTRALIA	S	FGN	314	600
GRB	GREEN BAY, WI, USA	N	YES	605	0
GRJ	GEORGE, SOUTH AFRICA	S	FGN	2178	2262
GRR	GRAND RAPIDS, MI, USA	N	YES	4831	3497
GRU	SAO PAULO-GUARULMOS, BRAZIL	S	FGN	41061	45163
GRZ	GRAZ, AUSTRIA	N	FGN	619	304
GSO	GREENSBORO/HPT/WIN-SALEM, NC, USA	N	YES	18586	14989
GSP	GREENVILLE/SPARTANBURG, SC, USA	N	YES	1508	2324
GTF	GREAT FALLS, MT, USA	N	YES	4356	3398
GUA	GUATELMALA CITY, GUATEMALA	N	FGN	1667	2848
GUM	GUAM, GUAM	N	FGN	289	366
GVA	GENEVA, SWITZERLAND	N	FGN	10594	10520
GWL	GWALIOR, INDIZ	N	FGN	1460	1422
GWT	GALWAY, IRELAND	N	FGN	130	136
GXF	SEIYUN, YEMEN	N	FGN	26	0
GXG	NEGAGE, ANGOLA	S	FGN	382	314
GYE	GUAYAQUIL,ECUADOR	S	FGN	1609	0
GYN	GOIANIA, BRAZIL	S	FGN	7891	8638
HAC	HACHIJO, JIMA ISLAND, JAPAN	N	FGN	834	1396
HAH	MORONI-HAHAYA, COMOROS	S	FGN	266	343
HAJ	HANOVER, FED REP OF GERMANY	N	FGN	8844	9804
HAK	HAIKOU, P. R. CHINA	N	FGN	770	1508
HAM	HAMBURG, FRG	N	FGN	25535	27695
HAN	HANOI, SOC REP OF VIETNAM	N	FGN	152	158

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
HAS	HAIL, SAUDI ARABIA	N	FGN	3642	2720
HBA	HOBART, TASMANIA, AUSTRALIA	S	FGN	3785	4822
HBT	HAFR ALBAPIN, SAUDI ARABIA	N	FGN	140	228
HDY	HAT YAI, THAILAND	N	FGN	3094	2434
HEL	HELSINKI, FINLAND	N	FGN	2797	3382
HER	HERAKLION, GREECE	N	FGN	1780	2406
HGH	HANGZHOU, P. R. CHINA	N	FGN	1390	1619
HIR	HONIARA, GUADALCANAL, SOLOMON IS.	S	FGN	436	648
HJR	HIROSHIMA, JAPAN	N	FGN	1460	1464
HKD	HAKODATE, JAPAN	N	FGN	1030	566
HKG	HONG KONG, HONG KONG	N	FGN	2792	6018
HKT	PHUKET, THAILAND	N	FGN	1932	2110
HLN	HELENA, MT, USA	N	YES	2046	2188
HLZ	HAMILTON, NEW ZEALAND	S	FGN	627	727
HME	HASSI MESSAOUD, ALGERIA	N	FGN	256	118
HND	TOKYO-HANEDA, JAPAN	N	FGN	14398	12095
HNL	HONOLULU, OAHU, HA, USA	N	NO	51139	51563
HOD	HODEIDAH, YEMEN	N	FGN	86	0
HOF	HOFUF, SAUDI ARABIA	N	FGN	992	960
HOR	HORTA FAIAL ISLAND, PORTUGAL	N	FGN	92	144
HOU	HOUSTON, TX, USA	N	YES	71429	81688
HPN	WHITE PLAINS, NY, USA	N	YES	2159	2049
HRB	HARBIN, MANCHURIA, P. R. CHINA	N	FGN	210	147
HRE	HARARE, ZIMBABWE	S	FGN	3314	5238
HRG	HORGHADA, ARAB REP OF EGYPT	N	FGN	760	732
HRL	HARLINGEN, TX, USA	N	YES	7446	7653
HSV	HUNTSVILLE/DECATUR, AL, USA	N	YES	1817	1972
HTI	HAMILTON ISLAND, QLD, AUSTRALIA	S	FGN	1351	1648
HTS	HUNTINGTON, WV, USA	N	YES	1152	1174
HUN	HUALIEN, TAIWAN	N	FGN	6508	7264
HYD	HYDERABAD, INDIA	N	FGN	2103	2214
IAD	DULLES INT'L, WASHINGTON, DC, USA	N	YES	84839	52922
IAH	HOUSTON INTERCONT, TX, USA	N	YES	35485	46187
IAM	IN AMENAS, ALGERIA	N	FGN	408	420
IBA	IBADAN, NIGERIA	N	FGN	1382	706
IBZ	IBIZA, SPAIN	N	FGN	124	220
ICT	WICHITA, KA, USA	N	YES	10698	6225
IDA	IDAHO FALLS, ID, USA	N	YES	2190	2756
IDR	INDORE, INDIA	N	FGN	1460	1426
IEV	KIEV, USSR	N	FGN	0	32
IFN	ISFAHAN, IRAN	N	FGN	2256	2874
IGL	IZMIR-CIGLI, TURKEY	N	FGN	26	22
IGR	IGUAZU, ARGENTINA	S	FGN	986	784
IGU	IGUASSU FALLS, BRAZIL	S	FGN	1776	2764
ILG	PHILADELPHIA-WILMINGTON, PA, USA	N	YES	440	0
ILM	WILMINGTON, NC, USA	N	YES	6254	5363
ILR	ILORIN, NIGERIA	N	FGN	1568	1884
IMF	IMPHAL, INDIA	N	FGN	1460	1464
IMP	IMPERATRIZ, BRAZIL	S	FGN	1186	1464
IND	INDIANAPOLIS, IN, USA	N	YES	12290	19730
INI	NIS, YUGOSLAVIA	N	FGN	57	0
INU	NAURU, REP OF NAURU	S	FGN	889	906
INZ	IN SALAH, ALGERIA	N	FGN	586	504
IOA	IOANNINA, GREECE	N	FGN	1354	1200
IOS	ILHEUS, BRAZIL	S	FGN	2920	2928
IQQ	IQUIQUE, CHILE	S	FGN	1460	1674
IQT	IQUTOS, PERU	S	FGN	210	304
IRJ	LA RIOJA, ARGENTINA	S	FGN	860	768
IRP	ISIRO, ZAIRE	N	FGN	104	156
ISA	MOUNT ISA, QLD, AUSTRALIA	S	FGN	546	1262
ISB	ISLAMABAD RAWALPINDI, PAKISTAN	N	FGN	3663	4673
ISG	ISHIGAKI, JAPAN	N	FGN	6936	7473
ISO	KINSTON, NC, USA	N	YES	2024	1464
ISP	LONG ISLAND MACARTHUR, NY, USA	N	YES	5816	3036
IST	ISTANBUL, TURKEY	N	FGN	2551	2343
ITH	ITHICA, NY, USA	N	YES	182	2
ITO	HILO HAWAII, HA, US	N	NO	8568	9273
IUE	NIUE ISLAND, NIUE	S	FGN	127	72
IVC	INVERCARGILL, NEW ZEALAND	S	FGN	2069	2076
IXA	AGARTALA, INDIA	N	FGN	1976	2720
IXB	BAGDOGRA, INDIA	N	FGN	2366	2196
IXC	CHANDIGAR, INDIA	N	FGN	1460	1464
IXD	ALLAHABAD, INDIA	N	FGN	392	500
IXE	MANGALORE, INDIA	N	FGN	2370	2168
IXJ	JAMMU, INDIA	N	FGN	1650	1576

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
IXL	LEH, INDIA	N	FGN	574	916
IXM	MADURAI, INDIA	N	FGN	1200	1142
IXR	RANCHI, INDIA	N	FGN	1460	1464
IXS	SILOHAR, INDIA	N	FGN	1748	1832
IXU	AURANGABAD, INDIA	N	FGN	1820	1464
IXZ	PORT BLAIR ANDAMAN ISLAND, INDIA	N	FGN	706	928
JAC	JACKSON, WY, USA	N	YES	2325	2179
JAI	JAIPUR, INDIA	N	FGN	4068	4876
JAN	JACKSON, MS, USA	N	YES	3392	3085
JAX	JACKSONVILLE, FL, USA	N	YES	10211	13077
JDH	JODHPUR, INDIA	N	FGN	2920	2928
JDO	JUAZEIRO DO NORTE CEARAH, BRAZIL	S	FGN	626	628
JED	JEDDAH, SAUDI ARABIA	N	FGN	19745	20292
JER	JERSEY CHANNEL ISLANDS, UK	N	FGN	1263	1112
JFK	KENNEDY, NEW YORK, NY, USA	N	YES	13217	8785
JGA	JAMNAGAR, INDIA	N	FGN	730	732
JHB	JOHOR BAHRU, MALAYSIA	N	FGN	4018	4164
JIB	DJIBOUTI, DJIBOUTI	N	FGN	508	686
JKH	CHIOS, GREECE	N	FGN	1858	1720
JNB	JOHANNESBURG, SOUTH AFRICA	S	FGN	13746	15620
JNU	JUNEAU, AS, US	N	NO	2255	2684
JOI	JOINVILLE, BRAZIL	S	FGN	626	628
JOS	JOS, NIGERIA	N	FGN	2596	2022
JPA	JOAO PESSOA, BRAZIL	S	FGN	1460	1832
JRH	JORHAT, INDIA	N	FGN	694	732
JRO	KILIMANJARO, TANZANIA	S	FGN	1667	1568
JSI	SKIATHOS, GREECE	N	FGN	412	342
JTR	SANTORINI, THIRA ISLAND, GREECE	N	FGN	1126	884
JUB	JUBA, SUDAN	N	FGN	38	0
JUJ	JUJUY, ARGENTINA	S	FGN	600	226
KAD	KADUNA, NIGERIA	N	FGN	3896	3639
KAN	KANO, NIGERIA	N	FGN	700	708
KBL	KABUL, AFGHANISTAN	N	FGN	208	208
KBR	KOTA BHARU, MALAYSIA	N	FGN	3024	3034
KCH	KUCHING, SARAWAK, MALAYSIA	N	FGN	5337	5482
KCZ	KOCHI, JAPAN	N	FGN	1522	816
KDU	SKARDU, PAKISTAN	N	FGN	190	688
KEF	REYKJAVIK-KEFLAVIK, ICELAND	N	FGN	561	936
KER	KERMAN, IRAN	N	FGN	532	52
KGA	KANANGA, ZAIRE	S	FGN	420	366
KGL	KIGALI, RWANDA	S	FGN	22	22
KGS	KOS, GREECE	N	FGN	550	566
KHH	KAOHSIUNG, TAIWAN	N	FGN	14596	18764
KHI	KARACHI, PAKISTAN	N	FGN	7384	9030
KHN	NANCHANG KIANGSI, P. R. CHINA	N	FGN	228	190
KIJ	NIIGATA, JAPAN	N	FGN	2190	2224
KIM	KIMBERLEY, SOUTH AFRICA	S	FGN	3888	4182
KIN	KINGSTON, JAMAICA	N	FGN	338	88
KKC	KHON KAEN, THAILAND	N	FGN	2264	1942
KLX	KALAMATA, GREECE	N	FGN	782	742
KMG	KUNMING, P.R. CHINA	N	FGN	2448	2577
KMI	MIYAZAKI, JAPAN	N	FGN	4686	3536
KMJ	KUMAMOTO, JAPAN	N	FGN	0	74
KMP	KEETMANSHOOP, NAMIBIA	S	FGN	174	0
KMQ	KOMATSU, JAPAN	N	FGN	730	828
KND	KINDU, ZAIRE	S	FGN	480	622
KNN	KANKAN, GUINEA	N	FGN	0	100
KNU	KANPUR, INDIA	N	FGN	1372	1578
KOA	KONA, HA, US	N	NO	11308	11047
KOJ	KAGOSHIMA, JAPAN	N	FGN	843	1913
KRN	KIRUNA, SWEDEN	N	FGN	0	18
KRP	KARUP, DENMARK	N	FGN	0	0
KRS	KRISTIANSAND, NORWAY	N	FGN	7646	7990
KRT	KHARTOUM, SUDAN	N	FGN	1921	2623
KSA	KOSRAE, CAROLINE ISLANDS	N	FGN	10	132
KSM	ST MARY'S, AS, US	N	NO	420	562
KST	KOSTI, SUDAN	N	FGN	0	0
KSU	KRISTIANSUND, NORWAY	N	FGN	2128	2024
KTM	KATHMANDU, NEPAL	N	FGN	2240	2200
KTN	KETCHIKAN, AS, US	N	NO	1460	1464
KUA	KUANTAN, MALAYSIA	N	FGN	426	420
KUH	KUSHIRO, JAPAN	N	FGN	1336	926
KUL	KUALA LUMPUR, MALAYSIA	N	FGN	21147	22237
KVA	KAVALA, GREECE	N	FGN	1242	1160
KWE	GUIYANG, P. R. CHINA	N	FGN	684	660

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
KWI	KUWAIT, KUWAIT	N	FGN	3659	2728
KWL	GUILIN, P. R. CHINA	N	FGN	3855	4671
LAD	LUANDA, ANGOLA	S	FGN	5680	5112
LAN	LANSING, MI, USA	N	YES	1120	1646
LAS	LAS VEGAS, NV, USA	N	YES	82033	89149
LAX	LOS ANGELES, CA, USA	N	YES	113329	123390
LBB	LUBBOCK, TX, USA	N	YES	13600	16396
LBU	LABUAN SABAH, MALAYSIA	N	FGN	2398	2406
LBV	LIBREVILLE, GABON	N	FGN	1553	1955
LCA	LARNACA, CYPRUS	N	FGN	1352	1277
LCE	LA CEIBA, HONDURAS	N	FGN	380	570
LDB	LONDRINA, BRAZIL	S	FGN	0	440
LDE	LOURDES/TARBES, FRANCE	N	FGN	8	0
LDI	LINDI, TANZANIA	S	FGN	10	0
LED	LENINGRAD, U.S.S.R.	N	FGN	198	163
LEI	ALMERIA, SPAIN	N	FGN	100	104
LEJ	LEIPZIG, GDR	N	FGN	16	28
LEX	LEXINGTON, KY, USA	N	YES	3916	4165
LFW	LOME, TOGO	N	FGN	985	812
LGA	NEW YORK LA GUARDIA, NY, USA	N	YES	32068	32703
LGB	LONG BEACH, CA, USA	N	YES	1299	3321
LGK	LANGKAWI, MALAYSIA	N	FGN	0	206
LGW	LONDON-GATWICK, ENGLAND	N	FGN	13117	17634
LHE	LAHORE, PAKISTAN	N	FGN	7188	9191
LHR	LONDON HEATHROW, ENGLAND, (UK)	N	FGN	69405	75934
LHW	LANZHOU, P. R. CHINA	N	FGN	0	83
LIH	LIHUE, KAUAI, HA, US	N	NO	17365	17708
LIL	LILLE, FRANCE	N	FGN	214	292
LIM	LIMA, PERU	S	FGN	1460	2157
LIN	MILAN LINATE, ITALY	N	FGN	7588	7604
LIS	LISBON, PORTUGAL	N	FGN	10558	13190
LIT	LITTLE ROCK, AK, USA	N	YES	10791	10853
LJA	LODJA, ZAIRE	S	FGN	106	104
LJU	LJUBLJANA, YUGOSLAVIA	N	FGN	1741	1704
LKO	LUCKNOW, INDIA	N	FGN	4396	4264
LLA	LULEA, SWEDEN	N	FGN	0	8
LLW	LILONGWE, MALAWI	S	FGN	752	786
LMT	KLAMATH FALLS, OR, USA	N	YES	1218	62
LNK	LINCOLN, NB, USA	N	YES	5816	5847
LNZ	LONZ, AUSTRIA	N	FGN	768	704
LOS	LAGOS, NIGERIA	N	FGN	16716	14969
LPA	GRAN CANARIA, CANARY ISLANDS	N	FGN	293	1439
LPB	LA PAZ, BOLIVIA	S	FGN	136	264
LPL	LIVERPOOL, ENGLAND	N	FGN	30	42
LRH	LA ROCHELLE, FRANCE	N	FGN	0	8
LST	LAUNCESTON, TASMANIA, AUSTRALIA	S	FGN	4721	5684
LTN	LONDON-LUTON INT'L, ENGLAND	N	FGN	192	270
LUN	LUSAKA, ZAMBIA	S	FGN	2302	1961
LUO	LUENA, ANGOLA	S	FGN	434	472
LUQ	SAN LUIS, ARGENTINA	S	FGN	196	0
LUT	LAURA STATION, AUSTRALIA	S	FGN	0	0
LUX	LUXEMBOURG, LUXEMBOURG	N	FGN	2615	3500
LXR	LUXOR, ARAB REP OF EGYPT	N	FGN	2161	2143
LXS	LEMNOS, GREECE	N	FGN	1040	996
LYH	LYNCHBURG, VA, USA	N	YES	1824	2306
LYP	FAISALABAD, PAKISTAN	N	FGN	790	1326
LYR	LONGYEARBYEN, NORWAY	N	FGN	14	223
LYS	LYON, FRANCE	N	FGN	5223	5439
MAA	MADRAS, INDIA	N	FGN	7714	8485
MAB	MARABA, BRAZIL	S	FGN	470	628
MAD	MADRID, SPAIN	N	FGN	6813	7477
MAF	MIDLAND ODESSA, TX, USA	N	YES	16021	14942
MAH	MAHON, MENORCA, SPAIN	N	FGN	84	174
MAJ	MAJURO, MARSHALL ISLAND	N	FGN	92	132
MAL	MANGOLE, INDONESIA	-0-	FGN	0	0
MAN	MANCHESTER, ENGLAND (UK)	N	FGN	5780	7490
MAO	MANAUS, BRAZIL	S	FGN	6627	7820
MBJ	MONTEGO BAY, JAMAICA	N	FGN	218	0
MBS	SAGINAW, MI, USA	N	YES	794	272
MBX	MARIBOR, YUGOSLAVIA	N	FGN	0	0
MCI	KANSIS CITY, MO, USA	N	YES	26453	29842
MCO	ORLANDO-INT'L, FL, USA	N	YES	23551	28187
MCP	MACAPA, AMAPA, BRAZIL	N	FGN	1888	2337
MCT	MUSCAT, OMAN	N	FGN	4409	5241
MCY	MAROOCHYDORE, QLD, AUSTRALIA	S	FGN	104	136

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
MCZ	MACEIO, ALAGOAS, BRAZIL	S	FGN	978	1646
MDE	MEDELLIN, COLOMBIA	N	FGN	312	312
MDI	MAKURDI, NIGERIA	N	FGN	730	695
MDK	MBANDAKA, ZAIRE	N	FGN	416	522
MDQ	MAR DEL PLATA, ARGENTINA	S	FGN	2964	2816
MDT	HARRISBURG-OLMSTEAD ST, PA, USA	N	YES	3784	3265
MDW	CHICAGO-MIDWAY, IL, USA	N	YES	33077	46544
MDZ	MENDOZA, ARGENTINA	S	FGN	1578	1106
MED	MEDINA, SAUDI ARABIA	N	FGN	4698	5236
MEG	MALANGE, ANGOLA	S	FGN	740	758
MEL	MELBOURNE, VICTORIA, AUSTRALIA	S	FGN	17124	21097
MEM	MEMPHIS, TN, USA	N	YES	8599	7534
MES	MEDAN, INDONESIA	N	FGN	730	732
MEX	MEXICO CITY, MEXICO	N	FGN	4170	5281
MFE	MC ALLEN, TX, USA	N	YES	288	1148
MFR	MEDFOR, OR, USA	N	YES	3529	2228
MFU	MFUWE, ZAMBIA	S	FGN	34	60
MGA	MANAGUA, NICARAGUA	N	FGN	3212	2689
MGM	MONTGOMERY, AL, USA	N	YES	148	896
MGQ	MOGADISHU, SOMALIA	N	FGN	94	46
MHD	MASHAD, IRAN	N	FGN	516	0
MHT	MANCHESTER, NH, USA	N	YES	0	1106
MIA	MIAMI, FL, USA	N	YES	28033	34912
MID	MERIDA, MEXICO	N	FGN	0	244
MIL	MILAN, ITALY	N	FGN	0	0
MIR	MONASTIR, TUNISIA	N	FGN	488	336
MIU	MAIDUGURI, NIGERIA	N	FGN	887	1042
MJM	MBUJI-MAYI, ZAIRE	S	FGN	364	510
MJN	MAJUNGA, MADAGASCAR	S	FGN	402	336
MJT	MYTILENE, GREECE	N	FGN	2852	2634
MKE	MILWAUKEE, WI, USA	N	YES	1056	3124
MKY	MALACCA, MALAYSIA	S	FGN	2109	2272
MLA	MALTA, MEDITERRANEAN SEA	N	FGN	2882	4492
MLB	MELBOURNE, FL, USA	N	YES	958	1474
MLE	MALE, MALDIVES	N	FGN	356	464
MLH	MULHOUSE/BASEL, FRANCE	N	FGN	1	4
MLI	MOLINE, IL, USA	N	YES	1947	2284
MLU	MONROE, LA, USA	N	YES	3670	3712
MMY	MIYAKO JIMA, JAPAN	N	FGN	3606	4836
MNL	MANILA, PHILIPPINES	N	FGN	1232	1211
MOB	MOBILE AL/PASCAGOULA, MS, USA	N	YES	3013	2274
MOC	MONTES CLAROS, BRAZIL	S	FGN	416	420
MOL	MOLDE, NORWAY	N	FGN	2129	2263
MOQ	MORONDAVA, MADAGASCAR	S	FGN	112	204
MOT	MINOT, ND, USA	N	YES	737	964
MPL	MONTPELLIER, FRANCE	N	FGN	52	52
MPM	MAPUTO, MOZAMBIQUE	S	FGN	2248	2289
MRS	MARSEILLE, FRANCE	N	FGN	3381	3805
MRU	MAURITIUS, MAURITIUS	S	FGN	321	437
MRY	MONTEREY, CA, USA	N	YES	3559	1923
MSN	MADISON, WI, USA	N	YES	1695	1489
MSO	MISSOULA, MT, USA	N	YES	3537	3427
MSP	MINNEAPOLIS-ST PAUL, MN, USA	N	YES	8120	11799
MSR	MUENSTER, FRG	N	FGN	4	0
MSY	NEW ORLEANS, LA, USA	N	YES	25950	32656
MSZ	NAMIBE, ANGOLA	S	FGN	228	262
MTS	MANZINI, SWAZILAND	S	FGN	96	192
MTY	MONTERREY, MEXICO	N	FGN	0	62
MUC	MUNICH, FRG	N	FGN	36435	44305
MUX	MULTAN, PAKISTAN	N	FGN	2488	2344
MUZ	MUSOMA, TANZANIA	S	FGN	8	0
MVB	FRANCEVILLE, GABON	N	FGN	1	5
MVD	MONTEVIDEO, URUGUAY	S	FGN	4977	5351
MVR	MAROUA, REP OF CAMEROON	N	FGN	1190	1052
MWZ	MWANZA, TANZANIA	S	FGN	79	530
MXP	MILAN-MALPENSA, ITALY	N	FGN	4	21
MXZ	MEIXIAN, P. R. CHINA	N	FGN	0	328
MYJ	MATSUYAMA, SHIKIKU, JAPAN	N	FGN	290	862
MYR	MYRTLE BEACH, SC, USA	N	YES	4864	5504
MYW	MTWARA, TANZANIA	S	FGN	370	312
MYY	MIRI, SARAWAK, MALAYSIA	N	FGN	3024	3244
MZG	MAKUNG, TAIWAN	N	FGN	8877	10980
MZT	MAZATLAN, MEXICO	N	FGN	976	554
NAG	NAGPUR, INDIA	N	FGN	2756	2440
NAN	NADI, FIJI	S	FGN	1373	1413

