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Statistics on Aircraft Gas Turbine Engine Rotor Failures that Occurred in U. S. Commercial Aviation During 1986

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16. Abstract

This report presents statistical information relating to gas turbine engine rotor failures which occurred during 1986 in U.S. commercial aviation service use. Two hundred forty-nine failures occurred in 1986. Rotor fragments were generated in 140 of the failures, and of these 16 were uncontained. The predominant failure involved blade fragments, 93 percent of which were contained. Two disk failures occurred and all were uncontained. Sixty-five percent of the 249 failures occurred during the takeoff and climb stages of flight.

This service data analysis is prepared on a calendar year basis and published yearly. The data are useful in support of flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses.

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EXECUTIVE SUMMARY

This service data analysis is prepared on a calendar-year basis and published annually. The data support flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses. The following statistics are based on gas turbine engine rotor failures that have occurred in United States commercial aviation during 1986.

Two hundred and forty-nine rotor failures occurred in 1986. These failures accounted for approximately 14.1 percent of the 1763 shutdowns experienced by the United States commercial fleet. Rotor fragments were generated in 140 of the failures and, of these, 16 were uncontained. This represents an uncontained failure rate of 1.3 per million gas turbine engine powered aircraft flight hours, or 0.6 per million engine operating hours. Approximately 12.0 million and 28.6 million aircraft flight and engine operating hours, respectively, were logged in 1986.

Turbine rotor fragment-producing failures were approximately four times greater than that of the compressor rotor fragment-producing failures; 103 and 25 respectively, of the total. Fan rotor failures accounted for 12 of the fragment-producing failures experienced.

Blade fragments were generated in 133 of the rotor failures; 10 of these were uncontained. The remaining 6 uncontained failures were produced by disk--2, rim--1, and seal--3.

Of the 149 known causes of failures (because of the high percentage of unknown causes of rotor failures, the percentages were based on the total number of known causes), the causal factors were (1) foreign object damage--67 (45.0 percent); (2) secondary causes--41 (27.5 percent); and (3) design and life prediction problems --36 (24.2 percent). One hundred and sixty-three (65.5 percent) of the 249 rotor failures occurred during the takeoff and climb stages of flight. Ninety-six (68.6 percent) of the 140 rotor fragment-producing failures and 11 (68.8 percent) of the 16 uncontained rotor failures occurred during these same stages of flight.

The incidence of engine rotor failures producing fragments has remained relatively constant when compared to 1985 (150 in 1985 and 140 in 1986). The number of uncontained engine rotor failures reported has increased 14.3 percent in 1986 (14 in 1985 and 16 in 1986). The 12-year (1975 through 1986) average of uncontained engine rotor failures is 15.2.

INTRODUCTION

This report is sponsored and co-authored by the Federal Aviation Administration (FAA) Technical Center, located at the Atlantic City International Airport, New Jersey.

This service data analysis is published yearly. The data support flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses.

The intent and purpose of this report is to present data as objectively as possible on gas turbine rotor failure occurrences in U.S. commercial aviation. Presented in this report are statistics on gas turbine engine utilization and failures that have occurred in U.S. commercial aviation during 1986. These statistics are based on service data compiled by the FAA Flight Standards District Office. The National Safety Data Branch of the FAA Aviation Standards National Field Office disseminated this information in a service difficulty data base and the Air Carrier Aircraft Utilization and Propulsion Reliability Reports. The FAA service data base contains only a fraction of the actual commercial helicopter fleet operating statistics. The number of turboshaft engines in use with the corresponding engine flight hours given herein are estimates derived primarily from statistics published by the Helicopter Association International in their helicopter annuals. The compiled data were analyzed to establish:

1. The incidence of rotor failures and the incidence of contained and uncontained rotor fragments (an uncontained rotor failure is defined as a rotor failure that produces fragments which penetrate and escape the confines of the engine casing).

2. The distribution of rotor failures with respect to engine rotor components, i.e., fan, compressor or turbine rotors and their rotating attachments or appendages such as spacers and seals.

3. The number of rotor failures according to engine model and engine fleet hours.

4. The type of rotor fragment (disk, rim, or blade) typically generated at failure.

5. The cause of failure.

6. The flight conditions at the time of failure.

7. Engine failure rate according to engine fleet hours.

RESULTS

The data used for analysis are contained in appendix A. The results of these analyses are shown in figures 1 through 7 and tables 1 and 2.

Figure 1 shows that 249 rotor failures occurred in 1986. These rotor failures accounted for approximately 14.1 percent of the 1763 shutdowns experienced by the gas turbine powered U.S. commercial aircraft fleet during 1986. Rotor fragments were generated in 140 of the failures experienced and, of these, 16 (11.4 percent of the fragment-producing failures) were uncontained. This represents an uncontained failure rate of 1.3 per million gas turbine engine powered aircraft flight hours, or 0.6 per million engine operating hours.

Approximately 12.0 million and 28.6 million aircraft flight and engine operating hours, respectively, were logged by the U.S. commercial aviation fleet in 1986. Gas turbine engine fleet operating hours relative to the number of rotor failures and type of engines in use are shown in figure 2.

Figure 3 shows the distribution of rotor failures that produced fragments according to the engine component involved (fan, compressor, turbine), the type of fragments that were generated, and the percentage of uncontained failures according to the type of fragment generated. These data indicate that:

1. The incidence of turbine rotor failures was approximately four times greater than that of the compressor rotor failures; these corresponded to 103 (73.6 percent) and 25 (17.9 percent), respectively, of the total number of failures. Fan rotor failures accounted for 12 (8.6 percent) of the failures experienced.

2. Blade fragments were generated in 133 (95.0 percent) of the failures; ten (7.1 percent) of these were uncontained. The remaining seven (5.0 percent) failures were produced by disk, rim, and seal. Both disk failures were uncontained, the one rim failure was uncontained, and three of the four seal failures were uncontained.

Figure 4 shows the rotor failure distribution among the engine models that were affected and the total number of models in use.

Figure 5 shows what caused the rotor failures to occur. Of the 149 known causes of failure (because of the high percentage of unknown causes of rotor failure, the percentages were based on the total number of known causes), the causal factors were (1) foreign object damage--67 (45.0 percent); (2) secondary causes --41 (27.5 percent); and (3) design and life prediction problems--36 (24.2 percent).