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
NAP	NAPLES, ITALY	N	FGN	739	584
NAS	NASSAU, BAHAMAS	N	FGN	7440	9851
NAT	NATAL, BRAZIL	S	FGN	4380	4976
NBO	NAIROBI, KENYA	S	FGN	1051	1087
NCE	NICE, FRANCE	N	FGN	3675	5258
NCL	NEWCASTLE, ENGLAND	N	FGN	1825	1589
NDD	SUMBE, ANGOLA	S	FGN	10	0
NDJ	N'DJAMENA, CHAD	N	FGN	18	0
NGE	N'GAOUNDERE, REP OF CAMEROON	N	FGN	1006	902
NGO	NAGOYA, JAPAN	N	FGN	5577	6995
NIM	NIAMEY, NIGER	N	FGN	62	0
NKC	NOUAKCHOTT, MAURITANIA	N	FGN	110	82
NKG	NANJING, P. R. CHINA	N	FGN	2476	2744
NLA	NDOLA, ZAMBIA	S	FGN	701	508
NLK	NORFOLK ISLAND, PACIFIC OCEAN	S	FGN	420	581
NNG	NANNING, P. R. CHINA	N	FGN	1157	1042
NOS	NOSSIBE, MADAGASCAR	S	FGN	508	614
NOU	NOUMEA, NEW CALEDONIA	S	FGN	219	209
NOV	HUAMBO, ANGOLA	S	FGN	520	630
NQN	NEUQUEN, ARGENTINA	S	FGN	1876	1838
NRT	TOKYO-NARITA, JAPAN	N	FGN	0	640
NUE	NUREMBURG, FRG	N	FGN	3516	4068
NVT	NAVEGANTES, BRAZIL	S	FGN	2608	2556
OAJ	JACKSONVILLE, NC, USA	N	YES	2428	1892
OAK	OAKLAND, SAN FRANCISCO, CA, USA	N	YES	27453	25240
ODE	ODENSE, DENMARK	N	FGN	567	496
OGG	KAHULUI, MAUI, HA, US	N	NO	27942	27757
OGN	YONAGUNI-JIMA, JAPAN	N	FGN	0	30
OGX	OUARGLA, ALGERIA	N	FGN	836	552
OHD	OHRID, YUGOSLAVIA	N	FGN	292	523
OIT	OITA, JAPAN	N	FGN	854	818
OKA	OKINAWA, RYUKYU IS, JAPAN	N	FGN	11818	13972
OKC	OKLAHOMA CITY, OK, USA	N	YES	25165	27072
OKJ	OKAJAMA, JAPAN	N	FGN	0	923
OLB	OLBIA, ITALY	N	FGN	40	42
OMA	OMAHA, NB, USA	N	YES	10800	10871
OME	NOME, AS, US	N	NO	2272	2232
ONT	ONTARIO, CA, USA	N	YES	33033	34539
OOL	GOLD COAST, QLD, AUSTRALIA	S	FGN	2812	3663
OPO	OPORTO, PORTUGAL	N	FGN	3349	3331
ORD	CHICAGO-O'HARE, IL, USA	N	YES	59542	79401
ORF	NORFOLK-VA. BEACH, VA, USA	N	YES	24618	20845
ORH	WORCESTER, MA, USA	N	YES	719	2976
ORK	CORK, IRELAND	N	FGN	2942	3322
ORN	ORAN, ALGERIA	N	FGN	4524	4495
ORY	PARIS - ORLY ARPT, FRANCE	N	FGN	6940	8806
OSA	OSAKA, JAPAN	N	FGN	1792	1262
OSL	OSLO, NORWAY	N	FGN	14168	0
OSM	MOSUL, IRAQ	N	FGN	312	314
OTP	BUCHAREST-OTOPENI, ROMANIA	N	FGN	487	405
OTZ	KOTZEBUE, AS, US	N	NO	2082	2050
OUA	OUAGADOUGOU, BURKINA FASO	N	FGN	14	0
OUD	OUJDA, MOROCCO	N	FGN	402	386
OUE	OUESSO, PEOP REP OF CONGO	N	FGN	258	260
OZZ	OUARAZATE, MOROCCO	N	FGN	161	395
PAP	PORT AU PRINCE, HAITI	N	FGN	0	88
PAT	PATNA, INDIA	N	FGN	4973	4408
PBI	WEST PALM BEACH, FL, USA	N	YES	10310	9469
PBM	PARAMARIBO, REP OF SURINAME	N	FGN	104	106
PCL	PUCALLPA, PERU	S	FGN	586	110
PDL	PONTA DELGADA, PORTUGAL (AZORES)	N	FGN	886	933
PDP	PUNTA DEL ESTE, URUGUAY	S	FGN	2332	1676
PDX	PORTLAND, OR, USA	N	YES	18968	17604
PEK	BEIJIN, P. R. CHINA	N	FGN	9169	9152
PEM	PUERTO MALDONADO, PERU	S	FGN	0	92
PEN	PENANG, MALAYSIA	N	FGN	9062	9591
PER	PERTH, WA, AUSTRALIA	S	FGN	1178	1503
PEW	PESHAWAR, PAKISTAN	N	FGN	418	440
PHC	PORT HARCOURT, NIGERIA	N	FGN	208	707
PHE	PORT HEDLAND, WA, AUSTRALIA	S	FGN	130	0
PHL	PHILADELPHIA/WILMINGTON, PA, USA	N	YES	34184	45759
PHS	PHITSANULOK, THAILAND	N	FGN	1460	1464
PHX	PHOENIX, AZ, USA	N	YES	163588	177325
PIA	PEORIA, IL, USA	N	YES	389	603
PIE	TAMPA-ST. PETERSBURG, FL, USA	N	YES	302	0

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
PIK	GLASGOW-PRESTWICK, SCOTLAND	N	FGN	52	104
PIT	PITTSBURGH, PA, USA	N	YES	69413	80005
PIU	PIURA, PERU	S	FGN	1068	62
PLZ	PORT ELIZABETH, SOUTH AFRICA	S	FGN	12531	14399
PMA	PEMBA ISLAND, TANZANIA	S	FGN	8	0
PMC	PUERTO MONTT, CHILE	S	FGN	1400	1565
PME	PORTSMOUTH, UK	N	FGN	0	0
PMI	PALMA MALLORCA ISLAND, SPAIN	N	FGN	2449	3158
PMO	PALERMO, ITALY	N	FGN	0	46
PMR	PALMERSTON, NEW ZEALAND	S	FGN	2592	2752
PNQ	POONA, INDIA	N	FGN	842	1554
PNR	POINTE NOIRE, PEOP REP OF CONGO	S	FGN	1265	912
PNS	PENSACOLA, FL, USA	N	YES	2180	1824
PNZ	PETROLINA, BRAZIL	S	FGN	720	732
POA	PORTO ALEGRE, BRAZIL	S	FGN	8156	7765
POG	PORT GENTIL, GABON	S	FGN	18	139
POL	PEMBA, MOZAMBIQUE	S	FGN	260	262
POS	PORT OF SPAIN, TRINIDAD/TOBAGO	N	FGN	52	52
PPG	PAGO PAGO, SAMOA	S	FGN	434	147
PPP	PROSERPINE, QLD, AUSTRALIA	S	FGN	437	521
PRG	PRAGUE, CZECHOSLOVAKIA	N	FGN	1231	1148
PSA	PISA, ITALY	N	FGN	1082	1026
PSC	PASCO, WA, USA	N	YES	864	2035
PSG	PETERSBURG, AS, US	N	NO	1460	1464
PSI	PASNI, PAKISTAN	N	FGN	208	208
PSP	PALM SPRINGS, CA, USA	N	YES	3083	3434
PSS	POSADAG, ARGENTINA	S	FGN	938	928
PTY	PANAMA CITY, PANAMA	N	FGN	2683	2922
PUB	PUEBLO, CO, USA	N	YES	2569	2395
PUQ	PUNTA ARENAS, CHILE	S	FGN	760	782
PUY	PULA, YUGOSLAVIA	N	FGN	76	286
PVD	PROVIDENCE, RI, USA	N	YES	5358	7982
PVH	PORTO VELHO, BRAZIL	S	FGN	4700	4786
PVR	PUERTO VALLARTA, MEXICO	N	FGN	880	888
PWM	PORTLAND, ME, USA	N	YES	2450	3650
PXO	PORTO SANTO, PORTUGAL (MADEIRA)	N	FGN	58	78
PZU	PORT SUDAN, SUDAN	N	FGN	925	1517
QTV	TREVISO, ITALY	N	FGN	0	0
RAE	ARAR, SAUDI ARABIA	N	FGN	1662	1576
RAH	RAFHA, SAUDI ARABIA	N	FGN	166	210
RAJ	RAJKOT, INDIA	N	FGN	730	732
RAK	MARRAKECH, MOROCCO	N	FGN	529	777
RAP	RAPID CITY, SD, USA	N	YES	4703	2847
RAR	RAROTONGA, COOK ISLAND, S. PACIFIC	S	FGN	152	63
RAS	RASHT, IRAN	N	FGN	540	40
RBA	RABAT, MOROCCO	N	FGN	0	562
RBR	RIO BRANCO, BRAZIL	S	FGN	3614	3146
RCU	RIO CUARTO, ARGENTINA	S	FGN	552	0
RDD	REDDING, CA, USA	N	YES	3151	737
RDU	RALEIGH-DURHAM, NC, USA	N	YES	23607	20624
REC	RECIFE, BRAZIL	S	FGN	8974	11088
REL	TRELEW, ARGENTINA	S	FGN	2448	1928
RES	RESISTENCIA, ARGENTINA	S	FGN	730	556
RGA	RIO GRANDE, ARGENTINA	S	FGN	1628	1278
RGL	RIO GALLEGOS, ARGENTINA	S	FGN	3170	2492
RHO	RHODES, GREECE	N	FGN	728	1132
RIC	RICHMOND, VA, USA	N	YES	8252	9847
RIJ	RIOJA, PERU	S	FGN	338	600
RIY	RIYAN, YEMEN	N	FGN	560	322
RJK	RIJEKA, YUGOSLAVIA	N	FGN	76	370
RKT	RAS AL KHAIMAH, U. A. EMIRATES	N	FGN	236	237
RNN	RONNE, DENMARK	N	FGN	298	242
RNO	RENO, NV, USA	N	YES	25150	20535
ROA	ROANOKE, VA, USA	N	YES	3910	4468
ROB	MONROVIA ROBERTS, LIBERIA	N	FGN	320	210
ROC	ROCHESTER, NY, USA	N	YES	13533	13078
ROK	ROCKHAMPTON, QLD, AUSTRALIA	S	FGN	3570	3750
ROR	KOROR, PALAU ISLAND, PACIFIC OCEAN	N	FGN	132	39
ROS	ROSARIO, ARGENTINA	S	FGN	1704	1478
ROT	ROTORUA, NEW ZEALAND	S	FGN	0	292
RPR	RAIPUR, INDIA	N	FGN	1460	830
RRS	ROROS, NORWAY	N	FGN	782	792
RSW	FORT MYERS REGIONAL, FL, USA	N	YES	2486	7120
RTB	ROATAN, HONDURAS	N	FGN	0	188
RUH	RIYADH, SAUDI ARABIA	N	FGN	21799	21703

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
RUN	REUNION ISLAND, INDIAN OCEAN	S	FGN	436	410
SAB	SABA, NETH. ANTILLES	N	FGN	0	0
SAH	SANAA, YEMEN	N	FGN	1580	1379
SAL	SAN SALVADOR, EL SALVADOR	N	FGN	6574	7271
SAN	SAN DIEGO, CA, USA	N	YES	36109	46848
SAO	SAO PAULO, BRAZIL	S	FGN	0	0
SAP	SAN PEDRO, SULA, HONDURAS	N	FGN	3411	4099
SAT	SAN ANTONIO, TX, USA	N	YES	31907	36421
SAV	SAVANNAH, GA, USA	N	YES	5077	4364
SBA	SANTA BARBARA, CA, USA	N	YES	2895	3035
SBN	SOUTH BEND, IN, USA	N	YES	1496	1708
SCC	PRUDHOE BAY, DEADHORSE, AS, US	N	NO	3834	3908
SCK	STOCKTON,CA, USA	N	YES	787	0
SCL	SANTIAGO, CHILE	S	FGN	3733	5184
SCN	SAARBRUECKEN, FRG	N	FGN	0	0
SDA	BAGHDAD-SADDAM, IRAQ	N	FGN	2599	1451
SDD	LUBANGO, ANGOLA	S	FGN	862	784
SDE	SANTIAGO DEL ESTERO, ARGENTINA	S	FGN	910	732
SDF	LOUISVILLE, KY, USA	N	YES	11936	11837
SDJ	SENDAI, JAPAN	N	FGN	2796	3276
SDK	SANDAKAN, SABAH, MALAYSIA	N	FGN	2190	2196
SDQ	SANTO DOMINGO, DOMINICAN REP	N	FGN	0	124
SEA	SEATTLE/TACOMA, WA, USA	N	YES	27059	29147
SEZ	MAHE IS. SEYCHELLES IS.	S	FGN	0	93
SFA	SFAX, TUNISIA	N	FGN	186	194
SFN	SANTA FE, ARGENTINA	S	FGN	624	784
SFO	SAN FRANCISCO-OAKLAND, CA, USA	N	YES	82408	78067
SGF	SPRINGFIELD, MO, USA	N	YES	3704	2335
SHA	SHANGHAI, P. R. CHINA	N	FGN	1678	2060
SHE	SHENYANG, P. R. CHINA	N	FGN	208	400
SHI	SHIMOJISHIMA, JAPAN	N	FGN	0	0
SHJ	SHARJAH, U. A. EMIRATES	N	FGN	2588	2845
SHV	SHREVEPORT, LA, USA	N	YES	3098	3472
SHW	SHARURAH, SAUDI ARABIA	N	FGN	730	730
SIA	XI AN, P. R. CHINA	N	FGN	848	991
SID	SAL, CAPE VERDE ISLAND	N	FGN	10	40
SIN	SINGAPORE, SINGAPORE	N	FGN	6631	6354
SIT	SITKA, AS, US	N	NO	778	782
SJC	SAN JOSE, CA, USA	N	YES	37310	37278
SJD	LOS CABOS, MEXICO	N	FGN	0	38
SJJ	SARAJEVO, YUGOSLAVIA	N	FGN	174	356
SJO	SAN JOSE, COST RICA	N	FGN	3317	3409
SJU	SAN JUAN, PUERTO RICO	N	FGN	0	60
SKG	THESSALONIKI, GREECE	N	FGN	1987	1721
SKO	SOKOTO, NIGERIA	N	FGN	1182	732
SKP	SKOPJE, YUGOSLAVIA	N	FGN	210	710
SKS	SKRYDSTRUP, DENMARK	N	FGN	45	0
SKZ	SUKKUR, PAKISTAN	N	FGN	566	720
SLA	SALTA, ARGENTINA	S	FGN	1934	1947
SLC	SALT LAKE CITY, UT, USA	N	YES	77961	72870
SLL	SALALAH, OMAN	N	FGN	882	964
SLZ	SAO LUIZ, MARANHAO, BRAZIL	S	FGN	3629	4701
SMF	SACRAMENTO, CA, USA	N	YES	18876	24452
SMI	SAMOS ISLAND, GREECE	N	FGN	1678	1608
SNA	ORANGE COUNTY, CA, USA	N	YES	24680	22489
SNN	SHANNON, IRELAND	N	FGN	1999	2715
SNO	SAKON NAKHON, THAILAND	N	FGN	566	282
SOF	SOFIA, BULGARIA	N	FGN	671	547
SPC	SANTA CRUZ LA PALMA, CANARY IS.	N	FGN	0	1272
SPP	MENONGUE, ANGOLA	S	FGN	224	208
SPU	SPLIT, YUGOSLAVIA	N	FGN	1592	2213
SRQ	SARASOTA/BRADENTON, FL, USA	N	YES	657	994
SSA	SALVADOR, BRAZIL	S	FGN	9230	11330
SSG	MALABO, EQUATORIAL GUINEA	N	FGN	126	206
STL	ST LOUIS, MO, USA	N	YES	20660	25797
STM	SANTAREM, BRAZIL	S	FGN	3318	3913
STN	LONDON-STANSTED, ENGLAND, UK	N	FGN	0	874
STR	STUTTGART, FRG	N	FGN	18747	19270
STT	ST THOMAS, VIRGIN ISLANDS	N	FGN	748	732
STV	SURAT, INDIA	N	FGN	0	0
STX	ST CROIX, VIRGIN ISLANDS	N	FGN	730	732
SUV	SUVA, FIJI	S	FGN	650	582
SUX	SIOUX CITY, IO, USA	N	YES	1536	2844
SVB	SAMBAVA, MADAGASCAR	S	FGN	274	220
SVG	STAVANGER, NORWAY	N	FGN	16946	18466

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
SVO	MOSCOW-SHEREMETYE, U.S.S.R.	N	FGN	864	962
SVP	KUITO, ANGOLA	S	FGN	422	392
SVQ	SEVILLE, SPAIN	N	FGN	0	804
SWA	SHANTON, P. R. CHINA	N	FGN	0	507
SXB	STRASBOURG, FRANCE	N	FGN	76	4
SXF	BERLIN, GDR	N	FGN	86	202
SXR	SRINAGAR, INDIA	N	FGN	2123	2035
SYA	SHEMYA IS., AS, USA	N	NO	0	16
SYD	SYDNEY, N.S.W., AUSTRALIA	S	FGN	16325	21343
SYR	SYRACUSE, NY, USA	N	YES	10961	18007
SYZ	SHIRAZ, IRAN	N	FGN	3868	3768
SZG	SALZBURG, AUSTRIA	N	FGN	648	653
TAI	TAIZ, YEMEN	N	FGN	820	872
TBO	TABORA, TANZANIA	S	FGN	36	0
TBP	TUMBES, PERU	S	FGN	404	576
TBT	TABATINGA, BRAZIL	S	FGN	764	852
TBU	TONGATAPU, TONGA ISLAND, PACIFIC	S	FGN	667	323
TBZ	TABRIZ, IRAN	N	FGN	214	0
TEE	TBESSA, ALGERIA	N	FGN	652	628
TER	TERCEIRA, PORTUGAL (AZORES)	N	FGN	87	260
TET	TETE, MOZAMBIQUE	S	FGN	364	364
TEZ	TEZPUR, INDIA	N	FGN	728	732
TFF	TEFE, BRAZIL	S	FGN	246	208
TFN	TENERIFE, SPAIN	N	FGN	0	1842
TFS	TENERIFFE-REINASOFIA, CANARY ISLAND	N	FGN	244	874
TGD	TITOGRAD, YUGOSLAVIA	N	FGN	616	754
TGG	KUALA, TERENGGANU, MALAYSIA	N	FGN	438	418
TGT	TANGA, TANZANIA	S	FGN	26	0
TGU	TEGUCIGALPA, HONDURAS	N	FGN	3746	4286
THE	TERESINA, PIAUI, BRAZIL	S	FGN	2920	3972
THR	TEHRAN, IRAN	N	FGN	4370	3536
TIA	TIRANA, ALBANIA	N	FGN	104	104
TIF	TAIF, SAUDI ARABIA	N	FGN	1484	926
TIN	TINDOUF, ALGERIA	N	FGN	1006	962
TIP	TRIPOLI, LIBYA	N	FGN	287	626
TIV	TIVAT, YUGOSLAVIA	N	FGN	188	364
TKQ	KIGOMA, TANZANIA	S	FGN	18	0
TLE	TULEAR, MADAGASCAR	S	FGN	490	528
TLH	TALLAHASSEE, FL, USA	N	YES	0	1376
TLM	TILIMSEN, ALGERIA	N	FGN	1046	831
TLS	TOULOUSE, FRANCE	N	FGN	1152	1107
TLV	TEL AVIV-YAFO, ISRAEL	N	FGN	2334	1608
TMM	TAMATAVE, MADAGASCAR	S	FGN	150	14
TMR	TAMANRASSET, ALGERIA	N	FGN	1228	1058
TMS	SAO TOME ISLAND, SAO TOME ISLAND	N	FGN	124	144
TNG	TANGIER, MOROCCO	N	FGN	2117	2241
TNN	TAINAN, TAIWAN	N	FGN	3324	3452
TNR	ANTANANARIVO, MADAGASCAR	S	FGN	1953	1801
TOE	TOZEUR, TUNISIA	N	FGN	86	18
TOL	TOLEDO, OH, USA	N	YES	1724	1192
TOS	TROMSO, NORWAY	N	FGN	2080	2518
TOY	TOYAMA, JAPAN	N	FGN	1522	446
TPA	TAMPA/ST PETERSBURG, FL, USA	N	YES	19425	19630
TPE	TAIPEI, TAIWAN	N	FGN	0	34
TPP	TARAPOTO, PERU	S	FGN	656	486
TRD	TRONDHEIM, NORWAY	N	FGN	11039	13061
TRI	TRI-CITY AIRPORT, TN, USA	N	YES	2166	2926
TRN	TURIN, ITALY	N	FGN	932	1798
TRU	TRUJILLO, PERU	S	FGN	28	28
TRV	TRIVANDRUM, INDIA	N	FGN	2374	2708
TRW	TARAWA, REP OF KIRIBATI	N	FGN	106	104
TRZ	TIRUCHIRAPALLY, INDIA	N	FGN	2318	2094
TSA	TAIPEI-SUNG SHAN, TAIWAN	N	FGN	22439	26214
TSN	TIANJIN, P. R. CHINA	N	FGN	954	1421
TSV	TOWNSVILLE, QLD, AUSTRALIA	S	FGN	6252	6051
TTJ	TOTTORI, JAPAN	N	FGN	1460	1464
TTT	TAITUNG, TAIWAN	N	FGN	1488	1802
TUC	TUCUMAN, ARGENTINA	S	FGN	2409	2433
TUL	TULSA, OK, USA	N	YES	30215	29642
TUN	TUNIS, TUNISIA	N	FGN	5129	3906
TUR	TUCURUI, BRAZIL	S	FGN	419	417
TUS	TUCSON, AZ, USA	N	YES	14844	14048
TUU	TABUK, SAUDI ARABIA	N	FGN	4152	3910
TVL	LAKE TAHOE, CA, USA	N	YES	2274	1985
TWU	TAWAU, SABAH, MALAYSIA	N	FGN	2920	2928

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
TXL	WEST BERLIN, GERMANY	N	FGN	17484	18958
TYL	TALARA, PERU	S	FGN	12	700
TYN	TAIYUAN, P. R. CHINA	N	FGN	104	122
TYS	KNOXVILLE, TN, USA	N	YES	4917	5269
UAQ	SAN JUAN, ARGENTINA	S	FGN	546	706
UBA	UBERABA, BRAZIL	S	FGN	1186	1464
UBJ	UBE, JAPAN	N	FGN	2496	1411
UBP	UBON PATCHATHANI, THAILAND	N	FGN	730	732
UDI	UBERLANDIA, BRAZIL	S	FGN	1186	1464
UDR	UDAIPUR, INDIA	N	FGN	1460	2126
UEL	QUELIMANE, MOZAMBIQUE	S	FGN	418	420
UET	QUETTA, PAKISTAN	N	FGN	832	1566
UIO	QUITO, ECUADOR	S	FGN	1609	0
UNK	UNALAKLEET, AS, US	N	NO	4	270
URT	SURAT THANI, THAILAND	N	FGN	798	1272
URY	GURAYAT, SAUDI ARABIA	N	FGN	740	942
USH	USHUAIA, ARGENTINA	S	FGN	1804	1544
UTH	UDON, THANI, THAILAND	N	FGN	738	732
UTN	UPINGTON, SOUTH AFRICA	S	FGN	882	856
UTP	UTAPAO, THAILAND	N	FGN	0	184
UVL	NEW VALLEY, ARAB REP OF EGYPT	N	FGN	315	312
VCE	VALVERDE, CANARY ISLANDS	N	FGN	1729	1335
VCP	SAO PAULO - VIRACOPOS, BRAZIL	S	FGN	104	56
VDM	VIEDMA, ARGENTINA	S	FGN	416	460
VFA	VICTORIA FALL, ZIMBABWE	S	FGN	610	1292
VHC	SAURIMO, ANGOLA	S	FGN	252	234
VIE	VIENNA, AUSTRIA	N	FGN	5820	6195
VIL	DAKHLA, MOROCCO	N	FGN	8	58
VIX	VITORIA, ESPIRITO SANTO, BRAZIL	S	FGN	2878	3794
VLC	VALENCIA, SPAIN	N	FGN	206	342
VLG	VILLA GESELL, ARGENTINA	S	FGN	154	148
VLI	PORT VILA, VANUATU	S	FGN	251	560
VNS	VARANASI, INDIA	N	FGN	3150	2686
VRN	VERONA, ITALY	N	FGN	0	3
VTE	VIENTIANE, LAOS	N	FGN	0	52
VTZ	VISHAKHAPATNAM, INDIA	N	FGN	1722	1774
VVI	SANTA CRUZ, VIRU VIRU, BOLIVIA	S	FGN	104	208
VXC	LICHINGA, MOZAMBIQUE	S	FGN	312	318
WAW	WARSAW, POLAND	N	FGN	1027	755
WDH	WINDHOEK, NAMIBIA	S	FGN	1862	1988
WKJ	WAKKANAI, JAPAN	N	FGN	0	550
WLG	WELLINGTON, NEW ZEALAND	S	FGN	17828	28370
WRG	WRANGELL, AS, US	N	NO	1460	1464
WUH	WUHAN, P. R. CHINA	N	FGN	2002	2073
XMN	XIAMEN, P. R. CHINA	N	FGN	2254	3433
XRY	JEREZ DE LA FRONTERA, SPAIN	N	FGN	0	0
YAK	YAKUTAT, AS, US	N	NO	1460	1464
YAM	SAULT STE MARIE, ONT., CANADA	N	FGN	3540	3286
YAO	YAOUNDE, REP OF CAMEROON	N	FGN	4147	3353
YBC	BAIE COMEAU, QUEBEC, CANADA	N	FGN	276	106
YBG	SAGUENAY, QUE, CANADA	N	FGN	520	264
YBR	BRANDON, MAN, CANADA	N	FGN	1252	948
YCB	CAMBRIDGE BAY, NWT, CANADA	N	FGN	239	296
YCG	CASTLEGAR, BC, CANADA	N	FGN	626	364
YCH	CHATHAM, NB, CANADA	N	FGN	626	550
YCL	CHARLO, NB, CANADA	N	FGN	626	550
YDF	DEER LAKE, NFLD, CANADA	N	FGN	2855	2432
YDQ	DAWSON CREEK, BC, CANADA	N	FGN	626	310
YEG	EDMONTON, ALTA, CANADA	N	FGN	11693	10938
YEV	INUVIK, NWT, CANADA	N	FGN	745	912
YFB	IQALIUT, NWT, CANADA	N	FGN	1769	1576
YFC	FREDERICTON, NB, CANADA	N	FGN	1342	1054
YFO	FLIN FLON, MAN, CANADA	N	FGN	420	374
YGJ	YONAGO, JAPAN	N	FGN	2190	2008
YGL	LA GRANDE, QUE, CANADA	N	FGN	1044	1092
YGW	KUUJJUARAPIK, QUE, CANADA	N	FGN	522	524
YGX	GILLAM, MAN, CANADA	N	FGN	832	848
YHD	DRYDEN, ONT, CANADA	N	FGN	2699	1520
YHY	HAY RIVER, NWT, CANADA	N	FGN	1252	1256
YHZ	HALIFAX, NS, CANADA	N	FGN	14221	14832
YJT	STEPHENVILLE, NFLD, CANADA	N	FGN	144	0
YKA	KAMLOOPS, BC, CANADA	N	FGN	2650	2804
YLW	KELOWNA, BC, CANADA	N	FGN	8790	7473
YMM	FT MCMURRAY, ALTA, CANADA	N	FGN	1148	1152
YMS	YURIMAGUAS, PERU	S	FGN	210	264

AIRPORT	APTDEF	HEMISPHR	CONUS	STGFY87	STGFY88
YMX	MONTREAL MIRABEL, QUE, CANADA	N	FGN	569	138
YNB	YANBU, SAUDI ARABIA	N	FGN	2513	2511
YNG	YOUNGSTOWN, OH, USA	N	YES	330	0
YOL	YOLA, NIGERIA	N	FGN	1279	1261
YOW	OTTAWA, ONT, CANADA	N	FGN	10695	15822
YPR	PRINCE RUPERT, BC, CANADA	N	FGN	1436	1412
YQB	QUEBEC, QUE, CANADA	N	FGN	1356	1003
YQD	THE PAS, MAN, CANADA	N	FGN	630	628
YQG	WINDSOR, ONT, CANADA	N	FGN	2351	1093
YQH	WATSON LAKE, YT, CANADA	N	FGN	335	184
YQM	MONCTON, NB, CANADA	N	FGN	0	557
YQR	REGINA, SASK, CANADA	N	FGN	3925	4110
YQT	THUNDER BAY, ONT, CANADA	N	FGN	6659	5058
YQU	GRANDE PRAIRIE, ALBA, CANADA	N	FGN	1568	912
YQX	GANDER, NFLD, CANADA	N	FGN	748	675
YQY	SYDNEY, NS, CANADA	N	FGN	1846	1464
YQZ	QUESNEL, BC, CANADA	N	FGN	442	304
YRB	RESOLUTE, NT, CANADA	N	FGN	417	418
YSB	SUBDURY, ONT, CANADA	N	FGN	1092	0
YSJ	SAINT JOHN, NB, CANADA	N	FGN	1358	1464
YSM	FT SMITH, NWT, CANADA	N	FGN	1252	1256
YSR	NANISIVIK NWT, CANADA	N	FGN	208	210
YTH	THOMPSON, MAN, CANADA	N	FGN	1006	1008
YUL	MONTREAL, QUEBEC, CANADA	N	FGN	19081	23752
YUM	YUMA, AZ, USA	N	YES	31	408
YUX	HALL BEACH, NWT, CANADA	N	FGN	210	210
YVO	VAL D'OR, QUE, CANADA	N	FGN	1887	1204
YVP	FT CHIMO, QUE, CANADA	N	FGN	1178	1036
YVQ	NORMAN WELLS, NWT, CANADA	N	FGN	1133	1618
YVR	VANCOUVER, BC, CANADA	N	FGN	38426	38128
YWG	WINNIPEG, MAN, CANADA	N	FGN	13898	16176
YWK	WABUSH, NFLD, CANADA	N	FGN	964	976
YWL	WILLIAMS LAKE, BC, CANADA	N	FGN	442	304
YXC	CRANBROOK, BC, CANADA	N	FGN	2712	2800
YXD	EDMONTON-MUNICIPAL, ALBERTA, CANADA	N	FGN	10271	11878
YXE	SASKATOON, SASK, CANADA	N	FGN	3934	4688
YXJ	FT ST JOHN, BC, CANADA	N	FGN	3958	3491
YXS	PRINCE GEORGE, BC, CANADA	N	FGN	5052	4592
YXT	TERRACE, BC, CANADA	N	FGN	1790	1412
YXU	LONDON, ONT, CANADA	N	FGN	422	992
YXY	WHITEHORSE, YT, CANADA	N	FGN	1479	1382
YYC	CALGARY, ALBERTA, CANADA	N	FGN	33327	33794
YYD	SMITHERS, BC, CANADA	N	FGN	904	1274
YYE	FT NELSON, BC, CANADA	N	FGN	962	548
YYF	PENTICTON, BC, CANADA	N	FGN	2964	1643
YYG	CHARLOTTETOWN, PEI, CANADA	N	FGN	1699	1403
YYJ	VICTORIA, BC, CANADA	N	FGN	871	1265
YYL	LYNN LAKE, MAN, CANADA	N	FGN	32	32
YYQ	CHURCHILL, MAN, CANADA	N	FGN	412	424
YYR	GOOSE BAY, NFLD, CANADA	N	FGN	1733	1721
YYT	ST JOHNS, NFLD, CANADA	N	FGN	4331	4782
YYY	MONT JOLI, QUE, CANADA	N	FGN	276	106
YYZ	TORONTO, ONTARIO, CANADA	N	FGN	44100	49334
YZF	YELLOWKNIFE, NWT, CANADA	N	FGN	3253	3578
YZP	SANDSPIT, BC, CANADA	N	FGN	774	1282
YZT	PORT HARDY, BC, CANADA	N	FGN	708	0
YZV	SETP-ILES, QUE, CANADA	N	FGN	603	612
ZAD	ZADAR, YUGOSLAVIA	N	FGN	52	109
ZAG	ZAGREB, YUGOSLAVIA	N	FGN	6743	8422
ZAH	ZAHEDAN, IRAN	N	FGN	88	210
ZCO	TEMUCO,CHILE	S	FGN	0	558
ZHA	ZHANGJIANG, P. R. CHINA	N	FGN	416	579
ZIH	IXTAPA/ZIHUATANEJO, MEXICO	N	FGN	44	146
ZNZ	ZANZIBAR, TANZANIA	S	FGN	1098	412
ZRH	ZURICH, SWITZERLAND	N	FGN	12226	13751
ZTH	ZAKINTHOS, GREECE	N	FGN	676	718
ZUM	CHURCHILL FALLS, NFLD, CANADA	N	FGN	216	210

APPENDIX B

CONTENTS OF FAA BIRD INGESTION DATA BASE
BOEING 737 AIRPLANE
OCTOBER 1986 - SEPTEMBER 1988

This appendix presents the contents of the Boeing 737 bird ingestion data base maintained by the FAA. The appendix presents actual data extracted from the FAA data base, and it consists of two sections. The first section contains the bird ingestion data supplied by the engine manufacturers and the second section contains data supplied to the FAA from other sources. The data base contents are described below:

COLUMN	DESCRIPTION OF COLUMN CONTENTS
EDATE	Date(mm/dd/yyyy) of ingestion event.
EVT#	FAA ingestion event sequence number reflecting order in which events were entered into the FAA bird ingestion data base.
ENG_POS	Engine position of engine ingesting bird. Since each engine ingestion event has a unique record in the data base, duplicate event numbers indicate multiple engine ingestion events. This column provides record uniqueness in such cases. 1 - left engine of 737 airplane 2 - right engine of 737 airplane
ETIME	Local time of bird ingestion.
SIGN_EVT	Significant event factors. AIRWRTHY - engine related airworthiness effects INV POS LOSS - involuntary power loss MULT BIRDS - multiple birds in 1 engine MULT ENG - multiple engine ingestion (1 bird in each engine) MULT ENG-BIRDS - multiple engine ingestion and 1 or both engines sustained multiple bird ingestion TRVS FRAC - transverse fan blade fracture OTHER - other significant factor, may be reported in narrative remarks NONE - no significant factor noted
AIRCRAFT	737 aircraft type.
POF	Phase of flight during which bird ingestion occurred. (TAXI;TAKEOFF;CLIMB;CRUISE;APPROACH;LANDING;UNKNOWN)
ALTITUDE	Altitude (ft. AGL) at time of bird ingestion.
SPEED	Air speed (knots) at time of bird ingestion.

FL_RULES — Flight rules in effect at time of bird ingestion.
- IFR - instrument flight rules
- VFR - visual flight rules
- UNK - unknown

LT_COND — Light conditions at time of bird ingestion.
(DARK;LIGHT;DAWN;DUSK;etc.)

WEATHER — Weather conditions at time of bird ingestion.

CREW_AC — Crew action taken in response to bird ingestion.
- ATO - aborted takeoff
- ATB - air turnback
- DIV - diversion
- UNK - unknown
- NONE - no crew action taken
- N/A - not applicable
- OTHER - some action taken, may be specified in narrative remarks

CREW_AL — Indicates whether crew alerted to presence of birds at time of bird ingestion.
(YES;NO;UNKNOWN)

BIRD_SEE — Indicates whether ingested bird(s) seen prior to ingestion
- NO - not seen
- YES - seen
- SEVERAL - 2 to 10 birds observed
- FLOCK - more than 10 birds observed

BIRD_NAM — Common bird name. Trailing asterisk (*) implies bird not positively identified as such.

BIRD_SPE — Species of positively identified bird. Alphanumeric identification code which conforms to Edward's† convention.

#_BIRDS — Number of birds ingested. An asterisk (*) implies more than one bird but the exact count is unknown.

WT_OZ_1 — Weight (oz.) of first ingested bird.

CTY_PRS — Scheduled city pairs of aircraft operation.
(from code:to code) 3 letter city airport code.
Reference AIRPORT column in Appendix A.

AIRPORT — Airport at which bird ingestion event occurred.
3 letter city airport code. Reference AIRPORT column in Appendix A.

LOCALE — Nearest town, state, country, etc.

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† Edwards, E.P., "A Coded List of Birds of the World," IBSN:911882-04-9, 1974.

US_INCID — Indicates whether bird ingestion occurred within United States boundaries.
(YES;NO)

ENGINE — Engine model. (CFM56;JT8D)

DASH — Engine dash number

DMG_CODE — Letter codes summarizing engine damage resulting from the bird ingestion. This column does not exist in the actual FAA data base, but was developed by the contractor to compress 17 YES/NO damage fields into a single column. A letter code appears for damage columns whose values are YES. Each page of damage information contains a legend identifying the damage type. In the explanation of damage codes below, a number in parentheses indicates the damage severity code which is further explained in the SEVERITY column. The data base column name is given in the explanation of the damage code.

- A(4) - ENG_DAM; engine damaged due to bird ingestion
- B(3) - LEAD_EDG; leading edge distortion/curl, minor fan blades
- C(3) - BEN/DEN; 1 to 3 fan blades bent or dented
- D(2) - BE/DE73; more than 3 fan blades bent or dented
- E(3) - TORN<3; 1 to 3 fan blades torn
- F(2) - TORN73; more than 3 fan blades torn
- G(2) - BROKEN; broken fan blade(s). leading edge and/or tip pieces missing; other blades also dented
- H(3) - SHINGLED; shingled (twisted) fan blades
- I(1) - TRVSFRAC; transverse fracture - a fan blade broken chordwise (across) and the piece liberated (includes secondary hard object damage)
- J(2) - SPINNER; dented, broken, or cracked spinner (includes spinner cap)
- K(1) - CORE; bent/broken compressor blades/vanes, blade/vane clash, blocked/disrupted airflow in low, intermediate, and high pressure compressors
- L(3) - NACELLE; dents and/or punctures to the engine enclosure (includes cowl)
- M(1) - FLANGE; flange separations
- N(2) - RELEASED; released (walked) fan blades (blade retention mechanism broken)
- O(1) - TURBINE; turbine damage
- P - OTHER; any damage not previously listed
- Q - UNKNOWN

NOTE: The maximum number of damage codes listed for an engine ingestion event is three. These three damage codes reflect the most severe damage that occurred. There may be other damage that occurred which is less severe that may be listed in the remarks column.

SEVERITY — Numeric code indicating the severity of engine damage resulting from the bird ingestion. This column does not exist in the actual FAA data base, but was developed by the contractor as a result of an analysis of reported damage in the data base. The lower the severity code, the more severe the damage. The severity rating assigned to a flight is determined as the lowest severity rating attained by any of the damage categories. The corresponding severity ratings for each damage category were given in parentheses in the DMG_CODE discussion above.

1 - most severe damage (damage is known)
2 - moderately severe damage (damage is known)
3 - least severe damage (damage is known)
4 - damage indicated, but not specified

POW_LOSS Degree of power loss as a result of bird ingestion
NONE - no power loss
EPR DEC - engine pressure ratio decrease
SPOOL DOWN - engine spooled down
N1 CHANGE - N1 rotor change
N2 CHANGE - N2 rotor change
COMPRESSOR - compressor surge/stall
UNKNOWN - unknown whether power loss occurred

MAX_VIBE Maximum vibration reported as a dimensionless unit.

THROTTLE Voluntary throttle change by crew in response to bird ingestion.
ADVANCE - voluntary throttle advance
RETARD - voluntary throttle retard
IDLE - voluntary throttle retard to idle
CUTOFF voluntary throttle retard to cutoff
NONE - no voluntary throttle change

IFSD Indicate whether a voluntary in-flight shutdown occurred in response to bird ingestion.
NO - no shutdown
VIBES - shutdown due to vibrations
STAL/SURG - shutdown due to compressor stall/surge
HI EGT - shutdown due to high exhaust gas temperature
EPR - shutdown due to incorrect engine pressure ratio
INVLNTRY - involuntary engine shutdown
PARAMTRS - shutdown due to incorrect engine parameters
VLNTRY - voluntary engine shutdown
OTHER - other reasons, may be listed in remarks
UNKNOWN - unknown cause for shutdown

REMARKS Narrative description providing additional information concerning some aspect of the ingestion.

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM
10/01/1986	1	1		NONE	300	UNKNOWN						NONE			
10/02/1986	2	2	16:20:00	NONE	300	CLIMB	700		IFR		OVERCAST	DIV			
10/02/1986	3	2		NONE	300	TAXI	0								
10/04/1986	235	2		NONE	200	UNKNOWN									
10/05/1986	4	1		NONE	300	TAKEOFF	100	160	VFR		CLEAR	ATB	NO-	YES	GULL*
10/08/1986	5	2		NONE	300	TAXI	0		VFR	LIGHT	CLEAR	NONE			
10/10/1986	233	2		NONE	200	UNKNOWN									
10/13/1986	6	1	8:00:00	MULT ENG	300	TAKEOFF		146	VFR	DAWN	SCATTERED	ATB		FLOCK	GRAY-HEADED LAPWING
10/13/1986	6	2	8:00:00	MULT ENG	300	TAKEOFF		146	VFR	DAWN	SCATTERED	ATB		FLOCK	GRAY-HEADED LAPWING
10/14/1986	232	2		NONE	200	LANDING	0	125							
10/16/1986	7	1		MULT ENG-BIRDS	300	APPROACH					CLEAR	NONE		FLOCK	STARLING
10/16/1986	7	2		MULT ENG-BIRDS	300	APPROACH					CLEAR	NONE		FLOCK	STARLING
10/19/1986	230	1		NONE	200	LANDING	0	90							
10/19/1986	231	1		NONE	200	TAKEOFF									
10/20/1986	228	1		NONE	200	UNKNOWN									
10/20/1986	229	1		NONE	200	TAKEOFF	0					ATO			
10/21/1986	226	2		NONE	200	TAKEOFF									
10/21/1986	227	1		NONE	200	TAKEOFF		145				ATB			
10/23/1986	62	1		MULT BIRDS	200	TAKEOFF						NONE			
10/25/1986	236	2		NONE	200	UNKNOWN									
10/26/1986	8	1		MULT ENG	300	TAKEOFF			VFR			DIV			
10/26/1986	8	2		MULT ENG	300	TAKEOFF			VFR			DIV			
10/28/1986	9	1		MULT ENG-BIRDS	200	APPROACH								SEVERAL	ROCK DOVE
10/28/1986	9	2		MULT ENG-BIRDS	200	APPROACH								SEVERAL	ROCK DOVE
10/28/1986	10	1		NONE	300	UNKNOWN						NONE			
10/29/1986	11	1		NONE	300	TAKEOFF	0	130	VFR	DAY	PARTLY CLOUD	ATB	YES	FLOCK	ROBIN OR PIGEON*
10/29/1986	12	1		NONE	300	CLIMB		90				NONE		SEVERAL	GULL*
10/30/1986	225	1		NONE	200	LANDING	0	20							
11/01/1986	13	1		NONE	200	UNKNOWN								NO	NIGHTHAWK
11/03/1986	14	1		NONE	300	UNKNOWN	0					NONE			
11/04/1986	15	1		NONE	300	TAKEOFF	0	<100	VFR		OVERCAST	NONE	NO	NO	
11/04/1986	73	2		NONE	200	TAKEOFF	0	145							
11/04/1986	161	1		NONE	200	UNKNOWN									
11/07/1986	16	2		NONE	200	UNKNOWN									
11/07/1986	74	1		NONE	200	LANDING	0	125							
11/09/1986	17	1		NONE	300	UNKNOWN						NONE			
11/09/1986	18	2		NONE	300	APPROACH						NONE			
11/10/1986	19	2		NONE	300	UNKNOWN						NONE			
11/10/1986	20	1	21:13:00	NONE	200	TAKEOFF	100		VFR	DARK	CLEAR	NONE	YES		
11/14/1986	75	1		NONE	200	TAKEOFF	0	145				ATB			
11/14/1986	76	1		NONE	200	TAKEOFF	0					ATO			
11/15/1986	21	1	18:30:00	MULT ENG-BIRDS	200	TAKEOFF				DARK		NONE	NO	NO	ROCK DOVE
11/15/1986	21	2	18:30:00	MULT ENG-BIRDS	200	TAKEOFF				DARK		NONE	NO	NO	ROCK DOVE
11/15/1986	22	2		NONE	300	UNKNOWN						NONE			
11/15/1986	23	2		NONE	300	LANDING						NONE			GRAY-HEADED LAPWING
11/18/1986	24	2		NONE	300	TAKEOFF						ATB			
11/20/1986	25	1	15:51:00	NONE	200	TAKEOFF	0	120	VFR	LIGHT	CLEAR	NONE	NO	NO	
11/22/1986	26	1	23:08:00	NONE	200	APPROACH	500			DARK	CLEAR	NONE		SEVERAL	
11/23/1986	27	1		MULT ENG	300	UNKNOWN									
11/23/1986	27	2		MULT ENG	300	UNKNOWN						NONE			
11/23/1986	28	1	13:00:00	NONE	300	TAKEOFF				LIGHT	CLEAR	NONE			
11/24/1986	300	1		MULT ENG	200	UNKNOWN									
11/24/1986	300	2		MULT ENG	200	UNKNOWN									
11/26/1986	29	1	15:50:00	NONE	200	TAKEOFF	0		VFR	LIGHT	CLEAR	OTHER	NO	NO	BLACK WINGED PLOVER
11/26/1986	30	2	19:30:00	NONE	200	TAKEOFF	0			DARK				YES	RING BILLED GULL
11/27/1986	31	1		NONE	300	LANDING						NONE			
11/29/1986	77	1		NONE	200	LANDING									
12/03/1986	32	1	7:14:00	MULT BIRDS	200	UNKNOWN									
12/08/1986	34	1	16:00:00	NONE	300	APPROACH					OVERCAST	NONE		FLOCK	
12/12/1986	35	2	19:00:00	NONE	300	CLIMB	500	180	VFR	DARK	CLEAR	NONE			
12/13/1986	36	1		MULT BIRDS	300	CLIMB	500		IFR		RAIN	ATB			
12/13/1986	79	2		MULT BIRDS	200	UNKNOWN									
12/14/1986	37	2	15:30:00	NONE	300	CLIMB	1000	190	IFR	DAY	OVERCAST	ATB	NO	FLOCK	HERRING GULL
12/14/1986	57	2		NONE	200	TAKEOFF	0	100				ATB			
12/15/1986	81			NONE	200	TAKEOFF	0	145							
12/17/1986	38	2		NONE	200	LANDING	0					ATB	NO	YES	MALLARD
12/17/1986	162	2		NONE	200	UNKNOWN									
12/19/1986	82	2		NONE	200	LANDING	0	90							
12/20/1986	58	1		NONE	200	TAKEOFF	0	130				ATB			
12/24/1986	237	2		NONE	200	TAKEOFF									
12/26/1986	42	2		TRVS FRAC	200	CLIMB	150				OVERCAST	ATB		YES	HERRING GULL
12/31/1986	39	1	11:39:00	MULT ENG	300	LANDING				LIGHT	CLEAR	NONE			
12/31/1986	39	2	11:39:00	MULT ENG	300	LANDING				LIGHT	CLEAR	NONE			
01/02/1987	43	2		NONE	200	TAKEOFF	0	50				ATO			
01/02/1987	301	1		NONE	200	LANDING	0	115							

BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
				BEG	BELGRADE, YUGOSLAVIA	NO	CFM56	3	A,B	3	NONE	2.0	NONE	NO	
				TVL	LAKE TAHOE, CA	YES	CFM56	3	A,B	3		4.0	NONE	NO	
				CTU	CHENGOU, CHINA	NO	CFM56	3	A,B	3			NONE	NO	
	1			XFO	CHINA	NO	JT8D		A,G	2					
	1			MDT	HARRISBURG, PA	YES	CFM56	3	A,H	3	NONE		NONE	NO	AM EVENT, MEDIUM BIRD
				PEK	BEIJING, CHINA	NO	CFM56	3			NONE		NONE	NO	
	1		BOM-	XFO	INDIA	NO	JT8D		A,H	3					
5N20	1	9.		KMG	KUNMING, CHINA	NO	CFM56	3	A,B,E	3		5.0	IDLE	NO	
5N20	1	9.		KMG	KUNMING, CHINA	NO	CFM56	3			NONE		NONE	NO	
	1		-BOM	BOM	BOMBAY, INDIA	NO	JT8D								THUD REPORTED
21Z75	1	3.		DAL	DALLAS/FT WORTH, TEX-LOVE	YES	CFM56	3			NONE		NONE	NO	
21Z75	3	3.		DAL	DALLAS/FT WORTH, TEX-LOVE	YES	CFM56	3			NONE		NONE	NO	
	1		-TRV	TRV	TRIVANDRUM, INDIA	NO	JT8D	9A							
			ELS-	ELS	EAST LONDON, SOUTH AFRICA	NO	JT8D	17							
	1			XFO	CHINA	NO	JT8D								
	1		CCU-	CCU	CALCUTTA, INDIA	NO	JT8D		A,C	3					
	1			XFO		NO	JT8D	17	A,C,G	2					
	1		GAU-	GAU	GAUHATI, INDIA	NO	JT8D	17A	A,C	3		YES			VIBRATION, THUD, SMELL
	*			GHU	GUALEQUAYCHU, CHINA	NO	JT8D	17A	A,B	3			NONE	NO	7 FAN BLADES REQUIRED LE TIP REPAIR
	1			XFO		NO	JT8D		A,C	3					3 FAN BLADES BENT
	1			SNA	ORANGE COUNTY, CA	YES	CFM56	3			NONE		NONE	NO	
	1			SNA	ORANGE COUNTY, CA	YES	CFM56	3	A,H	3	NONE	3.0	NONE	NO	
2P1	*	14.	PIT-ROA	ROA	ROANOAK, VA	YES	JT8D	15			NONE		NONE	NO	
2P1	1	14.	PIT-ROA	ROA	ROANOAK, VA	YES	JT8D	15			NONE		NONE	NO	TURBINE FAILED ON 11/10/86
				DAL	DALLAS/FT WORTH, TEX-LOVE	YES	CFM56	3			NONE		NONE	NO	
				CLT	CHARLOTTE, NC	YES	CFM56	3	A,C,H	3	NONE	5.0	IDLE	NO	
	1			BHM	BIRMINGHAM, ALA	YES	CFM56	3			NONE		NONE	NO	
	1	4.	GAU-	XFO	INDIA	NO	JT8D								
5T5	1	2.		XUS		YES	JT8D	15			NONE		NONE	NO	
				KHI	KARACHI, PAKISTAN	NO	CFM56	3	A,H	3	NONE	3.8	NONE	NO	
	1			ALB	ALBANY, NY	YES	CFM56	3	A,B,H	3	NONE		NONE	NO	
	1			HYD	HYDERABAO, INDIA	NO	JT8D							NO	
	1			XFO		NO	JT8D		A,C	3				NO	
			-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D	15			NONE		NONE	NO	
	1			SXR	SRINAGAR, INDIA	NO	JT8D	17A						NO	
				SAT	SAN ANTONIO, TEX	YES	CFM56	3			NONE		NONE	NO	
				DEN	DENVER, COL	YES	CFM56	3			NONE		NONE	NO	
			CLT-DCA	CLT	CHARLOTTE, NC	YES	CFM56	3			NONE	4.0	NONE	NO	
	1		PEN-KUL	PEN	PENANG, MAY	NO	JT8D	15A	A,C	3	NONE		NONE	NO	
	1			BLR	BANGALORE, INDIA	NO	JT8D							NO	
	1			BBI	BHUBANESWAR, INDIA	NO	JT8D							NO	
2P1	2	14.	ORD-CLT	ORD	CHICAGO, IL	YES	JT8D	15	A,C,E,G	2	NONE		NONE	NO	
2P1	1	14.	ORD-CLT	ORD	CHICAGO, IL	YES	JT8D	15	A,G	2	NONE		NONE	NO	
				CNS	CAIRNS, OLD.,AUSTRALIA	NO	CFM56	3	A,C,H	3	NONE		NONE	NO	
5N20	1	7.		AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3			NONE		NONE	NO	
				DFW	DALLAS/FT WORTH, TEX	YES	CFM56	3	A,H	3	NONE	5.0	IDLE	NO	
	1		LIH-HNL	LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	A,B,C	3	NONE		NONE	NO	SMALL BIRD
	1		KUL-ARD	ARD	KEDAH, MALAYSIA	NO	JT8D	15	A,D,H	2	NONE		NONE	NO	
	1			LHE	LAHORE, PAKISTAN	NO	CFM56	3	A	4	NONE		NONE	NO	
	1			LHE	LAHORE, PAKISTAN	NO	CFM56	3	A	4	NONE		NONE	NO	
				HOU	HOUSTON, TEX	YES	CFM56	3	A,B,H	3	NONE	HIGH	NONE	NO	
	1		-WLG	XFO	WELLINGTON, NEW ZEALAND	NO	JT8D								ODOR
	1		-WLG	XFO	WELLINGTON, NEW ZEALAND	NO	JT8D								ODOR
5N10	1	6.	LLW-BLZ	LLW	LILONGWE, MALAWI	NO	JT8D	17A	A,D,G	2	NONE		NONE	NO	ODOR IN CABIN
14N12	1	16.	LGA-CLE	LGA	NEW YORK, NY	YES	JT8D	7	A,C,G	2	NONE		NONE	NO	
				PDX	PORTLAND, ORE	YES	CFM56	3			NONE		NONE	NO	
	1			BLR	BANGALORE, INDIA	NO	JT8D							NO	
	2			VDM	ARGENTINA	NO	JT8D		A,G	2				NO	
				DAL	DALLAS/FT WORTH, TEX-LOVE	YES	CFM56	3			NONE		NONE	NO	
				TFS	TENERIFE	NO	CFM56	3	A,H	3	NONE	2.0	NONE	NO	
	*			AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3	A,B	3	NONE	OFFSC	IDLE	VIBES	
	*			XFO		NO	JT8D							NO	
14N14	1	40.		SFO	SAN FRANCISCO/OAKLAND, CA	YES	CFM56	3	A,B,H	3	NONE		NONE	NO	
				CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D	15			NONE	NONE	NONE	NO	
	1			MAD	MADRID, SPAIN	NO	JT8D							NO	
2J84	1	40.	MSO-MSO	MSO	MISSOULA, MONT	YES	JT8D		A,D,H	2	NONE			NO	ATB DUE TO WEATHER
	1			XFO		NO	JT8D		A,C	3				NO	
	1			TRV	TRIVANDRUM, INDIA	NO	JT8D	9A						NO	
	1			CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D	15	A,C	3	NONE		NONE	NO	
				XFO	BRAZIL	NO	JT8D	17A	A,C	3				YES	
14N14	1	40.	ORD-MSY	ORD	CHICAGO, IL	YES	JT8D	7	A,D,F,G,I,N	1		VIBS			#1 CMPT FIRE
	1			HOU	HOUSTON, TEX	YES	CFM56	3			NONE		NONE	NO	
	1			HOU	HOUSTON, TEX	YES	CFM56	3	A,H	3	NONE	HIGH	NONE	NO	
	1		FAT-BFL	FAT	FRESNO, CA	YES	JT8D	17			COMPRESSOR		IDLE	NO	
			OKA-MMY	MMY	MIYAKO JIMA, JAPAN	NO	JT8D								