Figure 6 indicates the flight conditions that existed when the various rotor failures occurred. One hundred and sixty-three (65.5 percent) of the 249 rotor failures occurred during the takeoff and climb stages of flight. Ninety-six (68.6 percent) of the rotor fragment-producing failures and 11 (68.8 percent) of the uncontained rotor failures occurred during these same stages of flight. The highest number of uncontained rotor failures, 6 (37.5 percent), happened during climb.

Table 1 contains a compilation of engine failure rates per million engine flight hours according to engine model, engine type, and containment conditions. The engine failure rates per million flight hours by engine type are turbofan--9.3, turboprop--9.2, and turboshaft--1.5. Uncontained engine failure rates per million flight hours by engine type were turbofan--0.6, turboprop--0.3, and turboshaft--1.0.

Table 2 is a cumulative tabulation that describes the distribution of uncontained rotor failures according to fragment type, engine component involved, cause category, and flight condition (takeoff and climb are defined as "high power," all other conditions are defined as "low power") for the years 1976 through 1986. This figure is expanded yearly to include all subsequent uncontained rotor failures. These data indicate that for "secondary causes" the number of uncontained failures was approximately six times greater at high power than low power (namely 33 and 6). For "design and life prediction problems" the number of high power uncontained failures was three time greater than low power (namely 27 and 8); and for "foreign object damage" the number of uncontained failures was four times greater at high power than low power (namely 8 and 2). This tabulation also indicates that of the 169 total uncontained incidences, blade failures accounted for 66.3 percent; disk failures 21.9 percent; rim failures 4.7 percent; and seal/spacer failures 7.1 percent.

Figure 7 shows the annual incidence of uncontained rotor failures in commercial aviation for the years 1962 through 1986. During 1986, the incidence of uncontained rotor failures increased by two over the previous year, 1985. Over the past 12 years, 1975 through 1986, an average of 15.2 uncontained rotor failures per year have occurred. During the same time period, the rate of uncontained rotor failures has remained relatively constant at an average of approximately one per million operating hours.

DISCUSSION AND CONCLUSIONS

The incidence of engine rotor fragment-producing failures has remained relatively constant when compared to 1985 (150 in 1985 and 140 in 1986). The uncontained engine rotor failures has increased 14.3 percent (16 in 1986 and 14 in 1985). The 12-year (1975 through 1986) average of uncontained engine rotor failures is 15.2.

Of the 16 uncontained events that occurred during 1986, 12 (75.0 percent) involved turbine rotors, 2 (12.5 percent) involved compressor rotors, and 2 (12.5 percent) involved fan rotors.

The predominant cause of failure was attributed to foreign object damage (45.0 percent of the known failures) and one uncontained failure occurred in this category. Secondary causes (27.5 percent of the known failures) and design and life prediction problems (24.2 percent of the known causes) had two uncontained failures each. Assembly and inspection error had one uncontained failure. The causes of the remaining ten uncontained failures (62.5 percent) are unknown.

Uncontained failures occurred in 5 of the 10 flight modes; i.e., 5 during takeoff (31.3 percent); 6 during climb (37.5 percent); 3 in cruise (18.8 percent), and 1 in hovering (6.3 percent).

The higher incidences of uncontained rotor failures in calendar years 1967 through 1973 (except for 1968) were probably due to the introduction of newly developed engines entering the commercial aviation fleet, such as the JT9D and CF6 engines.

Structural life predictions and verification are being improved by the increased use of spin chamber testing by government and industry as a means of obtaining failure data for statistically significant samples. In addition, increased development and application of high sensitivity, nondestructive inspection methods should increase the probability of cracks being detected prior to failure. The capability to reduce the causes of failures from secondary effects is also being addressed thr-- -h technology development programs. However, causes due to foreign object damag still appear to be beyond the control or scope of present technology.

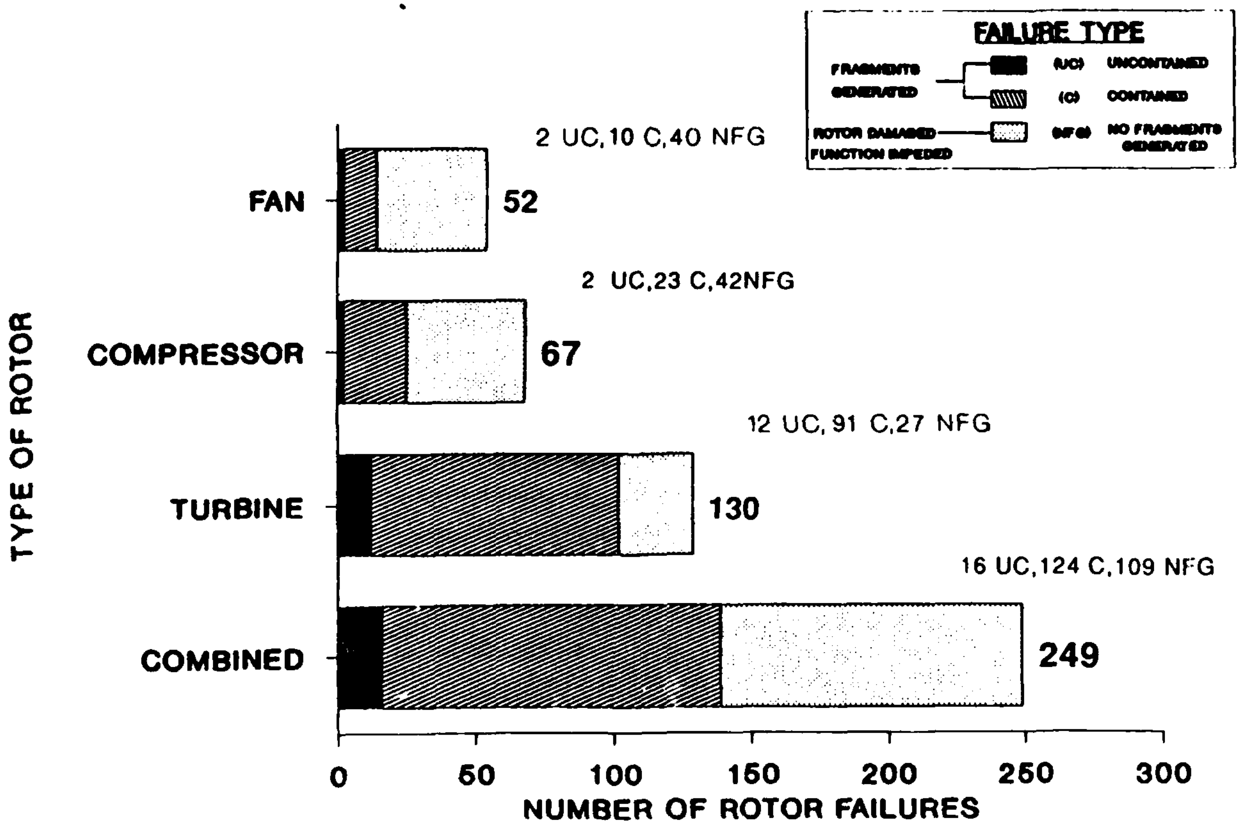


FIGURE 1. INCIDENCE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION - 1986