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE
01/04/1987	302			NONE	200	TAKEOFF	0	130											MMY-OKA	MMY	MIYAKO JIMA, JAPAN	NO	JT8D
01/07/1987	44	1		MULT BIRDS	300	LANDING						NONE					2			MEL	MELBOURNE, AUSTRALIA	NO	CFM56
01/08/1987	83	1		NONE	200	LANDING	0										1	4.		JAI	JAIPUR, INDIA	NO	JT8D
01/09/1987	84	2		NONE	200	UNKNOWN											1			VNS	VARANASI, INDIA	NO	JT8D
01/09/1987	238	1		NONE	200	TAKEOFF	0	130			SCATTERED						1			MAN	MANCHESTER, ENGLAND	NO	JT8D
01/09/1987	303			NONE	200	UNKNOWN													-AKL	XFO	AUCKLAND, NEW ZEALAND	NO	JT8D
01/09/1987	304	1		NONE	200	UNKNOWN													-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
01/10/1987	45	1		MULT BIRDS	300	LANDING						NONE		SEVERAL	CROW*		*			LST	LAUNCESTON, TASMANIA	NO	CFM56
01/16/1987	40	1		NONE	200	TAKEOFF			VFR			ATB		NO	HORNED LARK	17Z74	1	2.	OAK-NR	OAK	SAN FRANCISCO, CA-OAKLAND	YES	JT8D
01/17/1987	46	1		TRVS FRAC	300	TAKEOFF	0	-V1			ICY	DIV								MUC	MUNICH, GERMANY	NO	CFM56
01/19/1987	41	2	17:30:00	NONE	200	CLIMB	200	150	VFR	DUSK	SCATTERD	ATB	NO	FLOCK	CANADIAN GOOSE	2J30	1	128.	RNO-DEN	RNO	RENO, NEV	YES	JT8D
01/28/1987	47	1		MULT ENG	300	LANDING						NONE		FLOCK	GULL*		1			TGD	TITOGRAD, YUGOSLAVIA	NO	CFM56
01/28/1987	47	2		MULT ENG	300	LANDING						NONE		FLOCK	GULL*		1			TGD	TITOGRAD, YUGOSLAVIA	NO	CFM56
01/31/1987	239	2	12:58:00	NONE	200	LANDING	0	110			CLEAR	NONE	NO	FLOCK	GULL*		1			LCA	LARNACA, CYPRUS	NO	JT8D
02/06/1987	356	2		NONE	200	LANDING														XFO	SOUTH AFRICA	NO	JT8D
02/08/1987	240	2		NONE	200	UNKNOWN														XFO		NO	JT8D
02/10/1987	305	1		NONE	200	TAKEOFF														AKL	AUCKLAND, NEW ZEALAND	NO	JT8D
02/11/1987	85	2		NONE	200	UNKNOWN											1			TRV	TRIVANDRUM, INDIA	NO	JT8D
02/17/1987	59	1	10:30:00	NONE	200	TAKEOFF	35	150	VFR	DAY	CLEAR	ATB	NO	ONE	GOLDEN PLOVER	5N25	1	6.	OGG-HNL	OGG	KAHULUI, MAUI, HAWAII	YES	JT8D
02/19/1987	60	1	16:00:00	NONE	200	TAKEOFF	0					ATO					1		DUR-PLZ	DUR	DURBAN, SOUTH AFRICA	NO	JT8D
02/23/1987	61	2	10:30:00	NONE	200	CLIMB	10000	200	VFR	DAY	CLEAR	NONE	NO	NO	GLAUCOUS WINGED GULL	14N22	1	56.	PDX-RNO	PDX	PORTLAND, ORE	YES	JT8D
02/25/1987	241	1	11:55:00	NONE	200	TAKEOFF	0	145			SCATTERED			YES			1			MUC	MUNICH, GERMANY	NO	JT8D
02/27/1987	49	1		NONE	300	CLIMB			VFR		CLEAR	NONE								ALB	ALBANY, NY	YES	CFM56
02/27/1987	242	2	6:10:00	NONE	200	LANDING	0	100			RAIN		NO	SEVERAL			1			STR	STUTTGART, GERMANY	NO	JT8D
02/28/1987	86	2		NONE	200	TAKEOFF						ATB					1			CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
03/02/1987	306	2		NONE	200	UNKNOWN													-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
03/10/1987	50	1		NONE	300	LANDING					OVERCAST	NONE			SHORE (HORNED) LARK	17Z74	1	1.5		PEK	BEIJING, CHINA	NO	CFM56
03/11/1987	358	1		NONE	200	LANDING	100	124						NO					DEN-OAK	OAK	SAN FRANCISCO, CA-OAKLAND	YES	JT8D
03/12/1987	359	2		NONE	200	UNKNOWN														XFO		NO	JT8D
03/13/1987	63	2	13:20:00	NONE	200	TAKEOFF	50	125	VFR	DAY	CLEAR	NONE	NO	SEVERAL			1		LIH-HNL	LIH	LIHUE, KAUAI, HAWAII	YES	JT8D
03/16/1987	87	2		NONE	200	UNKNOWN											1			IXB	BAGDOGRA, INDIA	NO	JT8D
03/17/1987	64	1	7:45:00	NONE	200	UNKNOWN	400		VFR			NONE		NO	BLACK-HEADED GULL	14N36	1	10.	BAH-DHA	XFO	SAUDI-ARABIA	NO	JT8D
03/18/1987	88	2		NONE	200	UNKNOWN											1			JAI	JAIPUR, INDIA	NO	JT8D
03/19/1987	51	1		NONE	300	APPROACH						NONE								SYD	SIDNEY, NSW, AUSTRALIA	NO	CFM56
03/21/1987	52	1	13:50:00	NONE	300	LANDING						NONE								ZRH	ZURICH, SWITZERLAND	NO	CFM56
03/21/1987	53	1	19:00:00	NONE	300	TAKEOFF	1200	150	IFR		CLEAR	ATB			DUCK OR GOOSE*					MSP	MINN./ST. PAUL, MINN	YES	CFM56
03/21/1987	65	1	15:00:00	NONE	200	TAKEOFF	0	150			CLEAR	ATB		NO	GULL*				PIE-YYZ	PIE	ST. PETERSBURG, FL	YES	JT8D
03/21/1987	89	1		NONE	200	UNKNOWN											1			PAT	PATNA, INDIA	NO	JT8D
03/21/1987	90	2		MULT BIRDS	200	UNKNOWN											*			XFO		NO	JT8D
03/23/1987	54	1		NONE	300	UNKNOWN						NONE								UET	QUETTA, PAKISTAN	NO	CFM56
03/25/1987	307	2		NONE	200	TAKEOFF	0	120											MMY-OKA	MMY	MIYAKO JIMA, JAPAN	NO	JT8D
03/26/1987	66	1	18:35:00	INV POW LOSS	200	TAKEOFF	0	139			RAIN	ATB		YES	SPOTTED THICK-KNEE	9N4	1	15.	JNB-DUR	JNB	JOHANNESBURG, SOUTH AFRICA	NO	JT8D
03/26/1987	67	1		NONE	200	LANDING	0	80			CLEAR			NO			1		JNB-WDH	WDH	NAMIBIA, S.W. AFRICA	NO	JT8D
03/27/1987	91	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D
03/28/1987	55	2		NONE	300	TAKEOFF	1000		VFR		CLEAR	NONE							FLL-PHL	FLL	FT.LAUDERDALE/HOLLYWOOD,FL	YES	CFM56
03/29/1987	92	2		NONE	200	TAKEOFF	0	145				ATB					1			AKL	AUCKLAND, NEW ZEALAND	NO	JT8D
03/29/1987	243	2	12:47:00	NONE	200	LANDING	0	114			SCATTERED		NO	ONE			1			XFO	GERMANY	NO	JT8D
03/29/1987	360			NONE	200	LANDING	0	114												NCE	NICE, FRANCE	NO	JT8D
03/30/1987	56	1		NONE	300	TAKEOFF						ATB								DEN	DENVER, COL	YES	CFM56
03/30/1987	308	2		NONE	200	UNKNOWN													-AKL	XFO	AUCKLAND, NEW ZEALAND	NO	JT8D
04/01/1987	68	2	14:10:00	MULT BIRDS	200	TAKEOFF	0	90			CLEAR	ATO		FLOCK	SWALLOW*		*		PLZ-LON	PLZ	PORT ELIZABETH, S. AFRICA	NO	JT8D
04/03/1987	244	2	9:00:00	NONE	200	TAXI	0	40			SCATTERED			SEVERAL			1			FRA	FRANKFURT, GERMANY	NO	JT8D
04/03/1987	309			NONE	200	TAKEOFF														CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
04/05/1987	245	2	23:59:00	NONE	200	CLIMB	10	140			SCATTERED		NO	YES						KCH	KUCHING, MALAYSIA	NO	JT8D
04/07/1987	93	2		NONE	200	LANDING	0	90									1			CCU	CALCUTTA, INDIA	NO	JT8D
04/07/1987	361			NONE	200	UNKNOWN														XFO	ZAIRE	NO	JT8D
04/09/1987	106	1	19:40:00	NONE	300	TAKEOFF	0	-V1			CLEAR	DIV								CPH	COPENHAGEN, DENMARK	NO	CFM56
04/11/1987	107	1	22:30:00	NONE	300	CLIMB	600	160	IFR	DARK	CLEAR	NONE							SYD-MEL	SYD	SYDNEY, NSW, AUSTRALIA	NO	CFM56
04/12/1987	246	2		MULT BIRDS	200	APPROACH	100	140			SCATTERED		YES	SEVERAL			2			ZTH	ZAKINTHOS, GREECE	NO	JT8D
04/14/1987	108	1		NONE	300	UNKNOWN						NONE								FRA	FRANKFURT, GERMANY	NO	CFM56
04/17/1987	109	2		NONE	300	UNKNOWN									AMERICAN KESTREL	5K26	1	4.		DAL	DALLAS/FT.WORTH,TEX-LOVE	YES	CFM56
04/21/1987	70	1		NONE	200	TAKEOFF	0	130				ATB			ROCK DOVE	2P1	1	14.		XFO		NO	JT8D
04/22/1987	247		8:03:00	NONE	200	CLIMB		210			CLEAR		NO	NO			1			PEN	PENANG, MALAYSIA	NO	JT8D
04/23/1987	248	2	10:38:00	NONE	200	TAKEOFF	0	110			CLEAR		NO	YES			1			MAN	MANCHESTER, ENGLAND	NO	JT8D
04/26/1987	310	2		NONE	200	UNKNOWN													-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
04/26/1987	311	2		NONE	200	TAKEOFF													WLG-DUD	WLG	WELLINGTON, NEW ZEALAND	NO	JT8D
05/01/1987	312	1		NONE	200	UNKNOWN													-AKL	XFO	AUCKLAND, NEW ZEALAND	NO	JT8D
05/01/1987	362			NONE	200	UNKNOWN														XFO	NIGERIA	NO	JT8D
05/03/1987	69	2		NONE	200	TAKEOFF	0	150				ATB							PIE-YYZ	PIE	ST. PETERSBURG, FL	YES	JT8D
05/04/1987	110	1	18:38:00	NONE	300	TAKEOFF		+V1											SAT-HOU	SAT	SAN ANTONIO, TEX	YES	CFM56
05/10/1987	94	1		NONE	200	UNKNOWN											1			JRH	JORHAT, INDIA	NO	JT8D
05/10/1987	111	2	22:00:00	NONE	300	TAKEOFF					RAIN								LIT-HOU	LIT	LITTLE ROCK, ARK	YES	CFM56
05/12/1987	95	1		NONE	200	UNKNOWN											1			BOM	BOMBAY, INDIA	NO	JT8D
05/17/1987	313	2		NONE	200	LANDING														CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
05/18/1987	249	1	13:40:00	MULT BIRDS	200	APPROACH	300	140			SCATTERED		NO	YES			2			LHR	LONDON, ENGLAND-HEATHROW	NO	JT8D

DASH	DMG_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
3			NONE	NONE	NONE	NO	
						NO	
						NO	
							ODOR
3	A	4	NONE		NONE	NO	
17	A,O	1	EPR DEC		CUTOFF	VIBES	
3	A,C,I	1	NONE		NONE	NO	
17	A,G	2	NONE		NONE	NO	
3			NONE		NONE	NO	
3	A,H	3	NONE		NONE	NO	
							MEDIUM BIRD
17	A,C	3					
15	A,C	3					ENGINE REMOVED FOR FAN ASSEMBLY OVERHAUL
							ODOR
						NO	
9A	A,C,H	3	NONE		NONE	NO	SMALL BIRD
17A			NONE		NONE	NO	
7	A,D,G	2	NONE	NONE	NONE	NO	
3	A,H	3	NONE	4.9	NONE	NO	
15						NO	LARGE BIRD
15	A,G	2				NO	
3			NONE		NONE	NO	
17A	A,C	3					
9A			NONE		NONE	NO	MEDIUM BIRD
	A,H	3				NO	
15	A,D,H	2	NONE		NONE	NO	
						NO	
3			NONE		NONE	NO	
3	A,H	3	NONE		NONE	NO	
3	A,H	3	NONE	4.0	IDLE	NO	
9A	A,G	2	NONE			NO	
17	A,H	3				NO	
						NO	
3	A,D,E	2	NONE		NONE	NO	
17A	A,C	3	COMPRESSOR	HIGH	CUTOFF	INVLNTRY	
17A	A,C	3	NONE		NONE	NO	
						NO	
3	A,D	2	NONE		NONE	NO	
15	A,D,H	2				NO	
						NO	
15							
3	A,H	3	NONE		NONE	NO	
17A			COMPRESSOR		IDLE	NO	
						NO	SMALL BIRD
17						NO	
15	A,C	3					
3	A,H	3	NONE	3.9		NO	
3	A,C	3	NONE			NO	
						NO	
3			NONE			NO	
3			NONE			NO	
17A	A,G	2	COMPRESSOR				
	A,C	3				NO	
							SMALL BIRD
							ODOR
15A	A,G	2					
9A			COMPRESSOR		NONE	NO	
3			NONE			NO	
	A,H	3				NO	
3			NONE			NO	
						NO	
							LARGE BIRD
15							

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_CODE
05/20/1987	250	2	8:17:00	MULT BIRDS	200	TAKEOFF	0	100			CLEAR			SEVERAL			2			AOR	ALOR SETAR, MALAYSIA	NO	JT8D		
05/22/1987	96	1		NONE	200	UNKNOWN											1			BLR	BANGALORE, INDIA	NO	JT8D		A,H
05/22/1987	97	1		NONE	200	TAKEOFF	0	85				ATO					1			VNS	VARANASI, INDIA	NO	JT8D		
05/22/1987	98	1		NONE	200	UNKNOWN											1			XFO		NO	JT8D		
05/24/1987	99	1	7:35:00	TRVS FRAC	200	TAKEOFF	0	140	VFR			ATB		YES	CATTLE EGRET	1135	1	16.		LOS	LAGOS, NIGERIA	NO	JT8D	15	A,I
05/24/1987	251	2	6:30:00	NONE	200	LANDING	0	90			SCATTERED						1			ELS	EAST LONDON, SOUTH AFRICA	NO	JT8D		
05/25/1987	164	2	8:53:00	NONE	200	TAKEOFF	15		VFR		CLEAR			ONE	SPARROW*		1	3.		CGN	COLOGNE/BONN, GERMANY	NO	JT8D	15	
05/26/1987	252	1	16:00:00	NONE	200	APPROACH	300				CLEAR		NO	YES						KUL	KUALA LUMPUR, MALAYSIA	NO	JT8D		
05/27/1987	314	2		NONE	200	UNKNOWN													-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D		
05/28/1987	100	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,H
05/28/1987	165	1	20:30:00	NONE	200	APPROACH	300	150	VFR		SCATTERED			YES	SWALLOW*		1	3.	-FRA	FRA	FRANKFURT, GERMANY	NO	JT8D	15	
05/29/1987	112	2		NONE	300	UNKNOWN														AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3	
05/30/1987	253	2	10:50:00	NONE	200	APPROACH	82	140			CLEAR		NO	YES			1			ALG	ALGIERS, ALGERIA	NO	JT8D	15	
05/31/1987	113	2	14:55:00	NONE	300	TAKEOFF	0	110		BRIGHT	CLEAR	NONE								TNG	TANGER, MOROCCO	NO	CFM56	3	A,D
05/31/1987	254	1	17:06:00	NONE	200	APPROACH	150	135					YES	SEVERAL			1			DUB	DUBLIN, IRELAND	NO	JT8D		
06/02/1987	71	1	16:05:00	NONE	200	TAKEOFF	0		VFR		CLEAR	ATO	NO	NO	GULL*		1		ORF-CVG	ORF	NORFOLK, VA	YES	JT8D	15A	A,D
06/03/1987	315	1		NONE	200	LANDING	50	120											ISG-MMY	MMY	MIYAKO JIMA, JAPAN	NO	JT8D		
06/04/1987	114	1	14:45:00	NONE	300	TAKEOFF		+V1				NONE							KGS-GEN	KGS	KOS, GREECE	NO	CFM56	3	
06/05/1987	115	2		NONE	300	LANDING					CLEAR									GRZ	GRAZ, AUSTRIA	NO	CFM56	3	A,H
06/08/1987	116	1		NONE	300	CRUISE														SLC	SALT LAKE CITY, UT	YES	CFM56	3	A
06/09/1987	255	1	20:20:00	NONE	200	TAKEOFF	0	120			SCATTERED	ATO		YES			1			XFO	FRANCE	NO	JT8D		
06/10/1987	101	1	16:10:00	NONE	200	LANDING	0	120	VFR					YES			1		YYC-YXD	YXD	EDMONTON, ALTA-MUN.,CANADA	NO	JT8D	9A	
06/13/1987	117	1		NONE	300	TAKEOFF		+V1			CLEAR	ATB								LNZ	LINZ, AUSTRIA	NO	CFM56	3	A,H
06/13/1987	256	1	4:03:00	MULT ENG	200	TAKEOFF	0				SCATTERED			YES			1			LIN	MILAN, ITALY	NO	JT8D		
06/13/1987	256	2	4:03:00	MULT ENG	200	TAKEOFF	0				SCATTERED			YES			1			LIN	MILAN, ITALY	NO	JT8D		
06/13/1987	365			NONE	200	TAKEOFF	0	130												MIL	MILAN, ITALY	NO	JT8D	15	
06/14/1987	316	1		NONE	200	UNKNOWN													ISG-OKA	XFO	JAPAN	NO	JT8D		A,C
06/15/1987	257	2	16:45:00	NONE	200	TAKEOFF	0	130			CLEAR		NO	YES			1			ELS	EAST LONDON, SOUTH AFRICA	NO	JT8D		
06/17/1987	118	2		NONE	300	UNKNOWN														IAD	WASHINGTON, DC-DULLES	YES	CFM56	3	
06/17/1987	317	2		NONE	200	UNKNOWN													OKA-MMY	XFO	JAPAN	NO	JT8D		
06/19/1987	119	1	9:09:00	NONE	300	LANDING	50	140	VFR	DAY	PARTLY CLOUD	NONE	NO	FLOCK	GULL*					HRL	HARLINGEN, TEX	YES	CFM56	3	
06/22/1987	166	1	15:45:00	NONE	200	CLIMB	500		VFR		SCATTERED			YES	SWALLOW*		1	3.		FRA	FRANKFURT, GERMANY	NO	JT8D	15	
06/22/1987	258	1		NONE	200	APPROACH		114			SCATTERED		NO	YES			1			CDG	PARIS, FRANCE-DEGAULLE	NO	JT8D		
06/25/1987	102	2	12:56:00	NONE	200	LANDING	0	90	VFR		CLEAR		NO	ONE	NORTHERN MARSH HARRIER	3K78	1	18.	LAS-OAK	OAK	SAN FRANSICO,CA-OAKLAND	YES	JT8D	9A	A,C,H
06/27/1987	103			NONE	200	UNKNOWN									FERAL PIGEON*		1	14.		KHH	KAOHSIUNG, TAIWAN	NO	JT8D	17A	A,G
06/27/1987	259	1	10:07:00	NONE	200	LANDING	0	110			SCATTERED			YES			1			TUN	TUNIS, TUNISIA	NO	JT8D		
06/27/1987	318	2		NONE	200	TAKEOFF														CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D		A,C
07/02/1987	260	1	14:15:00	NONE	200	APPROACH	80	120			SCATTERED		NO	YES						LHR	LONDON, ENGLAND-HEATHROW	NO	JT8D	15	
07/02/1987	366			NONE	200	UNKNOWN													-HAJ	XFO	HANOVER, GERMANY	NO	JT8D	15	
07/03/1987	319	1		NONE	200	TAKEOFF						ATB								EZE	BUENOS AIRES, ARGENTINA	NO	JT8D		
07/04/1987	261	2	15:15:00	NONE	200	UNKNOWN					BELOW CLOUDS		NO							FRA	FRANKFURT, GERMANY	NO	JT8D	15	
07/05/1987	133	2	8:25:00	NONE	300	TAKEOFF		+V1			CLEAR	NONE					1		SDF-CLT	SDF	LOUISVILLE, KY	YES	CFM56	3	A,C
07/06/1987	134	2		NONE	300	UNKNOWN											1		-IAD	XUS	WASHINGTON, DC-DULLES	YES	CFM56	3	A
07/07/1987	104	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		
07/09/1987	135	2	0:42:00	NONE	300	LANDING				NIGHT		NONE							ORY-AJA	AJA	AJACCIO, CORSICA, FRANCE	NO	CFM56	3	
07/11/1987	262	1	12:20:00	NONE	200	CLIMB	3000	170			SCATTERED		NO	YES			1			BRU	BRUSSELS, BELGIUM	NO	JT8D		
07/13/1987	105	1		NONE	200	UNKNOWN													AGR-VNS	VNS	VARANASI, INDIA	NO	JT8D	17	A,G
07/13/1987	171	2		NONE	200	UNKNOWN								NO					-LAX	XUS	LOS ANGELES, CA	YES	JT8D		A,C,N
07/14/1987	136	2		NONE	300	UNKNOWN											1		-KHI	XFO	KARACHI, PAKISTAN	NO	CFM56	3	A
07/14/1987	137	2		NONE	300	APPROACH	7000	137	VFR	DAY	CLEAR		NO	NO			1		-TVL	XUS	LAKE TAHOE, CA	YES	CFM56	3	
07/14/1987	138	1		NONE	300	TAKEOFF		+V1				NONE					1		TLV-MUC	TLV	TELAVIA-YAFO, ISRAEL	NO	CFM56	3	
07/15/1987	263	1	9:35:00	NONE	200	TAKEOFF	0				CLEAR		NO	NO			1			DUR	DURBAN, SOUTH AFRICA	NO	JT8D		
07/16/1987	320	1		NONE	200	UNKNOWN													-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D		
07/17/1987	367			NONE	200	CLIMB	1000	155												NUE	NUREMBURG, GERMANY	NO	JT8D	15	
07/19/1987	139	2		NONE	300	UNKNOWN											1		-MUC	XFO	MUNICH, GERMANY	NO	CFM56	3	
07/19/1987	264	2	20:26:00	MULT BIRDS	100	TAKEOFF	0				SCATTERED		NO	SEVERAL			2			XFO	FRANCE	NO	JT8D		
07/21/1987	140	2	7:00:00	NONE	300	TAKEOFF		+V1		DAWN	CLEAR						1		DAB-CLT	DAB	DAYTONA BEACH, FL	YES	CFM56	3	A,C
07/21/1987	265	2	15:20:00	NONE	200	APPROACH	100	125			CLEAR		NO	YES			1			KST	KOSTI, SUDAN	NO	JT8D		
07/23/1987	122	2	19:00:00	NONE	200	TAKEOFF	0	110	VFR					NO			1		MMY-OKA	MMY	MIYAKO JIMA, JAPAN	NO	JT8D	17	A,C,H,N
07/26/1987	123	1	18:37:00	NONE	200	TAKEOFF	0	150						FLOCK					GOA-LGW	GOA	GENOVA, ITALY	NO	JT8D	15A	
07/26/1987	124	2	9:00:00	AIRWRTHY	200	TAKEOFF	100	150	VFR			ATB			GLAUCOUS-WINGED GULL	14N22	1	40.	YYZ-YQG	YYZ	TORONTO, ONT., CANADA	NO	JT8D	9A	A,B,G,H
07/26/1987	141	2		NONE	300	LANDING	0	80									1		-DUS	DUS	DUSSELDORF, GERMANY	NO	CFM56	3	
07/26/1987	266	1	20:37:00	NONE	200	TAKEOFF		140			CLEAR		NO	YES			1			XFO	ITALY	NO	JT8D		
07/29/1987	126	1	17:45:00	NONE	200	TAKEOFF	0	70						YES	SPOTTED DOVE	2P65	1	6.	ITO-HNL	ITO	HILO, HAWAII	YES	JT8D	9A	
07/29/1987	142	1		NONE	300	TAKEOFF											1		AMS-	AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3	
07/29/1987	368	2		NONE	200	UNKNOWN														XUS		YES	JT8D	7	A,C
07/30/1987	127	1	4:55:00	AIRWRTHY	200	TAKEOFF	0	130	VFR		CLEAR	ATO							TXL-BRE	TXL	BERLIN, WEST GERMANY	NO	JT8D	15A	A,C,G,K
07/30/1987	322			NONE	200	TAKEOFF	0	100											ISG-OKA	ISG	ISHIGAKI, JAPAN	NO	JT8D		
07/31/1987	143	1		NONE	300	LANDING						NONE					1		HRL-HOU	HOU	HOUSTON, TEX	YES	CFM56	3	
07/31/1987	144	1	9:55:00	MULT BIRDS	300	TAKEOFF	500	+V1	VFR	BRIGHT	OVERCAST	ATB		NO			2			ADL	ADELAIDE, S. AUSTRALIA	NO	CFM56	3	A,B,D,H
08/03/1987	128	1		NONE	200	UNKNOWN											1			XFO	JOHANNESBURG, SOUTH AFRIC/	NO	JT8D		
08/03/1987	129	2		NONE	200	TAKEOFF	0	90	VFR	DAY	PARTLY CLOUD	ATO	NO	YES			1		RAP-FSD	RAP	RAPID CITY, S. DAK	YES	JT8D	9	
08/03/1987	205	2		NONE	200	UNKNOWN													-YYZ	XFO	TORONTO, ONT., CANADA	NO	JT8D		
08/03/1987	267	2	9:22:00	MULT BIRDS	200	LANDING	0				BELOW CLOUDS			SEVERAL	GULL*		*	10.	MUC-ZRH	ZRH	ZURICH, SWITZERLAND	NO	JT8D	15	
08/03/1987	369			NONE	200	APPROACH	1000	140												XRY	JEREZ DELA FRONTERA, SPAI!	NO	JT8D	15	

TY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
3				NO	
	COMPRESSOR			NO	POWER LOSS
				NO	
1	COMPRESSOR			INVLNTRY	
				NO	LARGE BIRD
	NONE			NO	
					MEDIUM BIRD
3				NO	
	NONE			NO	
	NONE			NO	EVENT OCCURED DURING GO-ROUND
					SMALL BIRD
2	NONE	3.8	.	NO	
				NO	
2					
	NONE			NO	
3	NONE			NO	
4	NONE			NO	
					LARGE BIRD
	COMPRESSOR			NO	SURGED ON GROUND
3	NONE	5.0	RETARD	NO	
3					
				NO	MEDIUM BIRD
	NONE			NO	
	NONE			NO	
	NONE			NO	
				NO	
3	NONE		RETARD	NO	
2				NO	
3					
				NO	MEDIUM BIRD
				NO	
3	NONE	4.9		NO	
4	NONE			NO	
				NO	
	NONE			NO	
				NO	
2				NO	AIRCRAFT GROUNDED DUE TO FOD
2	NONE			NO	FOUND DURING GROUND INSPECTION
4	NONE			NO	FOUND DURING GROUND INSPECTION
	NONE			NO	FOUND ON GRD INSPECTION, SMALL BIRD
	NONE			NO	
	NONE			NO	FOUND DURING GROUND INSPECTION
				NO	
3	NONE			NO	
2				NO	
	EPR DEC			NO	STRONG ODOR IN CABIN
2	COMPRESSOR	YES		YES	METAL IN TAILPIPE,9th STAGE BLADE DAMAGE
	NONE			NO	
				NO	STRONG ODOR IN CABIN
	NONE			NO	
3					
1	EPR DEC		CUTOFF	EPR	FAN CHANGE,ENG SHUTDOWN ON TAXI,COMP DAM
	NONE			NO	STRONG ODOR IN CABIN
2			RETARD	NO	
	COMPRESSOR				#2 ENGINE STALLED AT 80 KTS, PM EVENT
				NO	

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE
08/04/1987	206	1		NONE	200	TAKEOFF						ATO							YAM-YYZ	YAM	SAULT STE. MARIE, CANADA	NO	JT8D
08/04/1987	323	2		NONE	200	TAKEOFF													WLG-DUD	WLG	WELLINGTON, NEW ZEALAND	NO	JT8D
08/05/1987	145	1		NONE	300	LANDING				DUSK	OVERCAST	NONE			GULL*				-BRS	BRS	BRISTOL, ENGLAND	NO	CFM56
08/05/1987	146	1		MULT ENG	300	LANDING						NONE					1		-IBZ	IBZ	IBIZA, SPAIN	NO	CFM56
08/05/1987	146	2		MULT ENG	300	LANDING						NONE					1		-IBZ	IBZ	IBIZA, SPAIN	NO	CFM56
08/05/1987	207	1		NONE	200	UNKNOWN													-YVR	XFO	VANCOUVER, B.C., CANADA	NO	JT8D
08/05/1987	370			NONE	200	TAKEOFF	0	130												FRA	FRANKFURT, GERMANY	NO	JT8D
08/06/1987	147	1		NONE	300	UNKNOWN													-AMS	XFO	AMSTERDAM, NETHERLANDS	NO	CFM56
08/13/1987	208	2		NONE	200	UNKNOWN													-YYZ	XFO	TORONTO, ONT., CANADA	NO	JT8D
08/17/1987	130	2	15:30:00	NONE	200	LANDING								NO-					YVR-YYC	YYC	CALGARY, ALTA , CANADA	NO	JT8D
08/17/1987	148	2		NONE	300	UNKNOWN													-SNA	XUS	ORANGE COUNTY, CA	YES	CFM56
08/19/1987	131	1		MULT BIRDS	200	LANDING	0		VFR					YES	KILLDEER AND STARLING	5N33	*	3.	YXJ-YXS	YXS	PRINCE GEORGE,B.C., CANADA	NO	JT8D
08/20/1987	209	1		NONE	200	UNKNOWN													-YLW	XFO	KELOWNA, B.C., CANADA	NO	JT8D
08/22/1987	324	1		NONE	200	UNKNOWN													ISG-OKA	XFO	JAPAN	NO	JT8D
08/22/1987	371	1		NONE	200	UNKNOWN													-BRU	XFO	BRUSSELS, BELGIUM	NO	JT8D
08/22/1987	372	1		NONE	200	UNKNOWN									GULL*				-FOR	XFO	FORTALEZA, CEARA, BRAZIL	NO	JT8D
08/23/1987	373	2		NONE	200	TAKEOFF														STV	SURAT, INDIA	NO	JT8D
08/25/1987	210	2		NONE	200	UNKNOWN													-YEG	XFO	EDMONTON, ALTA., CANADA	NO	JT8D
08/26/1987	188	1	8:23:00	TRVS FRAC	200	LANDING	0		VFR		SCATTERED			YES					TYO-HAC	HAC	HACHIJO, JAPAN	NO	JT8D
08/26/1987	374			NONE	200	TAKEOFF	0	140												HAM	HAMBURG, GERMANY	NO	JT8D
08/29/1987	211	2		NONE	200	UNKNOWN													-YXJ	XFO	FT. ST. JOHN, B.C., CANADA	NO	JT8D
08/29/1987	268	1		MULT BIRDS	200	TAKEOFF	0				BELOW CLOUDS			YES	SWALLOW*		2	3.	FRA-LNZ	FRA	FRANKFURT, GERMANY	NO	JT8D
08/29/1987	326	2		NONE	200	TAKEOFF													PMR-AKL	PMR	PALMERSTON, NEW ZEALAND	NO	JT8D
08/31/1987	149	2		NONE	300	UNKNOWN													-IAH	XUS	HOUSTON, TEX	YES	CFM56
08/31/1987	150	1		NONE	300	LANDING													-KHI	KHI	KARACHI, PAKISTAN	NO	CFM56
08/31/1987	151	2		NONE	300	UNKNOWN													-PHX	XUS	PHOENIX, ARIZ	YES	CFM56
08/31/1987	269	1	8:06:00	NONE	200	TAKEOFF	0		VFR					ONE	GULL*		1		DUS-ZRH	DUS	DUSSELDORF, GERMANY	NO	JT8D
09/06/1987	132	2	10:15:00	NONE	200	LANDING	0		VFR		CLEAR			ONE	OSPREY	2K1	1	56.	IAD-MCO	MCO	ORLANDO, FL	YES	JT8D
09/06/1987	152	1		NONE	300	UNKNOWN													-DUS	XFO	DUSSELDORF, GERMANY	NO	CFM56
09/07/1987	329	1		NONE	200	LANDING														PMR	PALMERSTON, NEW ZEALAND	NO	JT8D
09/10/1987	153	1		NONE	300	UNKNOWN													-MUC	XFO	MUNICH, GERMANY	NO	CFM56
09/12/1987	212	2		NONE	200	UNKNOWN													-YYC	XFO	CALGARY, ALTA., CANADA	NO	JT8D
09/12/1987	270	1	17:40:00	NONE	200	LANDING	0	110			BELOW CLOUDS		NO	YES	HAWK*		1		BEG-MUC	MUC	MUNICH, GERMANY	NO	JT8D
09/13/1987	154	1		NONE	300	TAKEOFF		+V1				NONE							YUL-SDF	YUL	MONTREAL QUE, CANADA	NO	CFM56
09/14/1987	172	2		NONE	200	UNKNOWN											1		PLZ-JNB	XFO	SOUTH AFRICA	NO	JT8D
09/15/1987	155	2	9:06:00	NONE	300	TAKEOFF	0	140	IFR	BRIGHT	CLEAR	ATB	NO	ONE	SHARP-SHINNED HAWK	3K105	1	6.		MAF	MIDLAND/ODESSA, TEX	YES	CFM56
09/15/1987	376	1		NONE	200	LANDING													ORD-BHM	BHM	BIRMINGHAM, ALA	YES	JT8D
09/16/1987	156	1	13:33:00	NONE	300	CLIMB			VFR	BRIGHT	CLEAR	NONE			YELLOW-BILLED CUCKOO	2R51	1	2.	AUS-DAL	AUS	AUSTIN, TEX	YES	CFM56
09/16/1987	377			NONE	200	UNKNOWN														XFO		NO	JT8D
09/17/1987	157	1		NONE	300	TAKEOFF		+V1				NONE							ZRH-AMS	ZRH	ZURICH, SWITZERLAND	NO	CFM56
09/17/1987	271	1	18:45:00	NONE	200	TAKEOFF	20	150					NO	FLOCK	DOVE*				BHX-FRA	BHX	BIRMINGHAM, ENGLAND	NO	JT8D
09/17/1987	378			NONE	200	TAKEOFF	20	150												BHX	BIRMINGHAM, ENGLAND	NO	JT8D
09/18/1987	158	1		NONE	300	UNKNOWN													-CBR	XFO	CANBERRA,A.C.T., AUSTRALIA	NO	CFM56
09/18/1987	167	1	16:50:00	NONE	200	TAKEOFF	20	150	VFR			ATB		NO	SPARROW*		1	4.	JNB-PLZ	JNB	JOHANNESBURG, SOUTH AFRICA	NO	JT8D
09/18/1987	379	2		NONE	200	UNKNOWN														XUS		YES	JT8D
09/22/1987	159	2	0:43:00	NONE	300	UNKNOWN			VFR	DARK	CLEAR	NONE					1		TUL-STL	XUS	ST. LOUIS, MO	YES	CFM56
09/22/1987	169	1	9:57:00	NONE	200	TAKEOFF	0		VFR		OVERCAST	ATO		NO	DOVE*		1	14.	CPT-PLZ	CPT	CAPE TOWN, SOUTH AFRICA	NO	JT8D
09/22/1987	272	1		NONE	200	TAKEOFF									VULTURE*		1			CMG	CORUMBA, BRAZIL	NO	JT8D
09/23/1987	160	1	19:20:00	NONE	300	UNKNOWN			VFR	DARK	CLEAR	NONE							AUS-HOU	XUS	HOUSTON, TEX	YES	CFM56
09/24/1987	380	1		NONE	200	UNKNOWN														XFO		NO	JT8D
09/25/1987	333	1		NONE	200	UNKNOWN													ISG-OKA	XFO	JAPAN	NO	JT8D
09/27/1987	334	1		NONE	200	UNKNOWN													-AKL	XFO	AUCKLAND, NEW ZEALAND	NO	JT8D
09/28/1987	170	1	17:23:00	NONE	200	TAKEOFF			VFR					NO					CLE-IAD	CLE	CLEVELAND, O	YES	JT8D
09/29/1987	173	2		NONE	200	UNKNOWN								NO			1		-DEN	XUS	DENVER, COL	YES	JT8D
09/30/1987	204	1		NONE	300	LANDING						NONE		ONE			1		-TSV	TSV	TOWNSVILLE, AUSTRALIA	NO	CFM56
10/01/1987	189	1		NONE	300	CRUISE					CLEAR	NONE							MIA-LAX	XUS		YES	CFM56
10/01/1987	213	2		NONE	200	UNKNOWN													-YYZ	XFO	TORONTO, ONT., CANADA	NO	JT8D
10/02/1987	335	1		NONE	200	UNKNOWN													ISG-OKA	XFO	JAPAN	NO	JT8D
10/05/1987	336			NONE	200	TAKEOFF	140	130											MMY-OKA	MMY	MIYAKO JIMA, JAPAN	NO	JT8D
10/05/1987	381	1		NONE	200	LANDING		100						NO			1		DCA-IAD	IAD	WASHINGTON,DC-DULLES	YES	JT8D
10/06/1987	190	2		NONE	300	CLIMB													PSA-	PSA	PISA, ITALY	NO	CFM5
10/06/1987	337	1		NONE	200	TAKEOFF	0	110											ISG-OKA	ISG	ISHIGAKI, JAPAN	NO	JT8D
10/06/1987	338	1		NONE	200	UNKNOWN													MMY-OKA	XFO	JAPAN	NO	JT8D
10/08/1987	382	2		TRVS FRAC	200	UNKNOWN														XFO		NO	JT8D
10/10/1987	383	2		NONE	200	TAKEOFF	0	115												STR	STUTTGART, GERMANY	NO	JT8D
10/11/1987	384			NONE	200	TAKEOFF	250	170												FCO	ROME-DA VINCI, ITALY	NO	JT8D
10/14/1987	191	2		NONE	300	CRUISE						NONE							-BEG	XFO	BELGRADE, YUGOSLAVIA	NO	CFM5
10/14/1987	214	1		NONE	200	UNKNOWN													-YUL	XFO	MONTREAL, QUE., CANADA	NO	JT8D
10/15/1987	385	2		NONE	200	UNKNOWN														XFO	MALAYSIA	NO	JT8D
10/16/1987	192	1		NONE	300	APPROACH						NONE			COMMON GULL	14N13	1	15.	BRS-FAO	FAO	FARO, PORTUGAL	NO	CFM5
10/17/1987	386			NONE	200	CRUISE	4000	190		DARK										XFO		NO	JT8D
10/19/1987	193	1	15:00:00	NONE	300	LANDING					BELOW CLOUDS	NONE							-NCL	NCL	NEWCASTLE, ENGLAND	NO	CFM5
10/20/1987	387	1		NONE	200	UNKNOWN														XUS		YES	JT8D
10/21/1987	388			NONE	200	TAKEOFF	0		VFR				NO	FLOCK	SPARROW*				SFO-SBA	SFO	SAN FRANCISCO/OAKLAND, CA	YES	JT8D
10/23/1987	194	2		NONE	300	UNKNOWN													-PEK	XFO	BEIJING, CHINA	NO	CFM5

DASH	DMG_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
9A							
	A,C	3					TIRE FAILURE
3	A,H	3	NONE	3.5		NO	
3	A,H	3	NONE	2.2		NO	EVENT OCCURRED IN PM
3	A,H	3	NONE			NO	
15							
3	A	4	NONE				
						NO	FOUND ON GRD INSPEC,4FAN BLADES REPLACED
17A	A,H	3					
3	A,C,H	3	NONE			NO	
15				HIGH		NO	
						NO	MOMENTARY EGT INC OF 70 DEG.C,2-4 BIRDS
9A	A,C,G,I						
15		1	NONE			NO	2,1st STAGE F BLADES WERE FRAC, 2nd DAM
	A,C	3					
15				YES		NO	SYMPTOM - VIBRATION
3			NONE				
3	A	4	NONE			NO	FOUND DURING GROUND INSPECTION
3	A	4	NONE	<2		NO	3 FAN BLADES DAMAGED
15			COMPRESSOR			NO	1 FAN BLADE DAMAGED
7	A,K	1				NO	
3			NONE			NO	LPC DAMAGED HOWEVER NOT DUE TO BIRD
						NO	FOUND DURING GROUND INSPECTION
3			NONE				
15						NO	FOUND DURING GROUND INSPRCTION
3	A,H	3	NONE			NO	MEDIUM BIRD
17A	A,C	3		2		NO	4 FAN MID ACOUSTICAL PANELS REPLACED
3	A,B,H	3	NONE				
	A,C	3				NO	
3			NONE				
9A	A,C	3				NO	
3			NONE				
15	A,C	3				NO	
15						NO	
3			NONE				
17A			COMPRESSOR			NO	FOUND DURING GROUND INSPECTION
15A	A,G	2				NO	
3			NONE				
	A,C	3				NO	FOUND DURING GRD INSPEC, ODOR IN CABIN
	A,C	3				YES	
	A,B	3	NONE				IGV AND COWL DAMAGE,1 FAN BLADE DAMAGED
	A,G	2				NO	FOUND DURING GROUND INSPECTION
	A,C	3					
	A	4	NONE			NO	
			NONE			NO	
			NONE			NO	FOUND DURING GROUND INSPECTION
	A,B,H	3	NONE	2.5		NO	ODOR IN CABIN
							PILOT HEARD "LOUD ENGINE NOISE"
	A,B,H	3	NONE			NO	SMALL BIRD
	A,I	1		HIGH			
	A,G	2					
	A,B	3	NONE			NO	TIP CORNER LE BENT ON 5 FAN BLADES
	A,C	3					
			NONE			NO	
	A,H	3	NONE				NIGHT EVENT
	A,C	3				NO	
	A,B,H	3	NONE			NO	FOUND DURING GROUND INSPECTION

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_CODE
10/24/1987	168	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,C
10/24/1987	195	1	14:36:00	NONE	300	LANDING	0	100									1		-MIA	MIA	MIAMI, FL	YES	CFM56	3	
10/26/1987	176	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,C
10/28/1987	182	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,C
10/28/1987	187	2		TRVS FRAC	200	UNKNOWN														XFO		NO	JT8D	17	A,I
10/29/1987	389			NONE	200	CRUISE	4500	210		DARK										XFO		NO	JT8D	15	
10/30/1987	273	1		NONE	200	TAKEOFF	0					ATO					1			CGR	CAMPO GRANDE, BRAZIL	NO	JT8D		
10/31/1987	174	1	14:02:00	NONE	200	TAKEOFF	0	80	VFR	DAY	CLEAR		NO	FLOCK	GULL*				SFO-MFR	SFO	SAN FRANCISCO, CA	YES	JT8D	7	A,G,K
11/02/1987	196	1	7:00:00	MULT ENG	300	APPROACH	200	135	IFR	DAWN	LOW CLOUDS	NONE			BLACK HEADED GULL	14N36	1	9.7	-MAN	MAN	MANCHESTER, ENGLAND	NO	CFM56	3	A,H
11/02/1987	196	2	7:00:00	MULT ENG	300	APPROACH	200	135	IFR.	DAWN	LOW CLOUDS	NONE			BLACK HEADED GULL	14N36	1	9.7	-MAN	MAN	MANCHESTER, ENGLAND	NO	CFM56	3	
11/03/1987	340	2		NONE	200	TAKEOFF	0	115				ATO								IVC	INVERCARGILL, NEW ZEALAND	NO	JT8D		A,H
11/05/1987	390			NONE	200	TAKEOFF	0	130		DARK										AMS	AMSTERDAM, NETHERLANDS	NO	JT8D	15	
11/06/1987	183	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,C
11/07/1987	184	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,C
11/08/1987	177	2	22:15:00		200	APPROACH			VFR					ONE	SNOW GOOSE	2J26	1	88.	YYZ-YVR	YVR	VANCOUVER, B.C., CANADA	NO	JT8D	17A	A,D,H,N
11/10/1987	185	2		NONE	200	UNKNOWN											1			XFO		NO	JT8D		A,B,C
11/10/1987	198	1	14:45:00	TRVS FRAC	300	TAKEOFF	0	90	VFR	BRIGHT	CLEAR	ATO	NO	YES	GREAT EGRET	1152	1	38.4	IAH-	IAH	HOUSTON, TEX	YES	CFM56	3	A,D,I
11/11/1987	341	1		NONE	200	UNKNOWN													-WLG	XFO	WELLINGTON, NEW ZEALAND	NO	JT8D		
11/12/1987	175	1	13:50:00	MULT BIRDS	200	TAKEOFF	0	75	VFR		CLEAR	ATO		SEVERAL	PIGEON*		2			ADD	ADDIS ABABA, ETHIOPIA	NO	JT8D	17A	A,C
11/14/1987	199	2	12:40:00	NONE	300	TAKEOFF	0	150	VFR	BRIGHT	CLEAR	DIV							BHX-PMI	BHX	BIRMINGHAM, ENGLAND	NO	CFM56	3	A,H
11/15/1987	200	1		NONE	300	CLIMB						NONE							DUS-	DUS	DUSSELDORF, GERMANY	NO	CFM56	3	A,H
11/15/1987	274	2		NONE	200	UNKNOWN														XFO		NO	JT8D	15	
11/18/1987	391			NONE	200	UNKNOWN				DARK									-HAM	XFO	HAMBURG, GERMNAY	NO	JT8D	15	
11/23/1987	201	1	17:00:00	NONE	300	TAKEOFF		+V1		DUSK		ATB		YES					DAY-	DAY	DAYTON, O	YES	CFM56	3	A,B
11/23/1987	215	1		NONE	200	UNKNOWN													-YOW	XFO	OTTAWA, ONT., CANADA	NO	JT8D		A,C
11/23/1987	275			NONE	200	TAKEOFF											1		SLZ-BEL	SLZ	SAO LUIZ, BRAZIL	NO	JT8D		
11/24/1987	392			NONE	200	CLIMB	1000	160												DUS	DUESSELDORF, GERMANY	NO	JT8D	15	
11/25/1987	202	2		NONE	300	TAKEOFF		+V1											-KHI	XFO	KARACHI, PAKISTAN	NO	CFM56	3	A
11/25/1987	393		21:50:00	NONE	200	TAKEOFF	0	135	VFR		CLEAR	ATO					1		SFO-RNO	SFO	SAN FRANCISCO/OAKLAND, CA	YES	JT8D		
12/02/1987	179	2	20:00:00	NONE	200	TAKEOFF	0		VFR					NO	GOLDEN PLOVER	5N25	1	6.	KOA-HNL	KOA	KONA, HAWAII	YES	JT8D	9A	A,C
12/02/1987	343	2		NONE	200	UNKNOWN													OKA-MMY	XFO	JAPAN	NO	JT8D		
12/03/1987	216	1		NONE	200	UNKNOWN													-YQB	XFO	QUEBEC, QUE., CANADA	NO	JT8D		A,C
12/06/1987	217	2		MULT BIRDS	200	TAKEOFF								FLOCK			*		ACA-YWG	ACA	ACAPULCO, MEXICO	NO	JT8D	17A	A,G
12/06/1987	276	2		NONE	200	TAKEOFF														XFO		NO	JT8D	17A	A,C
12/08/1987	277	2		NONE	200	TAKEOFF	0					ATO					1			AJU	ARACAJU, BRAZIL	NO	JT8D	7	
12/11/1987	180	1	7:20:00	MULT BIRDS	200	LANDING	0	100	VFR	TWILIGHT				FLOCK	HUNGARIAN PARTRIDGE	4L85	3	8.	TXL-HAJ	HAJ	HANOVER, GERMANY	NO	JT8D	15A	A,D,H
12/12/1987	394	2		NONE	200	UNKNOWN														XFO		NO	JT8D		A,C
12/15/1987	203	1		NONE	300	LANDING						NONE		FLOCK	GULL*				-DUB	DUB	DUBLIN, IRELAND	NO	CFM56	3	
12/17/1987	181		15:00:00	MULT BIRDS	200	TAKEOFF								NO	COMMON LAPWING	5N1	2	6.		XFO	LASHAM, ENGLAND	NO	JT8D	17	A,C
12/20/1987	278	1		NONE	200	LANDING	50	110	VFR	DAY	PARTLY CLOUI			YES	OWL*		1		BOS-CLT	CLT	CHALOTTE, NC	YES	JT8D	15	A,G
12/23/1987	219	2		NONE	200	UNKNOWN													-YYC	XFO	CALGARY, ALTA., CANADA	NO	JT8D		
12/29/1987	186	2		NONE	200	UNKNOWN														LOS	LAGOS, NIGERIA	NO	JT8D	15	A,C
01/04/1988	535	1		NONE	200	TAKEOFF											1			MDQ	MAR DEL PLATA, ARGENTINA	NO	JT8D	9	
01/07/1988	279	2	23:15:00	NONE	200	TAKEOFF	0	60				ATO		NO	GULL*		1		DUR-PLZ	DUR	DURBAN, S. AFRICA	NO	JT8D	9	
01/07/1988	395			NONE	200	UNKNOWN													-KIN	XFO	KINGSTON, JAMAICA	NO	JT8D	15	A,G
01/11/1988	283	2		NONE	300	UNKNOWN						NONE							-MEL	XFO	MELBOURNE, AUSTRALIA	NO	CFM56	3	
01/15/1988	220	1		NONE	200	UNKNOWN													-TRV	XFO	TRIVANDRUM, INDIA	NO	JT8D	17A	A,C
01/19/1988	221	1		NONE	200	UNKNOWN													-YYC	XFO	CALGARY, ALTA., CANADA	NO	JT8D		
01/25/1988	222	2		NONE	200	LANDING			VFR								1		TAN-CAS	CAS	CASABLANCA, MOROCCO	NO	JT8D		A,C
01/25/1988	284	2		NONE	300	UNKNOWN						NONE							-AMS	XFO	AMSTERDAM, NETHERLANDS	NO	CFM56	3	
01/25/1988	285	1		NONE	300	TAKEOFF		+V1				NONE							WG	GHB	GOVERNORS HARBOUR, BAHAMA:	NO	CFM56	3	A,C,H
01/28/1988	223	1	12:05:00	NONE	200	TAKEOFF	0		VFR					YES	BAR-SHOULDERED DOVE	2P103	1.		NL	LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	A,C
01/30/1988	286	2		NONE	300	UNKNOWN						NONE							)NT	XUS	ONTARIO, CA	YES	CFM56	3	
02/06/1988	287	1	16:35:00	NONE	300	TAKEOFF	500	160	VFR	DUSK	CLEAR	NONE							1AN	ALC	ALICANTE, SPAIN	NO	CFM56	3	A,C,H
02/07/1988	289	2		NONE	300	UNKNOWN						NONE							-LHE	XFO	LAHORE, PAKISTAN	NO	CFM56	3	
02/08/1988	290	1	8:30:00	NONE	300	CRUISE						NONE			LONG BILLED CURLEW	6N12	1	27.	SJC-SAN	XUS	CA	YES	CFM56	3	A,L
02/09/1988	288	1		NONE	300	UNKNOWN						NONE							-PHX	XUS	PHOENIX, ARIZONA	YES	CFM56	3	
02/10/1988	291	2	22:00:00	INV POW LOSS	300	TAKEOFF	100	128		DARK	RAIN	ATB	NO	NO	BARN OWL	1S2	1	11.25		GIG	RIO DE JANEIRO, BRAZIL	NO	CFM56	3	A,I,M,P
02/11/1988	292	1		NONE	300	UNKNOWN						NONE											CFM56	3	
02/15/1988	280	1	18:15:00	NONE	200	TAKEOFF	250	145	VFR			DIV		YES			1		SRQ-TPA	SRQ	SARASOTA/BRADENTON, FL	YES	JT8D	7	
02/19/1988	281	2		NONE	200	UNKNOWN													SFO-LAX	SFO	SAN FRANSICO/OAKLAND, CA	YES	JT8D	7	A,C,K
02/19/1988	293	1	7:10:00	NONE	300	TAKEOFF	0	60	VFR		CLEAR	NONE	YES	ONE	SPARROW*				DAL-HOU	DAL	DALLAS/FT. WORTH, TEX-LOV:	YES	CFM56	3	
02/24/1988	294	1	14:40:00	NONE	300	LANDING	0					NONE		ONE	HAWK*		1		-BNE	BNE	BRISBANE, AUSTRALIA	NO	CFM56	3	
02/27/1988	295	1		NONE	300	CRUISE									GULL*				-LPA	XFO	GRANCANARIA,CANARY ISLAND:	NO	CFM56	3	A,B,E,H
02/28/1988	401	1		NONE	200	UNKNOWN														XFO		NO	JT8D	17A	A,H
03/11/1988	282	2		NONE	200	TAKEOFF											1		ITO-HNL	ITO	HILO, HAWAII	YES	JT8D	9A	
03/13/1988	296	2		NONE	300	UNKNOWN						NONE							-LGA	XUS	NEW YORK-LA GUARDIA	YES	CFM56	3	A,L
03/14/1988	297	2		NONE	300	UNKNOWN						NONE							-GSO	XUS	SALEM, NC	YES	CFM56	3	
03/20/1988	298	1		NONE	300	LANDING						NONE							-ISA	ISA	MOUNT ISA, AUSTRALIA	NO	CFM56	3	
03/24/1988	299	2	18:40:00	NONE	300	CLIMB	300			OVERCAST	CLOUDY	ATB								MSY	NEW ORLEANS, LOUISIANA	YES	CFM56	3	A,D
04/01/1988	404	1		NONE	200	TAKEOFF													ITO-HNL	ITO	HILO, HAWAII	YES	JT8D	9A	A,C
04/02/1988	346	2		NONE	200	TAKEOFF													YYJ-YYC	YYJ	CALGARY, ALTA., CANADA	NO	JT8D		
04/02/1988	405	1	3:10:00	NONE	200	TAKEOFF		90	VFR	NIGHT	PARTLY CLOU		NO	NO	PLOVER*		1	5.	LIH-HNL	LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	
04/03/1988	462	1		NONE	300	UNKNOWN													-YVR	XFO	VANCOUVER, CANADA	NO	CFM56	3	A,D
04/04/1988	461	2	6:10:00	TRVS FRAC	300	TAKEOFF	50	145		DAWN	CLEAR	ATB			BLACKCROWNED NIGHT HERON	1124	1	22.		SMF	SACRAMENTO, CA	YES	CFM56	3	A,D,I,K