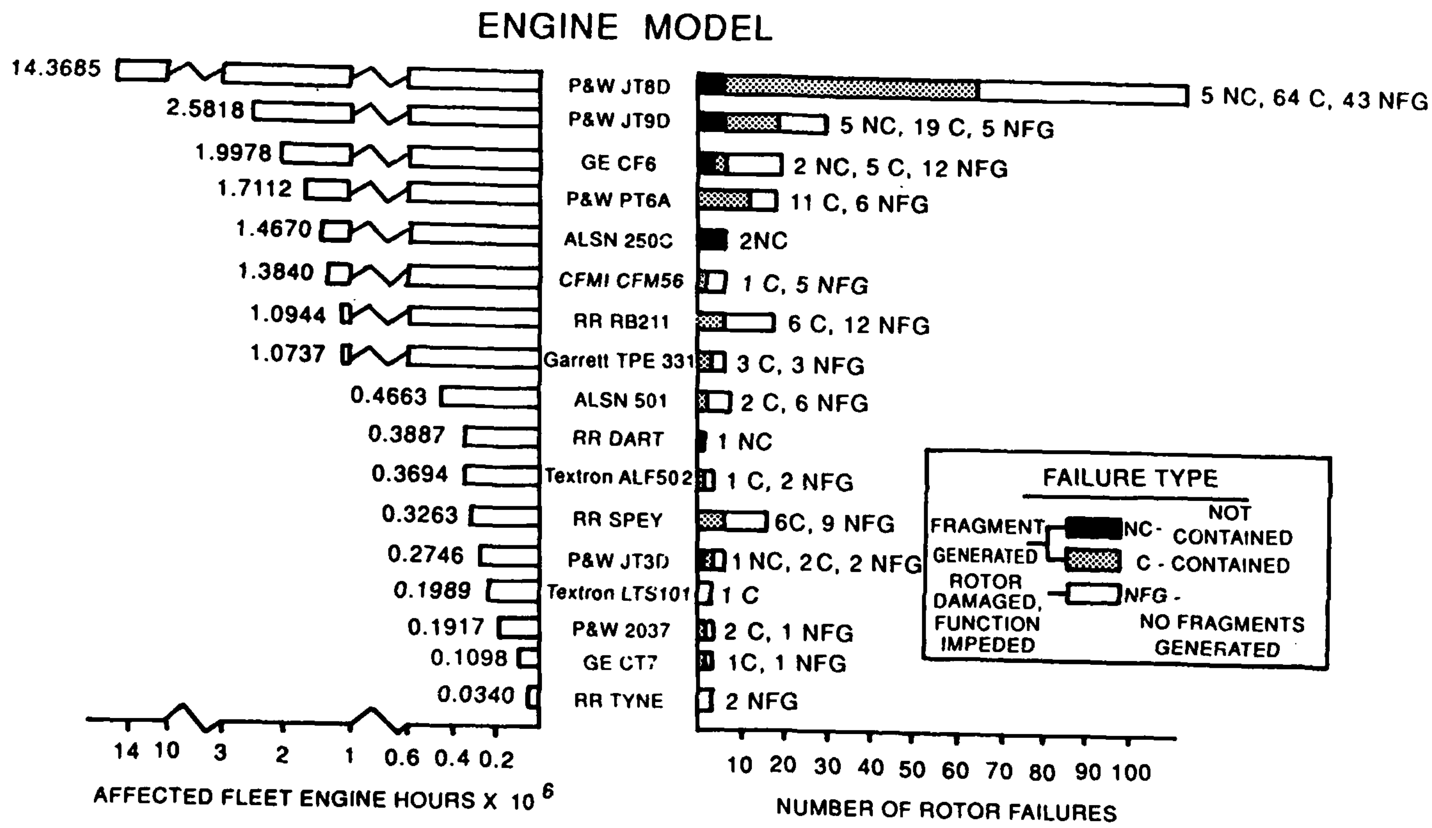


FIGURE 2. TYPE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION ACCORDING TO AFFECTED ENGINE MODEL AND ENGINE FLEET HOURS - 1986

ENGINE ROTOR COMPONENTS	TYPE OF FRAGMENT GENERATED									
	DISK		RIM		BLADE		SEAL		TOTAL	
	TF	UCF	TF	UCF	TF	UCF	TF	UCF	TF	UCF
FAN	0	0	0	0	12	2	0	0	12	2
COMPRESSOR	0	0	1	1	24	1	0	0	25	2
TURBINE	2	2	0	0	97	7	4	3	103	12
TOTAL	2	2	1	1	133	10	4	3	140	16

TF - TOTAL FAILURES

UCF - UNCONTAINED FAILURES

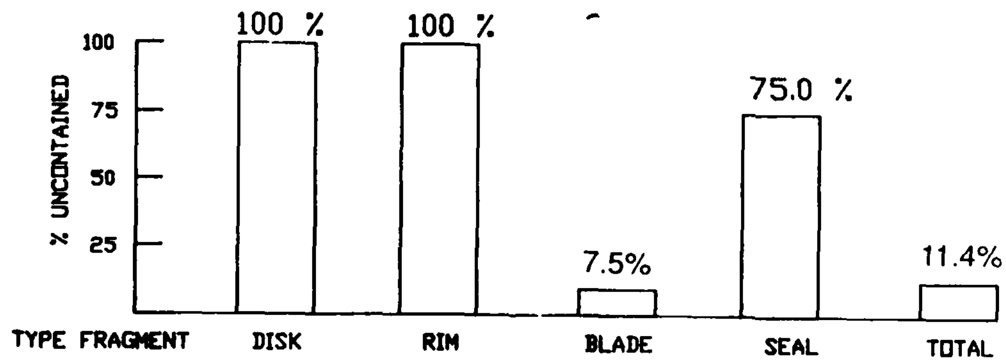
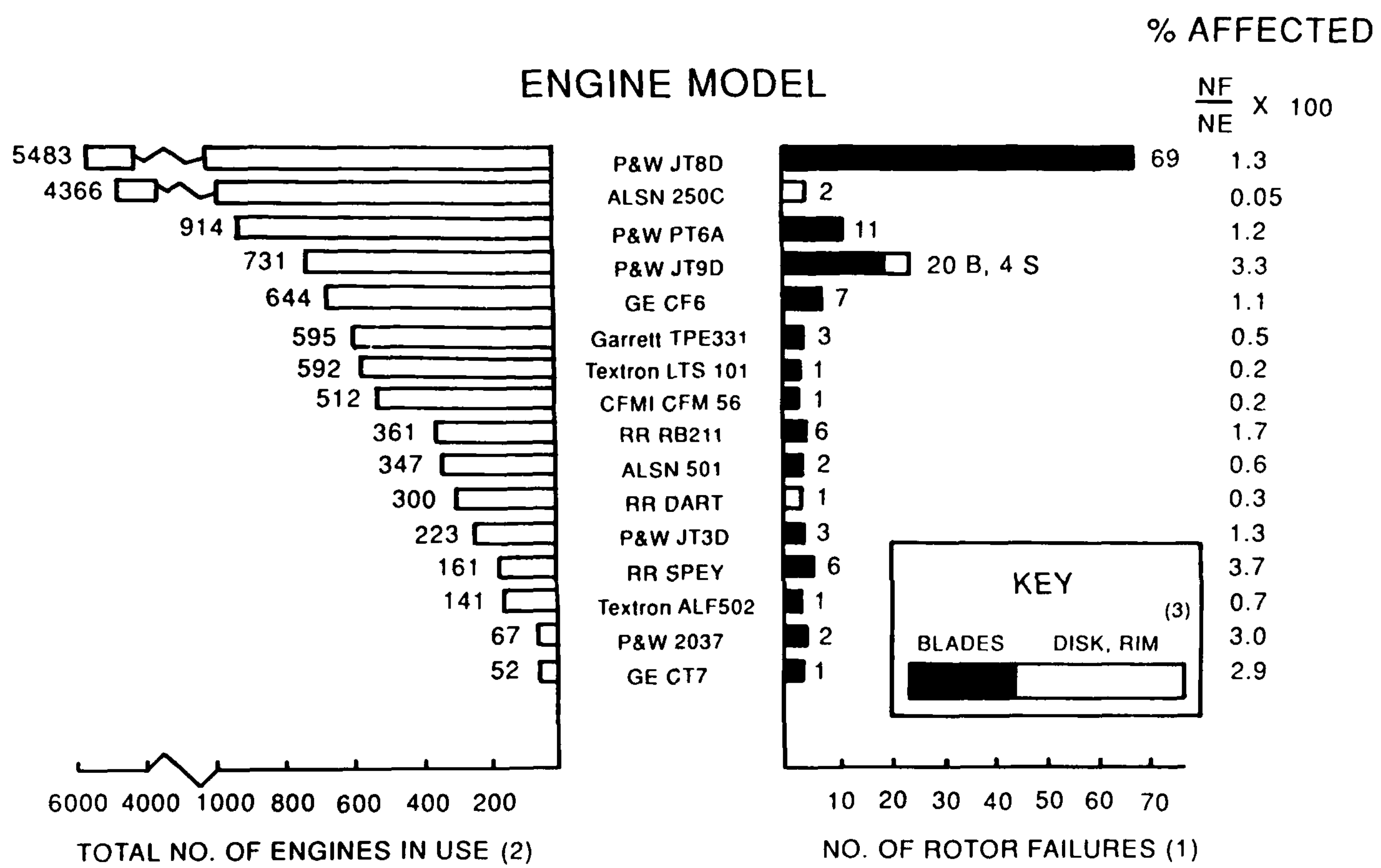


FIGURE 3. COMPONENT AND FRAGMENT TYPE DISTRIBUTIONS FOR CONTAINED AND UNCONTAINED ENGINE ROTOR FAILURES (FAILURES THAT PRODUCED FRAGMENTS) - 1986



NOTES: (1) FAILURES THAT PRODUCED FRAGMENTS
(2) YEARLY AVERAGE OF AIRCRAFT IN USE AT END OF EACH MONTH
(3) SEAL/SPACER FAILURES INCLUDED IN DISK/RIM COMPILATION

FIGURE 4. THE INCIDENCE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION ACCORDING TO ENGINE MODEL AND COMPONENT AFFECTED - 1986