	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
3					1 FAN BLADE BENT
	NONE			NO	
3					
3					
1					2, 1st STAGE F BLADES WERE FRAC, 2nd DAM
					NIGHT EVENT
					SMALL BIRD
1					HPC DAMAGE
3	NONE	NONE		NO	
	NONE			NO	
3					
					NIGHT EVENT
3					
3					
2					
3					
1				NO	FAN ABRABLE GOUGED,ACOUSTIC LINER TORN
3	COMPRESSOR		IDLE	NO	PWA FAIL CODE - EGT
3	NONE			NO	ODOR IN CABIN,EVIDENCE OF DEBRIS IN CORE
3	NONE	5.0		NO	
					FOUND DURING GROUND INSPECTION
					NIGHT EVENT
3	NONE	INC.	-	NO	
3					
					CABIN ODOR
4	NONE	4.5		NO	3 STAGE 1 BOOSTER VANES SHEARED OFF
3	NONE			NO	FOUND ON GROUND INSPEC DUE TO ENG ODOR
3					
2	COMPRESSOR			NO	EPR SYMPTOM, CABIN ODOR, SMALL BIRDS
3					
2	NONE			NO	
3					
	NONE	NONE		NO	
3	COMPRESSOR				
2					DAMAGE TO C1 AND C2, ENGINE REMOVED
3					
					DECREASE OF .05 IN EPR AND A DROP IN RPM
2					
	NONE			NO	FOUND DURING GROUND INSPECTION
3					ENGINE REMOVED
3					2 FAN BLADE SETS REPLACED
	NONE			NO	FOUND DURING GROUND INSPECTION
3	NONE	3.0		NO	3 MATCHED PAIRS OF FAN BLADES REPLACED
3					INGESTION CAUSED ENGINE "HUM"
	NONE			NO	FOUND DURING GROUND INSPECTION
3				NO	3 MATCHED PAIRS OF FAN BLADES REPLACED
	NONE			NO	FLUCTUATING VIBRATION INDICATION
3	NONE			NO	
	NONE			NO	
1	YES	HIGH		INVLNTRY	HEAVYDAMAGED ACOUSTIC PANELS,LOW OILPRES
	NONE			NO	FOUND DURING GROUND INSPECTION
	COMPRESSOR			NO	LARGE BIRD
1				NO	LPC+HPC DAMAGE, FOUND ON GROUND INSPEC.
	NONE			NO	ODOR IN COCPIT
	NONE			NO	
3		5		NO	AM EVENT
3					
					SMELL
3	NONE			NO	
	NONE			NO	FOUND DURING GROUND INSPECTION
	NONE			NO	
2			CUTOFF	YES	IFSD+POW LOSS NOT DUE TO BIRD INGESTION
3					
	COMPRESSOR				
					ODOR
2				NO	6 SETS OF FAN BLADES CHANGED
1	NONE	HIGH	RETARD	NO	ABRADABLE GOUGED, INNER INLET COWL PUNCS

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	D
04/06/1988	406			NONE	200	UNKNOWN													-KIN	XFO	KINGSTON, JAMAICA	NO	JT8D	1
04/06/1988	407	2		NONE	200	LANDING													DEN-OKC	OKC	OKLAHOMA CITY, OKLA	YES	JT8D	
04/08/1988	408	1		NONE	200	UNKNOWN						ATO			KITE*		1	32.		XFO	NIGERIA	NO	JT8D	1
04/09/1988	463	1	6:10:00	NONE	300	UNKNOWN						NONE							ATH-BEG	XFO	GREECE-YUGOSLAVIA	NO	CFM56	3
04/09/1988	464	2		NONE	300	UNKNOWN						NONE							-PEK	XFO	BEIJING, CHINA	NO	CFM56	3
04/10/1988	489	2		NONE	200	UNKNOWN														KOJ	KAGOSHIMA, JAPAN	NO	JT8D	9
04/12/1988	347	2		NONE	200	TAKEOFF	350	170	VFR	NIGHT	CLEAR		NO	NO			1		OGG-HNL	OGG	KAHULUI, MAUI, HAWAII	YES	JT8D	9
04/13/1988	465	1		NONE	300	TAKEOFF		+V1												HAM	HAMBURG, GERMANY	NO	CFM56	3
04/19/1988	466	1		NONE	300	TAKEOFF		+V1		BRIGHT	CLEAR	ATO								REC	RECIFE, BRAZIL	NO	CFM56	3
04/21/1988	490	1		NONE	200	UNKNOWN														SHI	SHIMOJISHIMA, JAPAN	NO	JT8D	1
04/24/1988	348	2		NONE	200	CLIMB	7000	180												HOU	HOUSTON, TEX	YES	JT8D	9
04/25/1988	412	1		NONE	200	TAXI	0												IAD-MSY	XUS	WASHINGTON, DC - LA	YES	JT8D	
04/26/1988	349	1		NONE	200	UNKNOWN														XUS		YES	JT8D	1
04/26/1988	413	2		NONE	200	CLIMB	0	125											LIT-OKC	LIT	LITTLE ROCK, ARK	YES	JT8D	
04/27/1988	350	1		NONE	200	TAKEOFF						ATB								DAL	DALLAS/FT WORTH, TEX-LOVE	YES	JT8D	9
04/27/1988	351	1		NONE	200	TAKEOFF														TUL	TULSA, OKLA	YES	JT8D	9
04/27/1988	467	1		NONE	300	TAKEOFF		+V1				NONE							DEN-BUR	DEN	DENVER, COL	YES	CFM56	3
04/28/1988	352	1		NONE	200	UNKNOWN													HOU-	XUS	HOUSTON, TEX	YES	JT8D	9
04/29/1988	414	1		NONE	200	LANDING													ORD-SAB	SAB	SABA, NETH, ANTILLES	NO	JT8D	
05/01/1988	353	2		NONE	200	TAKEOFF													CGR-GRU	CGR	CAMPO GRANDE, BRAZIL	NO	JT8D	
05/02/1988	354	2	20:00:00	TRVS FRAC	200	TAKEOFF	0	115				DIV			BLACK KITE	3K28	1	32.	LDE-CRL	LDE	LOURDES/TARBES, FRANCE	NO	JT8D	1
05/04/1988	415	2		NONE	200	LANDING	0	90												WLG	WELLINGTON, NEW ZEALAND	NO	JT8D	
05/05/1988	468	2	14:30:00	NONE	300	CLIMB			VFR	BRIGHT	CLEAR	NONE							DAL-HOU	DAL	DALLAS/FT WORTH, TEX-LOVE	YES	CFM56	3
05/06/1988	469	2		NONE	300	UNKNOWN						NONE			SWAINSON'S THRUSH	41Z246	1	1.	-HOU	XUS	HOUSTON, TEX	YES	CFM56	3
05/11/1988	416	2		NONE	200	UNKNOWN														XUS		YES	JT8D	1
05/11/1988	470	1		NONE	300	UNKNOWN													-AMS	XFO	AMSTERDAM, NETHERLANDS	NO	CFM56	3
05/11/1988	471	1	6:30:00	NONE	300	CLIMB				DAWN	CLEAR								SAT-DAL	SAT	SAN ANTONIO, TEX	YES	CFM56	3
05/15/1988	417	1		NONE	200	TAKEOFF									SWIFT*		1	1.		AUS	AUSTIN, TEX	YES	JT8D	
05/17/1988	355	1		NONE	200	UNKNOWN													EWR-IAD	XUS	NY-WASHINGTON, DC	YES	JT8D	7
05/19/1988	472	1		NONE	300	CLIMB				CLOUDY	RAIN									SAO	SAO PAULO, BRAZIL	NO	CFM56	3
05/21/1988	473	1	15:14:00	NONE	300	LANDING	0	110	VFR	DAY	PARTLY CLOUD	NONE	YES	YES	SWAINSON'S HAWK	3K171	1	36.	DAL-HOU	HOU	HOUSTON, TEX	YES	CFM56	3
05/22/1988	418	2		NONE	200	TAKEOFF											1		TUN-BRU	TUN	TUNIS, TUNISIA	NO	JT8D	1
05/23/1988	419	1		NONE	200	CLIMB	400	140				ATB					1			DEN	DENVER, COL	YES	JT8D	1
05/23/1988	438	2		TRVS FRAC	200	TAKEOFF	0	70				ATO			GULL*		1	16.		LXR	LUXOR, EGYPT	NO	JT8D	1
05/25/1988	474	1	9:45:00	MULT BIRDS	300	LANDING	0	125	VFR	BRIGHT	CLEAR	NONE		FLOCK	COMMON TURTLE DOVE	2P50	*	7.	EMA-QTV	QTV	TREVISO, ITALY	NO	CFM56	3
06/01/1988	475	2		NONE	300	LANDING														FRA	FRANKFURT, GERMANY	NO	CFM56	3
06/02/1988	533	2		NONE	300	LANDING	100	150									1		CVG-ORD	ORD	CHICAGO, ILL-OHARE	YES	CFM56	3
06/08/1988	439	1		NONE	200	TAKEOFF	0					ATB					1		YWG-YOW	YWG	WINNIPEG, CANADA	NO	JT8D	1
06/08/1988	476	1	11:42:00	NONE	300	LANDING				BRIGHT	CLEAR									FAT	FRESNO, CA	YES	CFM56	3
06/08/1988	492	2		NONE	200	UNKNOWN														XUS		YES	JT8D	9
06/10/1988	420	1		NONE	200	TAKEOFF									WESTERN MEADOWLARK	64Z68	1	4.	YQR-YWG	YQR	REGINA, SASK., CANADA	NO	JT8D	9
06/11/1988	576	2		NONE	300	UNKNOWN						NONE		NO					-OAK	XUS	CA	YES	CFM56	3
06/12/1988	477	2		NONE	300	UNKNOWN								NO									CFM56	3
06/13/1988	478	2		NONE	300	TAKEOFF		+V1			CLEAR				GULL*				BRS-CWL	BRS	BRISTOL, ENGLAND	NO	CFM56	3
06/14/1988	440	2		NONE	200	TAKEOFF													YUL-YOW	YUL	MONTREAL, CANADA	NO	JT8D	1
06/14/1988	479	1		NONE	300	UNKNOWN						NONE							-FRA	XFO	FRANKFURT, GERMANY	NO	CFM56	3
06/14/1988	480	2		NONE	300	LANDING									HAWK*					BNE	BRISBANE, AUSTRALIA	NO	CFM56	3
06/15/1988	481	1		NONE	300	TAKEOFF		+V1											EWR-ORD	EWR	NEW YORK, NY-NEWARK	YES	CFM56	3
06/16/1988	441			NONE	200	UNKNOWN									GULL*				-GIG	XFO	RIO DE JANEIRO, BRAZIL	NO	JT8D	
06/18/1988	442	2		MULT BIRDS	200	TAKEOFF						ATB			BONAPARTE'S GULL	14N38	*	7.	YKA-YVR	YKA	KAMLOOPS, CANADA	NO	JT8D	9
06/18/1988	443	2		NONE	200	TAKEOFF	0	140							HERRING GULL	14N14	1	40.	YYT-YHZ	YYT	ST. JOHNS, CANADA	NO	JT8D	9
06/20/1988	444	1		NONE	200	TAKEOFF	0					ATO							RUH-AHB	RUH	RIYADH, SAUDI ARABIA	NO	JT8D	
06/20/1988	482	1		NONE	300	LANDING						NONE			PIGEON*		1		PMI-PME	PME	PORTSMOUTH, ENGLAND	NO	CFM56	3
06/20/1988	483	2		MULT BIRDS	300	TAKEOFF		+V1				NONE			PIGEON*		*		PME-PMI	PME	PORTSMOUTH, ENGLAND	NO	CFM56	3
06/21/1988	445	1		NONE	200	UNKNOWN													-OKC	XUS	OKLAHOMA CITY, OKLA	YES	JT8D	
06/22/1988	484	2		NONE	300	UNKNOWN						NONE			CATTLE EGRET	1I35	1	16.		XUS		YES	CFM56	3
06/24/1988	446	2		NONE	200	TAKEOFF	0	110				ATO							YQT-YAM	YQT	THUNDER BAY, ONT., CANADA	NO	JT8D	9
06/26/1988	485	1	11:00:00	NONE	300	TAKEOFF		+V1				ATB							MXP-FUE	MXP	MILAN-MALPENSA, ITALY	NO	CFM56	3
06/26/1988	486	1		NONE	300	UNKNOWN													-BRE	XFO	BREMEN, GERMANY	NO	CFM56	3
06/27/1988	493	2		NONE	200	UNKNOWN														NGO	NAGOYA, JAPAN	NO	JT8D	1
06/28/1988	487	1		NONE	300	APPROACH	4000	210											STR-SCN	SCN	SAARBRUECKEN, GERMANY	NO	CFM56	3
06/28/1988	488	2	11:00:00	NONE	300	UNKNOWN						NONE							CTU-SHA	XFO	CHINA	NO	CFM56	3
06/28/1988	494	2		NONE	200	UNKNOWN														GAJ	YAMAGATA, HONSHU, JAPAN	NO	JT8D	1
07/01/1988	536	1		NONE	300	LANDING						NONE							BRU-CDG	CDG	PARIS-DE GAULLE, FRANCE	NO	CFM56	3
07/07/1988	447	2		NONE	200	LANDING													YHZ-YUL	YUL	MONTREAL, CANADA	NO	JT8D	1
07/09/1988	495	2		NONE	200	UNKNOWN													-BNA	XUS	NASHVILLE, TENN	YES	JT8D	9
07/12/1988	496			NONE	200	UNKNOWN														TTJ	TOTTORI, JAPAN	NO	JT8D	1
07/14/1988	497			NONE	200	UNKNOWN													-DUS	XFO	DUESSELDORF, GERMANY	NO	JT8D	
07/15/1988	498	1		NONE	200	TAKEOFF													YLW-YVR	YLW	KELOWNA, CANADA	NO	JT8D	9
07/15/1988	499	2		NONE	200	UNKNOWN			VFR		CLEAR			NO			1		BRR-ANC	XFO	SCOTLAND-ALASKA	NO	JT8D	1
07/15/1988	537	1		NONE	300	TAKEOFF		+V1				NONE		FLOCK			1			LJU	LJUBLJANA, YUGOSLAVIA	NO	CFM56	3
07/16/1988	538	2		NONE	300	LANDING	0				CLOUDY	NONE		NO			1			BRU	BRUSSELS, BELGIUM	NO	CFM56	3
07/18/1988	500	2		NONE	200	LANDING	50	120	VFR	DAY	CLEAR		NO	YES	BLACK BIRD*		1	40.		PHL	PHILADELPHIA, PA	YES	JT8D	1
07/18/1988	501	2	15:45:00	NONE	200	TAKEOFF	0								EURASIAN KESTREL	5K27	1	8.	BRU-LHR	BRU	BRUSSELS, BELGIUM	NO	JT8D	1
07/19/1988	502	1	19:30:00	NONE	200	TAKEOFF													CAG-BRU	CAG	CAGLIARI, ITALY	NO	JT8D	1

{G_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
G	2					
G	2					HEAVY DAMAGE
H	3	NONE			NO	FOUND DURING GROUND INSPECTION
		NONE			NO	FOUND DURING GROUND INSPECTION
						ODOR, MEDIUM BIRD
		NONE			NO	
)	2	NONE			NO	AM EVENT, REPLACED 2 FAN BLADES
						ODOR
:	3					
						ODOR
						ODOR
		NONE			NO	
						ODOR
						ODOR
	1	EPR DEC	HIGH		YES	EGT INCREASED TO FULL SCALE
,H	3	NONE			NO	
		NONE			NO	FOUND DURING GROUND INSPECTION
	3					
		NONE			NO	FOUND DURING GROUND INSPECTION
,H	3	NONE	3.5		NO	
	2					ODOR
	3	NONE	2.9		NO	PM EVENT, CHANGED 1 FAN BLADE
		NONE			NO	
	2		HIGH			
I	1					ODOR, SMALL BIRD
						HPT METALIZATION
H	2	NONE	2.5		NO	FAN ABRADABLE SLIGHTLY DAMAGED
		NONE			NO	
		NONE			NO	ODOR
	3		HIGH			ODOR, HUM, 3 FAN BLADES DAMAGED
	4	NONE			NO	ENGINE REMOVED FOR HIGH EGT
		NONE			NO	FOUND DURING GROUND INSPECTION
	3	NONE			NO	SYMPTOM-EGT
	3	NONE			NO	FOUND DURING GROUND INSPECTION
		NONE			NO	
	3	NONE			NO	
;,I	1	COMPRESSOR	HIGH		PARAMTRS	METAL IN TAILPIPE, SYMPTOM-EGT, 2 BLADES
I	2					4 FAN BLADES DAMAGED, ODOR
		COMPRESSOR				
	3	NONE			NO	
	3	NONE	SOME		NO	M/S SHROUD DISTORTED, CSD COOLER CLOGGED
						ODOR
	4	NONE			NO	FOUND DURING GROUND INSPECTION
	3	COMPRESSOR				
	3	NONE	2.6		NO	REPLACED 5 PAIR OF FAN BLADES
	4	NONE			NO	REPLACED 3 PAIR OF FAN BLADES
	3	NONE			NO	ENGINE NOISE
	1	NONE			NO	FOUND DURING GROUND INSPECTION, UER
	3		3.0		NO	REPLACED 6 PAIR OF FAN BLADES
						ODOR
N	2		HIGH			2 BLADES BROKEN TANGS, 1 CRACKED TANG
		NONE			NO	FOUND DURING GROUND INSPECTION
		NONE			NO	AM EVENT
	2		HIGH			INVESTIGATED, AM EVENT
	3					
	2		HIGH		NO	CREW NOTED NOISE AND VIBES AT TO