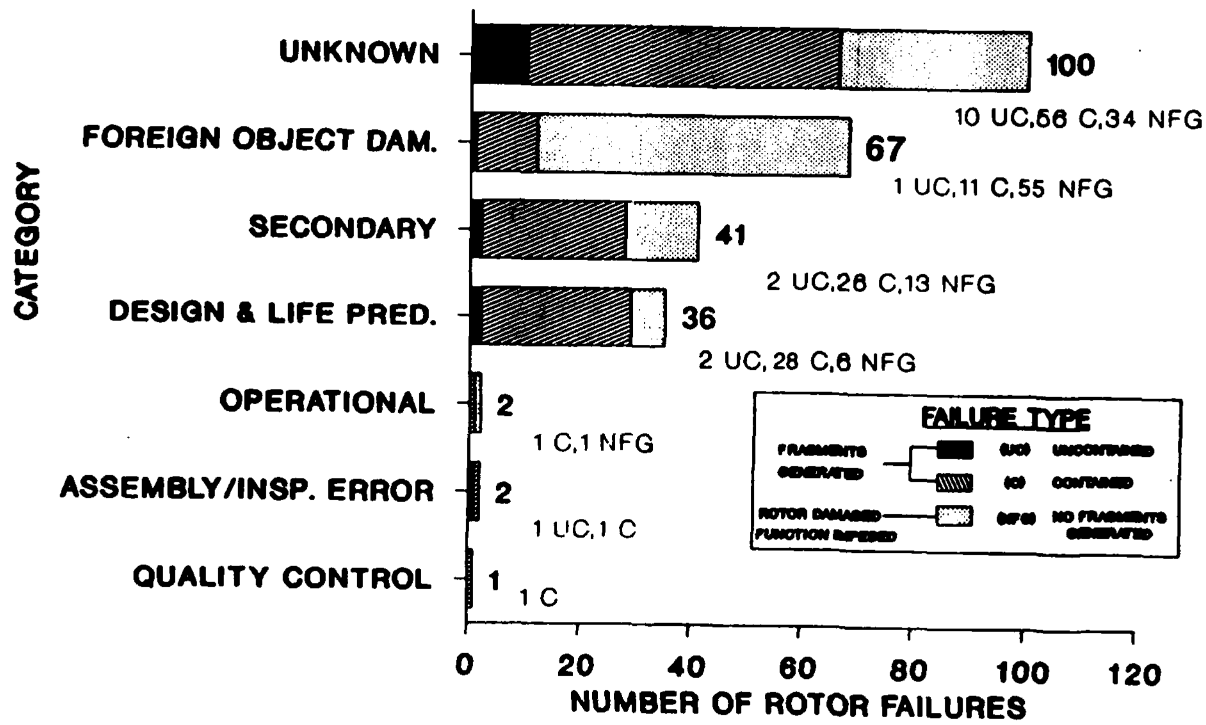


FIGURE 5. ENGINE ROTOR FAILURE CAUSE CATEGORIES - 1986

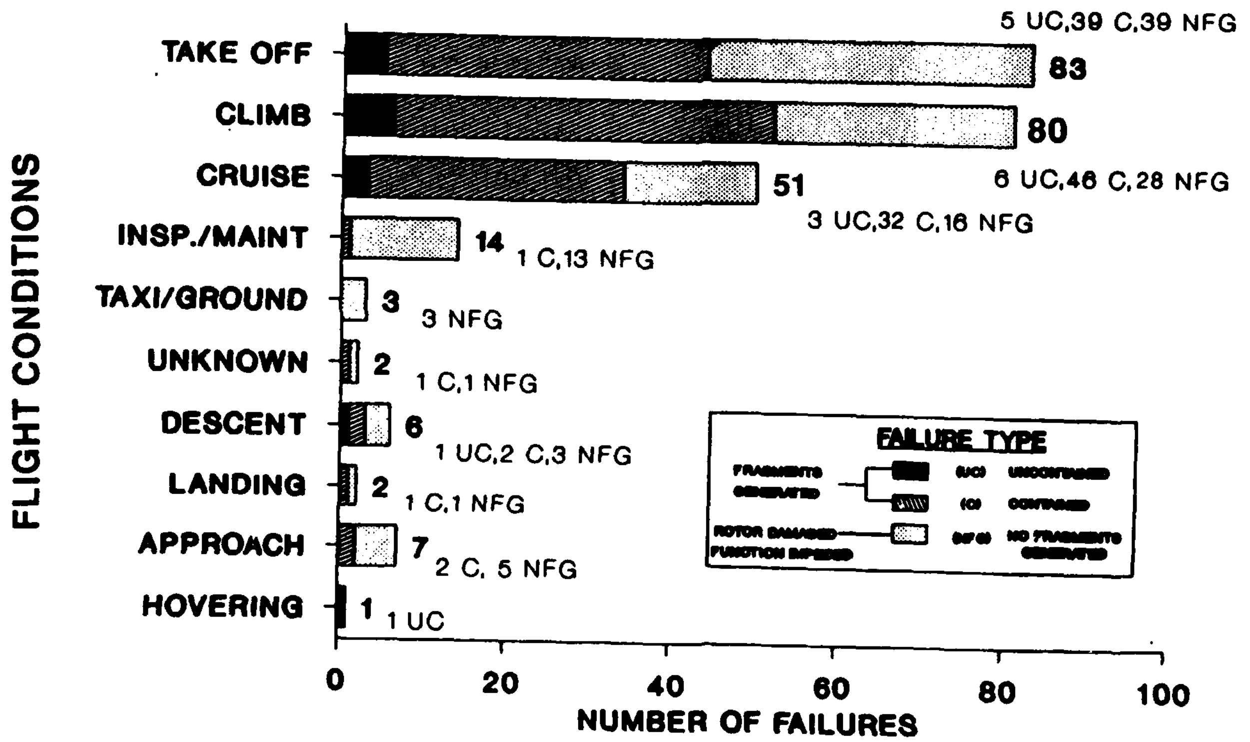


FIGURE 6. FLIGHT CONDITION AT ENGINE ROTOR FAILURE - 1986

TABLE 1. GAS TURBINE ENGINE FAILURE RATES ACCORDING TO ENGINE MODEL AND TYPE - 1986

TYPE/ MODEL	AVERAGE NUMBER IN USE	ENGINE FLIGHT HRS.x10^6	NO. OF FAILURES* C	NC	N	TOTAL	FAIL.RATES / 10^6 ENGINE FLIGHT HRS. C	NC	N	TOTAL
TURBOFAN/TURBOJET										
JT8D	5483	14.3685	64	5	43	112	4.5	0.3	3.0	7.8
JT3D	223	0.2746	2	1	2	5	7.3	3.6	7.3	18.2
JT9D	731	2.5818	19	5	5	29	7.4	1.9	1.9	11.2
CF6	644	1.9978	5	2	12	19	2.5	1.0	6.0	9.5
RB211	361	1.0944	6	0	12	18	5.5	0.0	11.0	16.4
2037	67	0.1917	2	0	1	3	10.4	0.0	5.2	15.6
SPEY	161	0.3263	6	0	9	15	18.4	0.0	27.6	46.0
TFE731	5	0.0051	0	0	0	0	0.0	0.0	0.0	0.0
CFM56	512	1.3840	1	0	5	6	0.7	0.0	3.6	4.3
ALF502	141	0.3694	1	0	2	3	2.7	0.0	5.4	8.1
TOTAL	8328	22.5936	106	13	92	210	4.7	0.6	4.1	9.3
TURBOPROP										
PT6A	914	1.7112	11	0	6	17	6.4	0.0	3.5	9.9
501	347	0.4663	2	0	6	8	4.3	0.0	12.9	17.2
TPE331	595	1.0737	3	0	3	6	2.8	0.0	2.8	5.6
DART	300	0.3887	0	1	0	1	0.0	2.6	0.0	2.6
120	36	0.0825	0	0	0	0	0.0	0.0	0.0	0.0
BASTAN	15	0.0275	0	0	0	0	0.0	0.0	0.0	0.0
TYNE	21	0.0340	0	0	2	2	0.0	0.0	58.8	58.8
CT7	52	0.1098	1	0	1	2	9.1	0.0	9.1	18.2
P&W115	18	0.0015	0	0	0	0	0.0	0.0	0.0	0.0
TOTAL	2298	3.8952	17	1	18	36	4.4	0.3	4.6	9.2
TURBOSHAFT										
250C	4366	1.4670	0	2	0	2	0.0	1.4	0.0	1.4
LTS101	592	0.1989	1	0	0	1	5.0	0.0	0.0	5.0
ALL OTHERS	1192	0.4005	0	0	0	0	0.0	0.0	0.0	0.0
TOTAL	6150**	2.0664**	1	2	0	3	0.5	1.0	0.0	1.5

C = CONTAINED NC = NOT CONTAINED
N = FUNCTION IMPEDED, NO FRAGMENTS GENERATED

*As reported by service difficulty reports only.