DATA SOURCE: ENGINE MANUFACTURER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_CODE
07/19/1988	503	2		NONE	200	UNKNOWN														SDJ	SENDAI, JAPAN	NO	JT8D	9A	
07/20/1988	539	2		NONE	300	CLIMB						NONE		NO			1			BEG	BELGRADE, YUGOSLAVIA	NO	CFM56	3	
07/20/1988	540	1	11:25:00	NONE	300	APPROACH	100			BRIGHT	CLEAR	NONE		NO	CARRION CROW	22Z94	1	19.	CDG-AMS	AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3	A,B
07/21/1988	504	1		NONE	200	UNKNOWN														KOJ	KOGOSHIMA, JAPAN	NO	JT8D	9A	
07/23/1988	505	1		NONE	200	APPROACH													YVR-YLW	YLW	KELOWNA, CANADA	NO	JT8D	9A	
07/23/1988	541	1		NONE	300	CLIMB						NONE		NO			1			SAN	SAN DIEGO, CA	YES	CFM56	3	A,H
07/23/1988	542	1		NONE	300	UNKNOWN						NONE		NO	CHIMNEY SWIFT	1U33	1	1.		XUS		YES	CFM56	3	
07/24/1988	543	2		NONE	300	TAKEOFF		+V1				NONE		NO			1		BRU-CDG	BRU	BRUSSELS, BELGIUM	NO	CFM56	3	A,H
07/25/1988	506	2		INV POW LOSS	200	TAKEOFF						ATB			GREY EAGLE-BUZZARD	3K161	1	80.		PVH	PORTO VELHO, BRAZIL	NO	JT8D	7	A,G,I,K
07/26/1988	507	2	22:10:00	INV POW LOSS	200	TAKEOFF	70	140				ATB		NO					PLZ-JNB	PLZ	PORT ELIZABETH, S. AFRICA	NO	JT8D	9	
07/26/1988	544	1		NONE	300	TAKEOFF		+V1				ATB					1			LHE	LAHORE, PAKISTAN	NO	CFM56	3	A,H
07/26/1988	545	2		NONE	300	TAKEOFF	0	-V1				ATO		YES	CROW*		1			CWL	CARDIFF, WALES	NO	CFM56	3	A,B,H
07/27/1988	508	2		NONE	200	TAKEOFF	0	100									1		CGR-GRU	CGR	CAMPO GRANDE, BRAZIL	NO	JT8D	7	
07/28/1988	509	1		NONE	200	UNKNOWN											1			YVR	VANCOUVER, CANADA	NO	JT8D	17A	A,C,H,K
07/29/1988	546	2	15:00:00	NONE	300	APPROACH					CLOUDY	NONE		ONE	COMMON SWIFT	1U55	1	2.		AMS	AMSTERDAM, NETHERLANDS	NO	CFM56	3	A
07/30/1988	510	1		NONE	200	LANDING									GULL*		1		YSM-YHY	YHY	HAY RIVER, CANADA	NO	JT8D	9A	
07/30/1988	511	2		NONE	200	LANDING														YVR	VANCOUVER, CANADA	NO	JT8D	9A	
08/05/1988	547	1		NONE	300	APPROACH						NONE		NO						BRU	BRUSSELS, BELGIUM	NO	CFM56	3	A,H
08/05/1988	548	1		NONE	300	UNKNOWN						NONE		NO			1		-NCE	XFO	FRANCE	NO	CFM56	3	
08/07/1988	512	1		NONE	200	TAKEOFF	0										1	4.	DUR-PLZ	DUR	DURBAN, S. AFRICA	NO	JT8D	17A	
08/07/1988	513	2		NONE	200	TAKEOFF											1		YXJ-YXY	YXJ	FT. ST. JOHN, CANADA	NO	JT8D	9A	
08/09/1988	514	2		NONE	200	TAKEOFF											1		YWG-YVR	YWG	WINNEPEG, CANADA	NO	JT8D	17A	
08/10/1988	515	1		NONE	200	TAKEOFF													YMM-YXD	YMM	FORT MCMURRAY, CANADA	NO	JT8D	9A	
08/11/1988	516	1		NONE	200	UNKNOWN													YQR-YWG	XFO	CANADA	NO	JT8D	9A	
08/12/1988	517	1		NONE	200	UNKNOWN														XFO	CHINA	NO	JT8D	17A	
08/12/1988	518	2		NONE	200	TAKEOFF						ATB			MOURNING DOVE	2P105	1	4.		HOU	HOUSTON, TEX	YES	JT8D	9A	
08/14/1988	549	1		NONE	300	UNKNOWN						NONE		NO			1		-FRA	XFO	GERMANY	NO	CFM56	3	
08/15/1988	519	1		NONE	200	UNKNOWN													YYZ-YXD	XFO	CANADA	NO	JT8D	9A	
08/15/1988	520	1		NONE	200	UNKNOWN									KILLDEER	5N33	1	3.	OMA-PHX	XUS	NEB-ARIZ	YES	JT8D	15	A,C,G
08/15/1988	550	2	21:45:00	MULT BIRDS	300	UNKNOWN						NONE					*		-STL	XUS	ST LOUIS, MO	YES	CFM56	3	A,D,I
08/16/1988	521	2		NONE	200	TAKEOFF	50	150				ATB								CLV		YES	JT8D	7B	
08/16/1988	551	2	15:45:00	MULT BIRDS	300	TAKEOFF	0	+V1		BRIGHT	CLEAR	ATB		FLOCK			*			MEL	MELBOURNE, AUSTRALIA	NO	CFM56	3	A,B,H
08/17/1988	552	2		NONE	300	UNKNOWN						NONE		NO					-CLT	XUS	NC	YES	CFM56	3	A,D
08/18/1988	553	1		NONE	300	UNKNOWN						NONE		NO			1		LHR-	XFO	LONDON, ENGLAND	NO	CFM56	3	
08/19/1988	522	1		NONE	200	TAKEOFF	0					ATO			UPLAND SANDPIPER	6N13	1	6.		HOU	HOUSTON, TEX	YES	JT8D	9A	
08/19/1988	554	1		NONE	300	CLIMB						NONE		NO						LGW	LONDON-GATWICK, ENGLAND	NO	CFM56	3	
08/21/1988	555	1	8:52:00	NONE	300	TAKEOFF		+V1				ATB		NO	AMERICAN KESTREL	5K26	1	3.5		TUL	TULSA, OKLA	YES	CFM56	3	
08/23/1988	523	1	6:18:00	MULT ENG	200	TAKEOFF	0	100				ATO		SEVERAL	BLACK HEADED GULL	14N36	1	10.	HAM-CGN	HAM	HAMBURG, GERMANY	NO	JT8D	15	A,C
08/23/1988	523	2	6:18:00	MULT ENG	200	TAKEOFF	0	100				ATO		SEVERAL	BLACK HEADED GULL	14N36	1	10.	HAM-CGN	HAM	HAMBURG, GERMANY	NO	JT8D	15	
08/26/1988	524	1		MULT BIRDS	200	TAKEOFF	0	135	VFR				NO	SEVERAL	SPARROW*		3		COS-YHY	COS	COLORADO SPRINGS, COL	YES	JT8D	15	
08/26/1988	556	1		MULT ENG	300	TAKEOFF	0	+V1				NONE		NO			1		TFS-SPC	TFS	TENERIFE, CANARY ISLANDS	NO	CFM56	3	A,D
08/26/1988	556	2		MULT ENG	300	TAKEOFF	0	+V1				NONE		NO			1		TFS-SPC	TFS	TENERRIFE, CANARY ISLANDS	NO	CFM56	3	
08/29/1988	557	1	8:43:00	MULT ENG-BIRDS	300	TAKEOFF	20	145	IFR	LIGHT	CLEAR	ATB	NO	FLOCK	COMMON STARLING	21Z75	2	3.		ORD	CHICAGO, ILL-OHARE	YES	CFM56	3	A,B,H
08/29/1988	557	2	8:43:00	MULT ENG-BIRDS	300	TAKEOFF	20	145	IFR	LIGHT	CLEAR	ATB	NO	FLOCK	COMMON STARLING	21Z75	1	3.		ORD	CHICAGO, ILL-OHARE	YES	CFM56	3	
08/30/1988	525	1		NONE	200	UNKNOWN													YYC-YXD	XFO	CANADA	NO	JT8D	9A	A,B
08/30/1988	558	1	14:30:00	NONE	300	UNKNOWN				BRIGHT	CLEAR	NONE	NO	NO			1		PIT-BDL	XUS	PA-MA	YES	CFM56	3	
09/02/1988	559	1	13:00:00	NONE	300	UNKNOWN						NONE		NO			1		HRL-HOU	XUS	TEX	YES	CFM56	3	
09/03/1988	560	2		NONE	300	UNKNOWN						NONE		NO			1		-BEG	XFO	BELGRADE, YUGOSLAVIA	NO	CFM56	3	
09/04/1988	526	2		NONE	200	APPROACH													YYZ-YAM	YAM	SAULT ST MARIE, CANADA	NO	JT8D	9A	
09/04/1988	561	1		NONE	300	UNKNOWN						NONE		NO					-PIT	XUS	PA	YES	CFM56	3	
09/05/1988	562	1		NONE	300	TAKEOFF		+V1				ATB	NO	NO						ORD	CHICAGO, ILL-OHARE	YES	CFM56	3	A
09/06/1988	563	2		NONE	300	TAKEOFF		+V1				NONE		NO						RNO	RENO, NEV	YES	CFM56	3	
09/08/1988	564	2		NONE	300	LANDING						NONE		NO						BFS	BELFAST, N. IRELAND	NO	CFM56	3	A,H
09/09/1988	527	1		MULT BIRDS	200	LANDING	0										*		CPT-PLZ	PLZ	PORT ELIZABETH, S. AFRICA	NO	JT8D	17A	A,C
09/10/1988	528	1		NONE	200	TAKEOFF														XMN	XIAMEN, CHINA	NO	JT8D	17A	A,C
09/10/1988	565	1		NONE	300	UNKNOWN						NONE		NO					-LGW	XFO	ENGLAND	NO	CFM56	3	
09/15/1988	529	1	9:45:00	MULT ENG-BIRDS	200	TAKEOFF	0	155		LIGHT	CLEAR	CRASHED	YES	FLOCK	SPECKLED PIGEON	2P4	8	11.5	BJR-ASM	BJR	BAHAR DAR, ETHIOPIA	NO	JT8D	17A	A,D,K,O,P
09/15/1988	529	2	9:45:00	MULT ENG-BIRDS	200	TAKEOFF	0	155		LIGHT	CLEAR	CRASHED	YES	FLOCK	SPECKLED PIGEON	2P4	6	11.5	BJR-ASM	BJR	BAHAR DAR, ETHIOPIA	NO	JT8D	17A	A,D,K,O,P
09/15/1988	566	1		NONE	300	TAKEOFF		+V1				NONE		NO						BFS	BELFAST, N. IRELAND	NO	CFM56	3	A,H
09/16/1988	567	1		NONE	300	CRUISE						NONE		NO			1		ZAG-ZRH	XFO	YUGOSLAVIA-SWITZERLAND	NO	CFM56	3	A,D
09/18/1988	568	1		NONE	300	LANDING						NONE		NO			1			LHR	LONDON-HEATHROW, ENGLAND	NO	CFM56	3	
09/20/1988	530	1		NONE	200	UNKNOWN													YQT-YYC	XFO	CANADA	NO	JT8D	9A	
09/20/1988	569	1		NONE	300	UNKNOWN						NONE		NO	BARRED DOVE	2P102	1	2.		XUS		YES	CFM56	3	
09/21/1988	570	1		MULT ENG	300	TAKEOFF	0	VR				ATB		FLOCK			1			LAS	LAS VEGAS, NEV	YES	CFM56	3	
09/21/1988	570	2		MULT ENG	300	TAKEOFF	0	VR				ATB		FLOCK			1			LAS	LAS VEGAS, NEV	YES	CFM56	3	A,H
09/23/1988	531	2		NONE	200	UNKNOWN														XFO	CANADA	NO	JT8D	9A	
09/24/1988	571	2		NONE	300	UNKNOWN						NONE		NO			1		STL-HOU	XUS	MO-TEX	YES	CFM56	3	A,K
09/25/1988	572	1		NONE	300	TAKEOFF		+V1				NONE		NO	ROCK DOVE	2P1	1	14.		LAX	LOS ANGELES, CA	YES	CFM56	3	A
09/26/1988	532	1		MULT BIRDS	200	TAKEOFF	100	150				DIV					2		LUT-TNR	LUT	MADAGASCAR	NO	JT8D	15	A,D
09/26/1988	573	1		NONE	300	CLIMB						ATB		NO	PARROT*		1			MEL	MELBOURNE, AUSTRALIA	NO	CFM56	3	A,H
09/27/1988	574	1	16:30:00	NONE	300	UNKNOWN				BRIGHT	CLEAR	NONE		NO					-DAL	XUS	TEX	YES	CFM56	3	A

POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
N1 DECREASE			NO	MOMENTARY 10% DEC. IN FAN SPEED
NONE				4 F BLADES HAD LE TIP CURL
NONE	3.0		NO	3 F BLADES SHINGLED, 1 BLADE REPLACED
NONE			NO	FOUND DURING LTR CHECK
NONE	3.0		NO	REPLACED 3 PAIR OF FAN BLADES
INVLNTRY			YES	1 F BLADE FRACTURED BELOW MSS
COMPRESSOR	HIGH		YES	MOMENTARY THRUST LOSS FOR APPROX. 10 SEC
NONE	5.0		NO	
NONE	NONE		NO	
				ODOR IN CABIN, SMALL BIRD
				HPC DAMAGED AND REMOVED
NONE			NO	BSI FOUND HPC STG6 BLD WITH A NICK
				SMALL BIRD
NONE	2.0		NO	6 FAN BLADES REPLACED
NONE				
				ODOR IN CABIN, SMALL BIRD
				FOUND DURING GROUND INSPECTION
				FOUND DURING GROUND INSPECTION
NONE			NO	FOUND DURING GROUND INSPECTION
				ODOR IN COCKPIT
				FOUND DURING GROUND INSPECTION
NONE			NO	8 F BLDS REPLACED, 1 WITH .5 IN CRACK
COMPRESSOR			YES	5% EPR LOSS
NONE	5.0	IDLE	NO	6 FAN BLADES REPLACED
NONE			NO	4 FAN BLDS REPLACED, FOUND ON GRD INSPEC
NONE			NO	
NONE			NO	MOMENTARY INCREASE IN EGT
NONE			NO	ODOR IN COCPIT
NONE			NO	SOME ABRADABLE MISSING
NONE			NO	
NONE	SMALL	RETARD	NO	REPLACED 5 PAIRS OF FAN BLADES
NONE	SMALL		NO	27 BIRDS CLEARED FROM RUNWAY
				1 F BLADE 1/4 INCH TIP CURL, GRD INSPEC
NONE			NO	INGESTED PIECE OF TIRE,ALSO FOUND BIRD
NONE			NO	
NONE			NO	
NONE			NO	
NONE			NO	REPLACED 4 PAIRS OF FAN BLADES
NONE			NO	
NONE			NO	
NONE			NO	
COMPRESSOR		ADVANCED	INVLNTRY	CONTINUOUS SURGING, ERRATIC EPR
COMPRESSOR		ADVANCED	INVLNTRY	CONTINUOUS SURGING, ERRATIC EPR
NONE	5.0	IDLE	NO	ODOR IN CABIN
NONE			NO	8 PAIRS OF FAN BLADES REPLACED
NONE	2.8		NO	
				FOUND DURING GROUND INSPECTION
NONE	1.9		NO	
NONE			NO	
NONE			NO	
NONE			NO	1 STG 4 HPC BLADE DAMAGED
NONE			NO	14 PAIRS OF FAN BLADES REPLACED
COMPRESSOR		CUTOFF	YES	POWER LOSS
	5.0	RETARD	NO	12 FAN BLADES SHINGLED
NONE			NO	15 FAN BLADES DAMAGED

DATA SOURCE: OTHER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE
10/10/1986	234	2		NONE	200	TAKEOFF						ATB							MAN-CDG	MAN	MANCHESTER, ENGLAND	NO	JT8D
11/02/1986	423	2		NONE	200	TAKEOFF						ATB								XUS	MIDWAY AIRPORT	YES	JT8D
11/27/1986	424	1		NONE	200	LANDING														PDX	PORTLAND, ORE	YES	JT8D
12/02/1986	72	1		NONE	200	UNKNOWN											1	2.	-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
12/14/1986	80	2		NONE	200	UNKNOWN														CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
12/14/1986	457	2		NONE	300	CLIMB	1000	210	IFR	DAY	OVERCAST		NO	NO	GULL*		1			SFO	SAN FRANCISCO, CA	YES	CFM56
01/31/1987	614	2	12:58:00	NONE	300	LANDING	0	110			CLEAR	NONE	NO	FLOCK	GULL*		1			LCA	LARNACA, CYPRUS	NO	CFM56
02/02/1987	459	1		NONE	200	TAKEOFF	0	120	VFR	DAY	RAIN		NO	ONE	DOVE*		1			OGG	KAHULUI, MAUI, HAWAII	YES	JT8D
02/06/1987	623	1	10:40:00	MULT BIRDS	300	TAKEOFF	0					NONE					*			FRA	FRANKFURT, GERMANY	NO	CFM56
02/10/1987	428	1		NONE	200	TAKEOFF	0	140	VFR	DAY	PARTLY CLOUD	ATB	YES	NO						SJC	SAN JOSE, CA	YES	JT8D
02/10/1987	429	1		NONE	200	TAKEOFF						ATB								SJC	SAN JOSE, CA	YES	JT8D
02/10/1987	458	1		MULT ENG	200	TAKEOFF	0	140	VFR	DAY	PARTLY CLOUD		YES	FLOCK	GULL*		1			MDW	MIDWAY, ILL	YES	JT8D
02/10/1987	458	2		MULT ENG	200	TAKEOFF	0	140	VFR	DAY	PARTLY CLOUD		YES	FLOCK	GULL*		1			MDW	MIDWAY, ILL	YES	JT8D
02/10/1987	655	2	18:41:00	NONE	200	CLIMB	350				CLOUDY	ATB	NO							EINN	SHANWICK, IRELAND	NO	JT8D
02/13/1987	430		12:52:00	NONE	300	TAKEOFF	0	140						SEVERAL	GULL*					HAM	HAMBURG, GERMANY	NO	CFM56
02/13/1987	589	2	17:45:00	NONE	300	LANDING						NONE			HAWK*		1			ASCB	CANBERRA, AUSTRALIA	NO	CFM56
02/14/1987	357	1		NONE	200	UNKNOWN														XFO	ARGENTINA	NO	JT8D
02/21/1987	663	1		NONE	200	TAKEOFF	0								KITE*		1			OPRN	CHAKLALA, PAKISTAN	NO	JT8D
02/22/1987	690	1	12:12:00	MULT ENG-BIRDS	200	TAKEOFF	0	150			CLOUDY	NONE	NO		KITE*		*			PIE	CLEARWATER, FL	YES	JT8D
02/22/1987	690	2	12:12:00	MULT ENG-BIRDS	200	TAKEOFF	0	150			CLOUDY	NONE	NO		KITE*		*			PIE	CLEARWATER, FL	YES	JT8D
03/02/1987	667	2	16:20:00	NONE	200	UNKNOWN					CLEAR	NONE			GULL*		1			LPFU	FUNCHAL, MADEIRA, PORTUGAL	NO	JT8D
03/03/1987	460			NONE		TAKEOFF	0	120	VFR	NIGHT	CLEAR		NO	NO			1			PIE	ST PETERSBURG, FL	YES	
03/07/1987	590	1	6:35:00	MULT BIRDS	300	LANDING					CLEAR	NONE	NO	FLOCK	TRUE SPARROW*		*			ABCG	COOLANGATTA, AUSTRALIA	NO	CFM56
03/12/1987	595	1	7:09:00	MULT BIRDS	300	TAKEOFF					CLOUDY	NONE	YES	SEVERAL	HAWK*		*			ABTL	TOWNSVILLE, AUSTRALIA	NO	CFM56
03/16/1987	647	1	21:00:00	NONE	200	LANDING	0				CLOUDY	NONE	NO							VABO	VADODARA, INDIA	NO	JT8D
03/26/1987	627	1	20:17:00	MULT ENG-BIRDS	200	CLIMB	700	160			CLEAR	ATB	NO				*			BNJ	BONN, GERMANY	NO	JT8D
03/26/1987	627	2	20:17:00	MULT ENG-BIRDS	200	CLIMB	700	160			CLEAR	ATB	NO				*			BNJ	BONN, GERMANY	NO	JT8D
03/27/1987	664	2	7:08:00	NONE	200	CLIMB	6000				CLOUDY	ATB		ONE			1			OPLA	LAHORE, PAKISTAN	NO	JT8D
03/31/1987	425	2		NONE	200	TAKEOFF						ATO								XUS		YES	JT8D
03/31/1987	684	1	9:30:00	NONE	300	TAKEOFF	0				CLOUDY	NONE					1			LHR	LONDON-HEATHROW, ENGLAND	NO	CFM56
04/06/1987	657			MULT BIRDS	200	TAKEOFF	0	140			CLEAR	OTHER	NO	SEVERAL			*			HKNA	JOMO KENYATTA, KENYA	NO	JT8D
04/08/1987	665	2	13:00:00	NONE	200	LANDING	200	140		OVERCAST		NONE		SEVERAL			1			FAO	FARO, PORTUGAL	NO	JT8D
04/09/1987	672	1	19:55:00	MULT ENG	200	TAKEOFF	0	100			CLEAR	NONE								IBZ	IBIZA, SPAIN	NO	JT8D
04/12/1987	596	1	10:50:00	NONE	300	TAKEOFF						NONE					1			ABTL	TOWNSVILLE, AUSTRALIA	NO	CFM56
04/14/1987	681	2	11:15:00	NONE	UNK	TAKEOFF	200	175			CLEAR	NONE		ONE	SPARROW*		1			BHX	BIRMINGHAM, ENGLAND	NO	UNK
04/26/1987	660	1	20:05:00	MULT BIRDS	300	LANDING	0					NONE					*			EHAM	SCHIPOL, NETHERLANDS	NO	CFM56
05/06/1987	591	1	20:00:00	MULT BIRDS	300	LANDING	0					NONE			AUSTRALIAN COURSER	10N9	*	2.5		ADDN	DARWIN, AUSTRALIA	NO	CFM56
05/08/1987	592	1	20:38:00	NONE	300	LANDING				CLOUDY	RAIN	NONE			GULL*					ASSY	KINGSFORD, AUSTRALIA	NO	CFM56
05/10/1987	622	2		NONE	200	UNKNOWN					CLEAR	NONE					1			XFO	FRANCE	NO	JT8D
05/10/1987	687	1	15:30:00	NONE	200	APPROACH		136			CLOUDY	NONE		ONE						EGNX	EAST MIDLANDS, ENGLAND	NO	JT8D
05/12/1987	363	1		NONE	200	UNKNOWN											1			XFO	ENGLAND	NO	JT8D
05/16/1987	364	2		NONE	200	UNKNOWN														XFO		NO	JT8D
06/05/1987	694	2	10:00:00	NONE	200	LANDING	0	80			CLOUDY	NONE	NO	SEVERAL	VULTURE*					TRV	TRIVANDRUM, INDIA	NO	JT8D
06/08/1987	662	1	7:48:00	MULT BIRDS	200	LANDING	150	125			CLOUDY	NONE	YES	SEVERAL	GULL*		*			CHC	CHRISTCHURCH, NEW ZEALAND	NO	JT8D
06/10/1987	608	1	10:40:00	NONE	200	LANDING	12	120			CLEAR	NONE	NO	ONE			1			YOW	OTTAWA, CANADA	NO	JT8D
06/12/1987	677	2	1:25:00	NONE	UNK	TAXI	0	12			CLOUDY	NONE	NO	SEVERAL			1			VTBD	BANGKOK, THAILAND	NO	UNK
06/19/1987	609	2	9:12:00	NONE	200	TAKEOFF	0	110			CLEAR	NONE	NO	SEVERAL	SWALLOW*		1			CYXS	PRINCE GEORGE, CANADA	NO	JT8D
06/23/1987	674	1	18:35:00	MULT BIRDS	200	TAKEOFF	0	140			CLEAR			FLOCK	GULL*		*			LERS	REUS, SPAIN	NO	JT8D
06/24/1987	676	2	4:40:00	NONE	200	CLIMB	3000	230			CLOUDY	NONE								LEPA	PALMA DE MALLORCA, SPAIN	NO	JT8D
06/24/1987	682	1	10:07:00	NONE	200	CLIMB	500	170			OVERCAST	NONE		ONE						GLA	GLASGOW, SCOTLAND	NO	JT8D
06/28/1987	671	2		NONE	200	LANDING	0					OTHER	NO				1			LEMD	BARAJAS, SPAIN	NO	JT8D
06/29/1987	427	1		NONE	200	CLIMB						ATB			RED TAI*					DAY	DAYTON, O	YES	JT8D
06/30/1987	628	2	7:50:00	NONE	200	LANDING	50	135			CLEAR	NONE		ONE			1			EDBT	TEGEL, W. BERLIN, GERMANY	NO	JT8D
07/01/1987	629	2	17:38:00	NONE	300	TAKEOFF	10	135			CLEAR		NO	SEVERAL	GULL*		1			LGSK	SKIATHOS, GREECE	NO	CFM56
07/02/1987	431			NONE	300	UNKNOWN														TNG	TANGER, MOROCCO	NO	CFM56
07/13/1987	692	1		NONE	UNK	UNKNOWN									PARTRIDGE*		1			XFO		NO	UNK
07/17/1987	432		18:39:00	NONE	300	APPROACH	300	130						ONE						MUC	MUNICH, GERMANY	NO	CFM56
07/17/1987	632	2	7:35:00	NONE	200	TAKEOFF	0	90			CLOUDY	ATO	NO	ONE	KITE*		1			AMD	AHMEDABAD, INDIA	NO	JT8D
07/19/1987	685	1	16:54:00	NONE	200	TAKEOFF	0	130			OVERCAST	NONE								LTN	LONDON-LUTON, ENGLAND	NO	JT8D
07/21/1987	426	2		NONE	200	TAKEOFF						ATO								EWR	NEW YORK, NY-NEWARK	YES	JT8D
07/21/1987	615	2	15:20:00	NONE	UNK	LANDING	100	125			CLEAR	NONE	NO	ONE			1			KRP	KASTRUP, DENMARK	NO	UNK
07/24/1987	606	2	18:20:00	MULT BIRDS	200	TAKEOFF	0	100			CLOUDY	NONE	YES	SEVERAL	KILLDEER	5N33	*	3.		YCG	CASTLEGAR, CANADA	NO	JT8D
07/25/1987	605	1	11:40:00	NONE	200	TAKEOFF	0	50			CLEAR	ATO	NO	FLOCK	GULL*		1			YYC	CALGARY, ALTA, CANADA	NO	JT8D
07/26/1987	612	2	9:00:00	NONE	200	CRUISE						ATB					1			XFO	NPEARSON INTL, CANADA	NO	JT8D
07/27/1987	321	1		NONE	200	TAKEOFF		130				ATO								XFO		NO	JT8D
07/27/1987	635	1	13:20:00	NONE	200	TAKEOFF	20	140			CLOUDY	NONE	YES	ONE						ATQ	AMRITSAR, INDIA	NO	JT8D
07/29/1987	619	2	19:30:00	NONE	200	LANDING	0			OVERCAST	RAIN	NONE	NO	SEVERAL	HAWK*		1			LFBT	OSSUN-LOURDES, FRANCE	NO	JT8D
07/30/1987	658	2	14:16:00	MULT BIRDS	200	LANDING	10	135			CLOUDY	NONE		SEVERAL	PIGEON*		*			LMML	LUQA, MALTA	NO	JT8D
07/31/1987	624	1	16:24:00	NONE	200	LANDING	0	128			OVERCAST	NONE		ONE			1			EDUO	GUTERSLOH, GERMANY	NO	JT8D
08/01/1987	600	2	7:01:00	NONE	200	LANDING	0	100			CLEAR	NONE	NO	SEVERAL			1			LOWS	SALZBURG, AUSTRIA	NO	JT8D
08/05/1987	643	1		NONE	200	LANDING	0	123				NONE			KITE*					PAT	PATNA, INDIA	NO	JT8D
08/06/1987	626	2	18:10:00	NONE	200	LANDING	0	20			CLOUDY	NONE		FLOCK	LAPWING*		1			MUC	MUNICH, GERMANY	NO	JT8D
08/07/1987	649	1	8:15:00	NONE	200	TAKEOFF	0	130		OVERCAST	RAIN	NONE	NO	ONE			1			VTZ	VISAKHAPATNAM, INDIA	NO	JT8D
08/07/1987	653	2	9:54:00	NONE	200	CLIMB		140			CLOUDY	ATB	NO							LKO	LUCKNOW, INDIA	NO	JT8D
08/12/1987	597	2	14:10:00	NONE	300	TAKEOFF	0	130			OVERCAST	ATO	NO	ONE			1			LOWL	LINZ, AUSTRIA	NO	CFM56