**Estimated total number in use and engine flight hours for entire U.S. commercial fleet.

TABLE 2. UNCONTAINED ENGINE ROTOR FAILURE DISTRIBUTIONS ACCORDING TO CAUSE AND FLIGHT CONDITIONS - 1976 THROUGH 1986

TYPE OF FRAGMENT GENERATED		DISK			RIM			BLADE			SEAL				
ENGINE ROTOR COMPONENT		FAN	COMP	TURB	FAN	COMP	TURB	FAN	COMP	TURB	FAN	COMP	TURB	SUB TOT	TOTAL
CAUSE	FLIGHT COND.														
DESIGN/LIFE	HI	0	5	0	0	2	0	8	8	2	0	1	0	27	
PREDICTION	LOW	0	1	3	0	0	0	1	0	3	0	0	0	8	35
PROBLEMS	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
SECONDARY	HI	0	1	0	0	0	0	5	4	20	0	0	3	33	
CAUSES	LOW	0	0	1	0	0	0	0	2	3	0	0	0	6	40
	UNK	0	0	0	0	0	0	0	0	1	0	0	0	1	
FOREIGN	HI	1	0	1	0	0	0	6	0	0	0	0	0	8	
OBJECT	LOW	0	0	0	0	0	0	1	0	0	0	0	0	2	12
DAMAGE	UNK	0	0	0	0	0	0	2	0	0	0	0	0	2	
QUALITY	HI	0	1	0	0	0	1	2	0	0	0	0	0	4	
CONTROL	LOW	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
OPERATIONAL	HI	0	0	0	0	0	0	0	0	0	0	0	0	0	
	LOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
ASSEMBLY/	HI	0	0	0	0	0	0	0	0	0	0	0	0	0	
INSP.	LOW	0	0	1	0	0	0	0	0	0	0	0	0	0	1
REPORTS	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
UNKNOWN	HI	0	2	11	0	3	0	6	10	12	1	2	3	50	
	LOW	1	0	7	0	1	0	0	3	8	0	1	1	22	77
	UNK	0	0	1	0	0	0	1	0	3	0	0	0	5	
	HI	1	9	12	0	6	1	27	22	34	1	3	6	122	
SUBTOTAL	LOW	1	1	12	0	1	0	3	5	14	0	1	1	39	169
	UNK	0	0	1	0	0	0	3	0	4	0	0	0	8	
TOTAL			37			8			112			12		169	169

*Takeoff and climb are defined as "High Power" and all other conditions are defined as "Low Power"

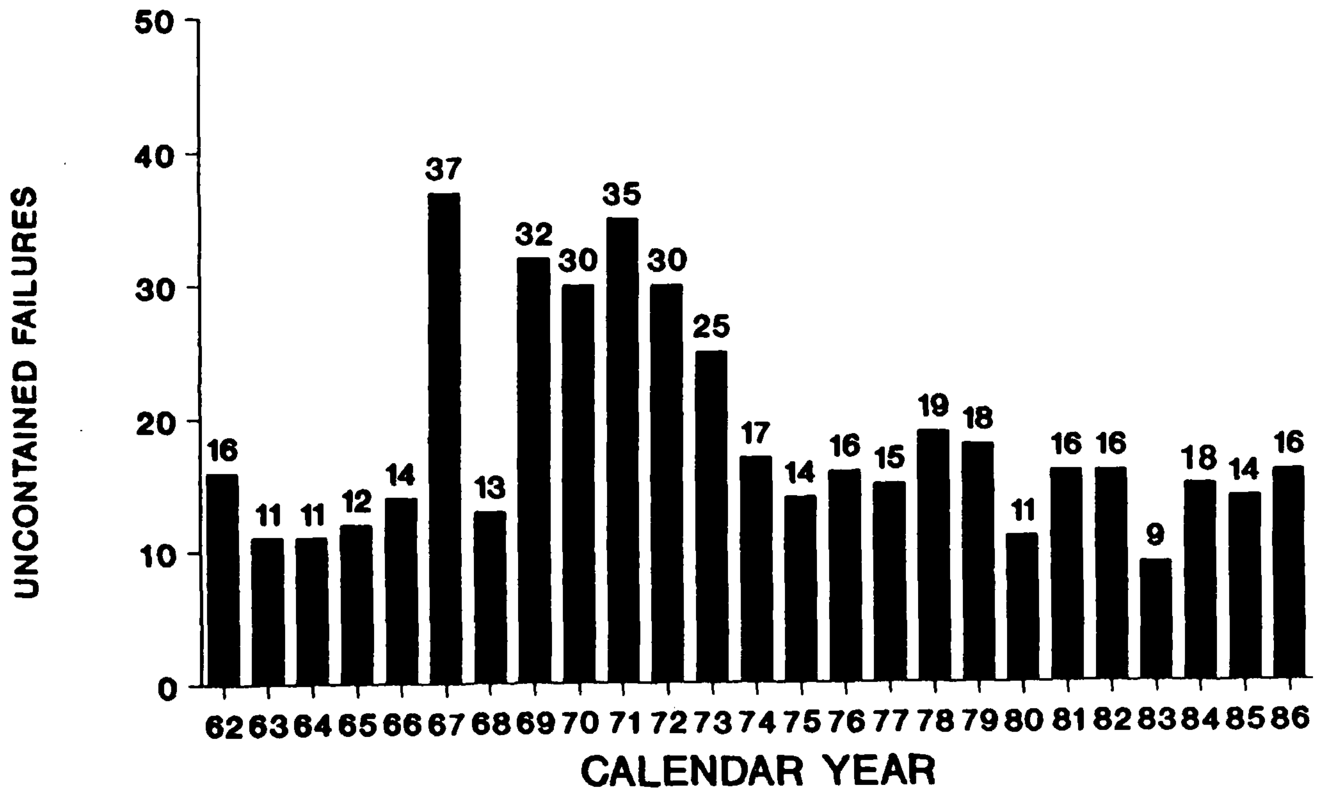


FIGURE 7. THE INCIDENCE OF UNCONTAINED ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION, 1962 through 1986

APPENDIX A

Data of Engine Rotor Failures in U.S. Commercial Aviation for 1986. Compiled from the Federal Aviation Administration Service Difficulty Reports.

Data Compilation Key

Component Code:

F - Fan
C - Compressor
T - Turbine

Fragment Type Code:

D - Disk
R - Rim
B - Blade
S - Seal
N - None

Cause Code:

1 - Design and Life Prediction Problems
2 - Secondary Causes
3 - Foreign Object Damage
4 - Quality Control
5 - Operational
6 - Assembly and Inspection Error
7 - Unknown

Containment Condition Code:

C - Contained
NC - Not Contained
N - No Fragments Generated

Flight Condition Code:

1 - Insp/Maint
2 - Taxi/Grnd Hdl
3 - Takeoff
4 - Climb
5 - Cruise
6 - Descent
7 - Approach
8 - Landing
9 - Hovering
10 - Unknown

CHARACTERISTICS OF ROTOR FAILURES - 1986

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860131057	SWXA	DC9	JT8D	C	B	7	C	8
860418016	REPA	DC9	JT8D	F	N	3	N	7
860926097	REPA	DC9	JT8D	C	B	2	C	7
860512024	REPA	DC9	JT8D	T	B	2	C	3
861107073	CALA	DC9	JT8D	T	B	7	C	3
860210110	OZAA	DC9	JT8D	C	N	7	N	4
860512030	MIDA	DC9	JT8D	T	N	7	N	3
861121020	MIDA	DC9	JT8D	T	N	7	N	4
860310029	REPA	DC9	JT8D	T	B	2	C	4
861020038	USAA	DC9	JT8D/NO.1	F	B	7	NC	3
860502005	EALA	DC9	JT8D	C	B	2	C	4
861117052	EALA	DC9	JT8D	C	B	2	C	4
860929133	EALA	DC9	JT8D	C	B	2	C	4
860825016	USAA	DC9	JT8D	F	N	3	N	3
861031040	REPA	DC9	JT8D/NO.1	T	N	2	N	5
860103185	EALA	DC9	JT8D	T	B	2	NC	4
860314009	USAA	DC9	JT8D	T	B	1	C	3
861117108	MIDA	DC9	JT8D	T	N	7	N	3
861024024	EALA	DC9	JT8D	T	B	1	C	4
860512060	NYAA	DC9	JT8D	T	B	7	C	5
861228025	USAA	DC9	JT8D	T	B	7	C	5
860929127	REPA	DC9	JT8D	T	B	1	C	5
860131085	OZAA	DC9	JT8D	F	B	3	C	5
861024043	ABXA	DC9	JT8D	F	B	3	C	3
860418042	REPA	DC9	JT8D	F	N	3	N	5
860321069	EALA	DC9	JT8D	C	B	2	C	5
860824023	EALA	DC9	JT8D/NO.1	F	B	3	NC	6
860902058	REPA	DC9	JT8D	C	B	1	C	3
860418043	REPA	DC9	JT8D	T	B	7	C	6
860516112	REPA	DC9	JT8D	T	B	7	C	3
860929131	EALA	DC9	JT8D	T	B	1	C	4
860404052	REPA	DC9	JT8D	T	B	2	C	5
861010029	PSAA	DC9	JT8D	T	N	7	N	3
861215020	NYAA	DC9	JT8D	T	N	7	N	7
860224030	JAMA	DC9	JT8D	F	N	3	N	3
860103182	EALA	DC9	JT8D	T	B	2	C	4
860404046	JAMA	DC9	JT8D	T	N	7	N	3
860418052	REPA	DC9	JT8D	T	B	7	C	3
860530108	TWAA	DC9	JT8D	T	B	7	C	5
860606001	REPA	DC9	JT8D	T	B	1	C	4
860811017	NYAA	DC9	JT8D	T	N	7	N	4
860110077	NWAA	B727	JT8D	T	B	7	C	3
861117064	REPA	B727	JT8D	T	B	7	C	3
861205034	GATA	B727	JT8D	C	N	3	N	4
860616042	CALA	B727	JT8D	F	B	2	C	3
861205032	GATA	B727	JT8D	T	B	2	C	4
860915047	EIAA	B727	JT8D	C	B	3	C	3

CHARACTERISTICS OF ROTOR FAILURES - 1986

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860822052	EIAA	B727	JT8D	C	N	7	N	3
860729033	EISA	B727	JT8D	T	N	7	N	5
860715014	FDEA	B727	JT8D	T	B	1	C	3
860630012	AALA	B727	JT8D	F	B	3	C	4
860103179	EALA	B727	JT8D	C	N	3	N	1
860502004	EALA	B727	JT8D	C	B	1	C	4
861128069	EALA	B727	JT8D	C	B	3	C	5
861003017	EALA	B727	JT8D	F	N	3	N	3
861020081	EALA	B727	JT8D	C	N	3	N	4
860824022	EALA	B727	JT8D	T	B	3	C	5
860630013	EALA	B727	JT8D	T	B	2	C	5
860902056	EALA	B727	JT8D/NO.3	T	B	7	NC	3
860527001	EALA	B727	JT8D	T	B	2	C	4
861014103	EALA	B727	JT8D	T	B	2	C	4
860310009	PEXA	B727	JT8D	C	B	2	C	4
861128033	USAA	B727	JT8D	C	N	1	N	1
860228094	NWAA	B727	JT8D	T	B	1	C	3
860224021	TWAA	B727	JT8D	T	B	7	C	5
860131068	TWAA	B727	JT8D	T	B	7	C	4
860516111	TWAA	B727	JT8D	T	B	7	C	4
860224023	DALA	B727	JT8D	F	B	1	C	4
860418035	DALA	B727	JT8D	F	B	1	C	4
861010023	DALA	B727	JT8D	F	N	1	N	1
861010026	DALA	B727	JT8D	F	N	1	N	1
860721022	PEXA	B727	JT8D	T	B	7	C	4
861205027	PEXA	B727	JT8D	T	N	2	N	3
861006225	PAIA	B727	JT8D	T	N	7	N	4
861128083	PAIA	B727	JT8D	T	B	7	C	3
860210108	EALA	B727	JT8D	F	B	3	C	3
860404047	EALA	B727	JT8D	C	N	2	N	4
861215031	EALA	B727	JT8D	F	B	3	C	5
860210106	NWAA	B727	JT8D	C	B	7	C	3
861201002	NWAA	B727	JT8D	F	N	3	N	3
860929045	NWAA	B727	JT8D	T	B	1	C	3
860321070	NWAA	B727	JT8D	T	B	1	C	4
860411021	REPA	B727	JT8D	C	N	3	N	5
860328002	REPA	B727	JT8D	F	N	7	N	5
860224024	NWAA	B727	JT8D	C	B	7	C	5
861024027	TAGA	B727	JT8D	T	B	7	C	3
861128067	TWAA	B727	JT8D	T	B	2	C	4
860310035	TWAA	B727	JT8D	T	B	2	C	4
860902062	TWAA	B727	JT8D	T	B	7	C	5
860902051	AWXA	B737	JT8D	F	N	2	N	3
860218025	PEXA	B737	JT8D	F	N	3	N	3
861205020	PEXA	B737	JT8D	T	B	7	C	4
860616043	ACLA	B737	JT8D	T	B	7	C	6