DMG_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
A,C	3					CCOC PS4 CRACK
		NONE		NONE	NO	
					NO	
A,D	2					PM EVENT
						MEDIUM BIRD
A,K	1					AM EVENT
A,K	1					COMPRESSOR SECTION BLADE DAMAGE
						LOUD BANG HEARD
A	4					PM EVENT
A	4					PM EVENT, EXTENSIVE INLET DAMAGE
A,Q	4					MEDIUM BIRD, MINOR DAMAGE
A,C	3					
A,Q	4					4 FAN BLADES DANAGED
						LARGE BIRD
						LARGE BIRD
						MEDIUM BIRD
						PM EVENT
						SMALL BIRD
						LARGE BIRD
						SMALL BIRD
A,Q	4					MEDIUM BIRD, MINOR DAMAGE
A,Q	4					MEDIUM BIRD, MINOR DAMAGE
						SMALL BIRD
						SMALL BIRD
						MEDIUM BIRD
						SMALL BIRD
						SMALL BIRD
						SMALL BIRD
						SMALL BIRD
						SMALL BIRD
						MEDIUM BIRD
						MEDIUM BIRD
A,C	3					3 FAN BLADES DAMAGED
A,C	3					
A,Q	4					SUBSTANTIAL DAMAGE
						MEDIUM BIRD
						SMALL BIRD
						SMALL BIRD
A,Q	4					SUBSTANTIAL DAMAGE, ENGINE CHANGED
						LARGE BIRD
						SMALL BIRD
						LARGE BIRD
						MEDIUM BIRD
A	4					
						MEDIUM BIRD
A	4	YES				FAN BLADE DAMAGE
						MEDIUM BIRD
						SMALL BIRD
						MEDIUM BIRD
A,G,H	2					EPR SYMPTOM
A,H,Q	3					SMALL BIRD, SUBSTANTIAL DAMAGE
						LARGE BIRD
						MEDIUM BIRD
						MEDIUM BIRD
						SMALL BIRD
						MEDIUM BIRD
						MEDIUM BIRD
						SMALL BIRD
A,Q						
						MEDIUM BIRD

DATA SOURCE: OTHER

EDATE	EVT#	ENG_POS	ETIME	SIGN_EVT	AIRCRAFT	POF	ALTITUDE	SPEED	FL_RULES	LT_CONDS	WEATHER	CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_COD
08/12/1987	693	2		NONE	200							NONE					1			XFO		NO	JT8D		A,Q
08/14/1987	645	2	10:00:00	NONE	200	LANDING	0	100			CLEAR	NONE	NO	SEVERAL			1			VERC	RANCHI, INDIA	NO	JT8D		
08/15/1987	433		9:00:00	NONE	300	LANDING	20	135						ONE	FALCON*					TNG	TANGIER, MOROCCO	NO	CFM56	3	
08/15/1987	659	2	17:50:00	NONE	200	LANDING	0	100			CLEAR	NONE		ONE	HAWK*		1			GMTT	BOUKHALF, MOROCCO	NO	JT8D		A,Q
08/18/1987	625	2	7:38:00	MULT BIRDS	UNK	LANDING	0	100		OVERCAST	RAIN	OTHER	NO	FLOCK	GULL*		*			HAM	HAMBURG, GERMANY	NO	UNK		
08/18/1987	679	1	6:18:00	NONE	200	TAKEOFF	0	150			CLEAR	NONE		SEVERAL						LTBS	MUGLA, TURKEY	NO	JT8D		
08/19/1987	640	2	15:17:00	NONE	200	TAKEOFF	0	90			CLOUDY	ATO								JRH	JORHAT, INDIA	NO	JT8D		
08/22/1987	633	2	8:15:00	NONE	200	TAKEOFF	0	60				ATO	NO	ONE						AMD	AHMEDABAD, INDIA	NO	JT8D		
08/22/1987	650	1	13:05:00	NONE	200	APPROACH	1500	170			CLEAR	NONE	NO	SEVERAL	VULTURE*		1			DEL	DELHI, INDIA	NO	JT8D		
08/23/1987	680	1	12:00:00	MULT BIRDS	200	LANDING	0	100			CLEAR	NONE	NO	FLOCK	COMMON LAPWING	5N1	*	7.7		SVO	MOSCOW-SHEREMETYE, USSR	NO	JT8D		
08/26/1987	451			NONE	200	TAKEOFF	0	+V1		NIGHT	CLEAR	ATO	NO	NO						LEX	LEXINGTON, KY	YES	JT8D		
08/27/1987	666	1	6:20:00	MULT BIRDS	200	TAKEOFF	0	135			CLEAR	NONE		SEVERAL			*			FAO	FARO, PORTUGAL	NO	JT8D		
08/27/1987	689	1	20:00:00	NONE	200	UNKNOWN						NONE								NCL	NEW CASTLE, ENGLAND	NO	JT8D		
08/28/1987	325	1		NONE	200	TAKEOFF						ATO								OPO	PORTO, PORTUGAL	NO	JT8D		
08/28/1987	607	1	20:00:00	NONE	200	TAKEOFF	0								COMMON SNIPE	6N47	1	4.		YXJ	FT ST JOHN, CANADA	NO	JT8D		A,Q
08/29/1987	598	1	14:10:00	MULT BIRDS	UNK	LANDING	0	115			OVERCAST	OTHER	NO	SEVERAL	SWALLOW*		*			LOWL	LINZ, AUSTRIA	NO	UNK		
08/29/1987	620	1	18:00:00	NONE	200	TAKEOFF	0				CLEAR	NONE	NO	SEVERAL	EURASIAN KESTREL	5K27	1	7.		LFBT	OSSUN-LOURDES	NO	JT8D		
08/31/1987	669	1	15:23:00	NONE	200	TAKEOFF	0	120			CLEAR	ATO	NO				1			FAWH	J.G.STRIJDOM, S. AFRICA	NO	JT8D		
09/01/1987	327	1		NONE	200	TAKEOFF		100						FLOCK	PIGEON*					FNC	FUNCHAL, PORTUGAL	NO	JT8D		
09/01/1987	603	1	22:15:00	NONE	UNK	UNKNOWN	0	100			CLEAR	NONE	NO				1			EBOS	OOSTENDE, BELGIUM	NO	UNK		
09/01/1987	604	1	11:05:00	NONE	200	TAKEOFF	0	140			CLEAR	NONE	NO	ONE			1			WBSB	BRUNEI INTL, BRUNEI DARUS	NO	JT8D	15	
09/02/1987	328	1		NONE	200	LANDING											1		MZG-KHH	KHH	KAOHSIUNG, TAIWAN	NO	JT8D		A,H
09/03/1987	375	1		NONE	200	UNKNOWN														XFO	ENGLAND	NO	JT8D	9A	A,C
09/04/1987	593	2	9:00:00	NONE	300	TAKEOFF	0	140			CLOUDY	NONE		ONE						AMML	MELBOURNE, AUSTRALIA	NO	CFM56	3	
09/04/1987	672	2	19:55:00	MULT ENG	200	TAKEOFF	0	100			CLEAR	NONE								IBZ	IBIZA, SPAIN	NO	JT8D		
09/04/1987	696	1		MULT ENG-BIRDS	200	TAKEOFF	0	90			CLEAR	NONE	NO	FLOCK			*			YSM	FT SMITH, CANADA	NO	JT8D		
09/04/1987	696	2		MULT ENG-BIRDS	200	TAKEOFF	0	90			CLEAR	NONE	NO	FLOCK			*			YSM	FT SMITH, CANADA	NO	JT8D		
09/05/1987	618	1	10:39:00	NONE	300	LANDING	0	100			CLEAR	NONE	NO	SEVERAL			1			LFMN	CONTE D'AZUR, FRANCE	NO	CFM56	3	
09/06/1987	599	2	11:20:00	NONE	300	LANDING	0	80		OVERCAST	RAIN	NONE	NO	SEVERAL	GULL*		1			LOWL	LINZ, AUSTRIA	NO	CFM56	3	
09/08/1987	449	2		NONE	200	LANDING	35	130	VFR	DAY	CLEAR		NO	FLOCK	GULL*					ORF	NORFOLK, VA	YES	JT8D	15	
09/09/1987	330	2		NONE	200	TAKEOFF		140				ATB								ORY	PARIS-ORLY, FRANCE	NO	JT8D		
09/10/1987	434		6:25:00	NONE	300	TAKEOFF	0	100							BUZZARD OR FALCON*					FRA	FRANKFURT, GERMANY	NO	CFM56	3	
09/16/1987	644	1	7:55:00	NONE	200	TAKEOFF	0	100			CLOUDY	ATO	NO	SEVERAL	KITE*		1			PAT	PATNA, INDIA	NO	JT8D		
09/17/1987	331	2		NONE	200	LANDING		40							GULL*					SCC	PRUDHOE BAY, ALASKA	YES	JT8D		
09/18/1987	631	1	6:30:00	NONE	200	LANDING	0	70			CLEAR	NONE	NO	SEVERAL			1			VIAG	AGRA, INDIA	NO	JT8D		
09/20/1987	332	1		NONE	200	TAKEOFF		140				ATO								BRU	BRUSSELS, BELGIUM	NO	JT8D		
09/21/1987	621	1	9:55:00	NONE	UNK	TAKEOFF	0	140			CLEAR	NONE		FLOCK			1			LFBT	OSSUN-LOURDES, FRANCE	NO	UNK		
09/21/1987	673	2	13:40:00	NONE	200	TAKEOFF	0	140			CLOUDY	NONE		SEVERAL	SWIFT*		1			IBZ	IBIZA, SPAIN	NO	JT8D		
09/22/1987	668	1	10:57:00	NONE	200	TAKEOFF	0	150			CLEAR	NONE	NO		DOVE*		1			FACT	D.F.MALAN, S. AFRICA	NO	JT8D		
09/23/1987	450	2		NONE	200	TAKEOFF		80	VFR	DAY	PARTLY CLOUD	ATO	NO	NO	DOVE*		1			BWI	BALTIMORE, MD	YES	JT8D		
10/01/1987	613	1	19:35:00	NONE	200	CRUISE						ATB					1			XFO	NPEARSON INTL, CANADA	NO	JT8D		
10/04/1987	630	1	8:55:00	NONE	200	TAKEOFF	10	140			CLEAR	NONE	NO	ONE			1			HKG	HONG KONG, HONG KONG	NO	JT8D		
10/04/1987	686	2	19:10:00	NONE	UNK	TAKEOFF	75				CLOUDY	NONE			LAPWING*		1			EGNV	TEES-SIDE, ENGLAND	NO			
10/07/1987	654	1	11:43:00	NONE	200	LANDING	0				CLOUDY	NONE	NO		GULL*		1			EICK	CORK, IRELAND	NO	JT8D		
10/10/1987	448			NONE		UNKNOWN														BHM	BIRMINGHAM, ALA	YES			A,B
10/11/1987	601	1		NONE	300	APPROACH	100	140			CLEAR	NONE	NO				1			LOWW	WIEN-SCHWECHAT, AUSTRIA	NO	CFM56	3	
10/11/1987	616	1	16:11:00	NONE	100	TAKEOFF	0					ATB	NO	ONE	COMMON BUZZARD	3K180	1	32.		LFBO	BLAGNAC, FRANCE	NO	JT8D		
10/11/1987	634	2	8:08:00	NONE	200	TAKEOFF	0	136			CLEAR	NONE	NO	SEVERAL			1			AMD	AHMEDABAD, INDIA	NO	JT8D		
10/11/1987	683	2	9:30:00	NONE	200	PARKED	0				CLEAR	NONE								GLA	GLASGOW, SCOTLAND	NO	JT8D		
10/13/1987	648	1	12:00:00	NONE	200	TAKEOFF	0	60				NONE	NO	ONE	SPARROW*		1			VABO	VADODARA, INDIA	NO	JT8D		
10/19/1987	661	1	20:15:00	MULT BIRDS	300	LANDING	0					NONE					*			EHAM	SCHIPOL, NETHERLANDS	NO	CFM56	3	A
10/25/1987	339	2		NONE	200	TAKEOFF						ATO								AUS	AUSTIN, TEX	YES	JT8D		
10/28/1987	435			NONE	300	UNKNOWN								ONE						DEU	GERMANY	NO	CFM56	3	
10/29/1987	594	1	7:00:00	NONE	300	TAKEOFF	0	130			CLOUDY	NONE		ONE	AUSTRALIAN BELL MAGPIE	23Z7	1	11.		ABRK	ROCKHAMPTON, AUSTRALIA	NO	CFM56	3	
10/29/1987	636	2		NONE	200	TAKEOFF	0	140			CLEAR	NONE	NO	ONE	VULTURE*					BLR	BANGALORE, INDIA	NO	JT8D		
10/31/1987	675	2	18:13:00	NONE	200	LANDING	200	125			CLOUDY	NONE		SEVERAL	OWL*		1			LERS	REUS, SPAIN	NO	JT8D		
11/04/1987	422	1		MULT BIRDS	200	TAKEOFF		100				ATO		FLOCK			*			LAX	LOS ANGELES, CA	YES	JT8D	15	
11/08/1987	610	2	6:06:00	NONE	200	LANDING	275					NONE	YES		GOOSE*					YVR	VANCOUVER, CANADA	NO	JT8D		A
11/08/1987	642	1	8:10:00	NONE	200	LANDING	0	128			CLEAR	NONE	NO	ONE	KITE*		1			MAL	MANGALORE, INDIA	NO	JT8D		
11/08/1987	652	2	20:10:00	NONE	200	UNKNOWN		120			CLEAR	NONE	NO	ONE						VOHY	HYDERABAD, INDIA	NO	JT8D		
11/09/1987	611	2	22:22:00	MULT BIRDS	200	LANDING	250	130			CLEAR		YES	SEVERAL	GOOSE*		*			YVR	VANCOUVER, CANADA	NO	JT8D		A
11/10/1987	452	2		NONE		LANDING	0										1			SFO	SAN FRANCISCO/OAKLAND, CA	YES			
11/11/1987	617	2		NONE	100	TAKEOFF	0					OTHER	NO		COMMON SKYLARK	17Z72	1	1.5		LFBO	BLAGNAC, FRANCE	NO	JT8D		
11/14/1987	436		9:52:00	NONE	300	CLIMB														MUC	MUNICH, GERMANY	NO	CFM56	3	A
11/16/1987	437		14:45:00	NONE	300	CRUISE														HAM	HAMBURG, GERMANY	NO	CFM56	3	A
11/20/1987	695	1	18:00:00	NONE	200	TAKEOFF	0	120			CLOUDY	NONE	NO				1			FVCP	PRINCE CHARLES, ZIMBABWE	NO	JT8D		
11/22/1987	637	1	19:25:00	NONE	200	TAKEOFF	0	100			CLEAR	ATO	NO	ONE			1			BOM	BOMBAY, INDIA	NO	JT8D		A
11/23/1987	421	1		MULT ENG	300	TAKEOFF						ATB					1			DAY	DAYTON, O	YES	CFM56	3	A,D
11/23/1987	421	2		MULT ENG	300	TAKEOFF						ATB					1			DAY	DAYTON, O	YES	CFM56	3	
11/24/1987	646	2	14:30:00	NONE	200	TAKEOFF	10	138			CLEAR	ATB	NO	SEVERAL	KITE*					SXR	SRINAGAR, INDIA	NO	JT8D		
11/26/1987	342	2		NONE	200	TAKEOFF														ISG	ISHIGAKI, JAPAN	NO	JT8D		A,C
11/26/1987	453	1		MULT ENG-BIRDS	200	TAKEOFF	0	120	VFR	DAY	PARTLY CLOUD		NO	FLOCK	DOVE*		1			LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	
11/26/1987	453	2		MULT ENG-BIRDS	200	TAKEOFF	0	120	VFR	DAY	PARTLY CLOUD		NO	FLOCK	DOVE*		2			LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	
11/26/1987	454	2		NONE	200	TAKEOFF	0	120	VFR	DAY	PARTLY CLOUD	ATO	NO	FLOCK			1			LIH	LIHUE, KAUAI, HAWAII	YES	JT8D	9A	
11/26/1987	656	1	11:05:00	MULT BIRDS	200	TAKEOFF	0	142			RAIN	NONE		SEVERAL	GULL*		*			LIPE	BORGO PANIGALE, ITALY	NO	JT8D		A

	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
4					
					SMALL BIRD
4					
					MEDIUM BIRD
					MEDIUM BIRD
					MEDIUM BIRD
					LARGE BIRD
					MEDIUM BIRD
					PM EVENT, LOUD ENGINE NOISE
4					SMALL BIRD, MINOR DAMAGE
					SMALL BIRD
					MEDIUM BIRD
					MEDIUM BIRD
					MEDIUM BIRD
					SMALL BIRD
3					3 FAN BLADES SHINGLED
3					
					MEDIUM BIRD
					SMALL BIRD
					SMALL BIRD
					SMALL BIRD
					SMALL BIRD
					LARGE BIRD
					AM EVENT
	COMPRESSOR				ODOR
					SMALL BIRD
					SMALL BIRD
	COMPRESSOR				
					MEDIUM BIRD
					SMALL BIRD
					SMALL BIRD
					AM EVENT
					SMALL BIRD
					MEDIUM BIRD
					LARGE BIRD
3					FOUND DURING GROUND INSPECTION
					SMALL BIRD
					LARGE BIRD
					MEDIUM BIRD
					SMALL BIRD
4					3 FAN BLADES DAMAGED
	COMPRESSOR				
					MEDIUM BIRD
					MEDIUM BIRD
					LARGE BIRD, MINOR DAMAGE
					MEDIUM BIRD
					SMALL BIRD
4				YES	MINOR DAMAGE, LARGE BIRD
					SMALL BIRD
4					
4					
					SMALL BIRD
4					SMALL BIRD
2					REPLACED FOUR PAIRS OF FAN BLADES
					SMALL BIRD
3					
					PM EVENT
					PM EVENT
					AM. EVENT, SMALL BIRD
					MEDIUM BIRD, MINOR DAMAGE

CREW_AC	CREW_AL	BIRD_SEE	BIRD_NAM	BIRD_SPE	#_BIRDS	WT_OZ_1	CTY_PRS	AIRPORT	LOCALE	US_INCID	ENGINE	DASH	DMG_CODE	SEVERITY	POW_LOSS	MAX_VIBE	THROTTLE	IFSD	REMARKS
ATO	NO	ONE						BOM	BOMBAY, INDIA	NO	JT8D		A,K	1		HIGH		VIBES	DAMAGE TO COMPRESSOR BLADES
NONE	NO	ONE						GAU	GAUHATI, INDIA	NO	JT8D								SMALL BIRD
							ISG-OKA	ISG	ISHIGAKI, JAPAN	NO	JT8D								
NONE					*			LHR	LONDON-HEATHROW, ENGLAND	NO	CFM56	3							
NONE	NO							XFO	CHANDIGARH-DELHI, INDIA	NO	JT8D		A	4		HIGH			SUNSTANTIAL FAN BLADE DAMAGE
ATB								ORY	PARIS-ORLY, FRANCE	NO	JT8D		A,G	2	COMPRESSOR	HIGH		YES	
ATB					1			DTTA	CARTHAGE, TUNISIA	NO	JT8D		A	4					6 FAN BLADES DAMAGED, ENGINE REMOVED
ATO	NO	ONE						MAA	MADRAS, INDIA	NO	JT8D								MEDIUM BIRD
NONE	NO		IBISE*		1			FAJS	JAN SMUTS, S. AFRICA	NO	JT8D								LARGE BIRD
								GOT	GOTHENBURG, SWEDEN	NO	JT8D								
								DUD	DUNEDIN, NEW ZEALAND	NO	JT8D								
								XFO	ENGLAND	NO	JT8D	7	A,C	3					
								XFO		NO	JT8D								ODOR
							-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D								
								EWR	NEW YORK, NY-NEWARK	YES	JT8D								
							-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D								
							-CHC	XFO	CHRISTCHURCH, NEW ZEALAND	NO	JT8D								
							-WLG	XFO	WELLINGTON, NEW ZEALAND	NO	JT8D								
								XFO	ARGENTINA	NO	JT8D	9A	A,C	3					
	NO	NO	GULL*		1			MDW	MIDWAY, ILL	YES	JT8D	17							AM EVENT
	NO	YES	HAWK*		1			ROC	ROCHESTER,NY	YES	JT8D	15A	A,H	3					AM EVENT, MEDIUM BIRD, 1 BLADE SHINGLED
ATB								PTY	PANAMA CITY, PANAMA	NO	JT8D	9	A,K	1					2 1ST STG COMPRESSOR BLADES DAMAGED
		YES					CLE-BOS	BOS	BOSTON, MASS	YES	CFM56	3							ODOR IN CABIN
	NO	YES	PIGEON*		1			DFW	DALLAS/FT. WORTH, TEX	YES	CFM56	3							MEDIUM BIRD
							-DEN	XUS	COL	YES	CFM56	3							FOUND ON GRD INSPECTION, BLOOD ON COWL
	NO	NO						BNA	NASHVILLE, TENN	YES	JT8D								SMALL BIRD
D ATB	NO						-IAD	XUS	SYRACUSE, NY	YES	JT8D								
ATB							DAY-SDF	XUS	OHIO	YES	JT8D							NO	
NONE	NO	NO					-CLE	XUS	OHIO	YES	CFM56	3	A	4					
ATB								MDW	CHICAGO, ILL-MIDWAY	YES	JT8D	15	A	4				NO	DAMAGE TO C2 FAN BLADES, REPLACED C2 ASS
ATB		ONE						MDW	MIDWAY, ILL	YES	JT8D	15A	A,C	3					
ATB								CRW	CHARLESTON, W. VA	YES	JT8D	9A						NO	
NONE		NO			1			XUS		YES	CFM56	3	A,C,K	1	NONE			NO	HPC BLADES BEYOND MM LIMITS

APPENDIX C

STATISTICAL HYPOTHESIS TESTING

Statistical analyses are based on an underlying probabilistic model of the process that gave rise to the data. For example, to provide the basis for comparing the weights of ingested birds in the United States and overseas, it is necessary to hypothesize an underlying random distribution of bird weights. Statistical analyses are somewhat more sophisticated than descriptive data analyses and more care is required to ensure that the methods are appropriate for data.

Statistical analysis is basically formalized inductive reasoning. Hypotheses about bird ingestion hazards are evaluated for consistency with the data that have been collected. Statistical analysis provides the rules for quantifying the level of consistency forming the basis for objective and unbiased decisions. The process is known formally as statistical hypothesis testing and a brief outline of the procedure is presented here.

The basis of a statistical hypothesis test is the hypothesis; which is a formal statement about a relationship in the data. In comparing the weight distributions of U. S. ingestions versus foreign ingestions, one hypothesis is that there is no difference in the sizesof the birds ingested here versus those ingested overseas. If the data are found to be consistent with the hypothesis it is accepted; otherwise the hypothesisis rejected.

The rules for deciding whether to accept or reject the hypothesis are based on the possible errors that could be made. A type I error refers to the situation in which the hypothesis is true; however we reject the hypothesis. Alternatively when we accept the hypothesis when it is not true we commit a type II error.

The goal of the statistician is to minimize the likelihood of both types of errors. Unfortunately the likelihood of a type I error is reciprocally linked to the likelihood of a type II error so that lowering the likelihood of a type I error will increase the likelihood of a type II error. Since only one error can be fully controlled it has become standard practice to control the likelihood of a type I error; which is called the significance level of the test. The test hypothesis is chosen so that it should be accepted unless there is strong evidence that it is not true and the test is constructed to minimize the likelihood of a type II error for the given significance level over a broad range of alternatives.

The mechancis of conducting a statistical hypothesis test are implemented by calculating a test statistic. The test statistic is a function of the data that is related to the test hypothesis. It is usually constructed so that small values are consistent with the null hypothesis and large values are consistent with the alternative hypothesis. The cutoff for accepting or rejecting the null hypothesis is called the critical value and is a function of the desired significance level.

Another aspect in evaluating the efficiency of a statistical test is its ability to detect when the test hypothesis is false. This ability is called the power of the test and is defined to be the probability of rejecting the test hypothesis when it is false. Generally there are many alternatives to the test hypothesis so that the power of the test is a function of the specific alternate hypothesis.

A variation on the statistical hypothesis test is the calculation of a confidence interval for a parameter such as the overall probability of ingestion (POI). Since there is no specific hypothesis about the POI, a confidence interval is used to describe the range of probabilities that are consistent with the data. The confidence level associated with a confidence interval corresponds to one minus the significance level of a hypothesis test and is a measure of the likelihood that the true value of the parameter (in this case the POI) is contained in the interval.

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