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SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860816037	AWXA	B737	JT8D	T	B	7	C	3
860519002	AWXA	B737	JT8D	F	N	3	N	3
860926086	SWAA	B737	JT8D	F	N	3	N	4
860210111	TSAA	B737	JT8D	T	B	7	C	4
860411017	PAIA	B737	JT8D	F	N	3	N	8
860905010	PAIA	B737	JT8D	F	N	3	N	1
860310027	PAIA	B737	JT8D	C	N	3	N	3
860310032	PAIA	B737	JT8D	T	N	7	N	5
861202009	PAIA	B737	JT8D/NO.2	T	B	1	NC	3
860502003	AWXA	B737	JT8D	T	B	1	C	4
860926113	ACLA	B737	JT8D	T	B	1	C	4
860314002	AWXA	B737	JT8D	F	N	3	N	3
860509012	ACLA	B737	JT8D	T	B	7	C	1
860411018	TSAA	JT8D	JT8D	F	N	3	N	3
860309004	REPA	DC9	JT8D	F	N	3	N	4
860620032	OZAA	DC9	JT8D	F	N	3	N	3
860707035	OZAA	DC9	JT8D	F	N	3	N	3
860929014	EIAA	DC9	JT8D	F	N	3	N	3
861117109	EALA	DC9	JT8D	F	N	3	N	3
860729040	PAAA	A310	JT9D/NO.1	T	S	7	NC	[illegible]
861010164	PAAA	A310	JT9D/NO.2	T	S	7	NC	4
860516108	UALA	B747	JT9D	T	B	7	C	5
860630038	FTLA	B747	JT9D	T	B	7	C	3
860528064	PAAA	B747	JT9D/NO.4	T	B	7	NC	4
860121058	FTLA	B747	JT9D	T	B	7	C	4
860729037	UALA	B747	JT9D	T	B	7	C	5
860707060	PAAA	B747	JT9D	T	B	2	C	4
860110062	TAGA	B747	JT9D	T	B	7	C	4
860902016	TWRA	B747	JT9D	T	B	1	C	5
861028040	TWRA	B747	JT9D	T	B	1	C	3
860929134	NWAA	DC10	JT9D	T	B	7	C	4
860210103	NWAA	DC10	JT9D	C	N	2	N	4
860630009	NWAA	DC10	JT9D	T	B	1	C	4
861128062	TWAA	B747	JT9D	T	B	1	C	5
860912116	FTLA	B747	JT9D	F	N	3	N	3
860303046	NWAA	B747	JT9D	T	B	1	C	3
860824026	PEXA	B747	JT9D	T	B	7	C	4
860512028	PEXA	B747	JT9D	T	B	7	C	5
860210107	NWAA	B747	JT9D	T	S	7	C	3
860929043	NWAA	B747	JT9D	T	N	5	N	5
860328001	PEXA	B747	JT9D	T	B	7	C	3
861020073	FTLA	B747	JT9D	T	N	7	N	5
861201006	FTLA	B747	JT9D	F	N	3	N	3
860929126	TWAA	B747	JT9D	T	B	7	C	3
861228010	TWAA	B747	JT9D	T	B	2	C	4
860721033	TWAA	B747	JT9D	T	B	1	C	4
861217015	SW99	B747	JT9D/NO.4	T	B	7	NC	5

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SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860911006	EU51	B747	JT9D/NO.4	T	S	7	NC	5
861109039	PAIA	F28	SPEY	C	B	7	C	3
860418010	PAIA	F28	SPEY	F	B	7	C	3
860728033	PAIA	F28	SPEY	F	N	7	N	5
861010080	PAIA	F28	SPEY	C	N	7	N	3
860310015	PLGA	F28	SPEY	C	N	3	N	3
861117091	PLGA	F28	SPEY	C	N	1	N	5
861006019	PAIA	F28	SPEY	C	N	3	N	2
861201009	PAIA	F28	SPEY	C	N	3	N	7
860811019	PAIA	F28	SPEY	C	N	3	N	4
860121062	EMPA	F28	SPEY	C	B	7	C	3
860630042	FLEA	BAC111-2	SPEY	C	N	7	N	3
860502019	FLEA	BAC111-2	SPEY	C	N	7	N	3
861128071	USAA	BAC111-2	SPEY	T	B	7	C	5
861128037	USAA	BAC111-2	SPEY	T	B	7	C	5
860310013	USAA	BAC111-2	SPEY	T	B	7	C	3
860226106	MAAA	F27	DART/NO.1	C	R	1	NC	3
860616040	AMWA	SF340A	CT7-5A	T	B	7	C	3
860808002	AMWA	SF340A	CT7-5A	T	N	7	N	4
860625058	ERAA	DHC6	PT6A	C	N	7	N	2
861014050	BRIA	B99	PT6A	T	N	7	N	7
860128008	ERAA	DHC6	PT6A	C	N	2	N	3
860108051	PLGA	DHC6	PT6A	T	B	7	C	3
860306008	PLGA	DHC6	PT6A	T	B	3	C	3
860424176	ERAA	DHC6	PT6A	T	B	7	C	5
860714042	MLSA	B99	PT6A	T	B	7	C	5
860923016	PCAA	DHC6	PT6A	T	B	7	C	4
860513008	RAYA	EMB110	PT6A	T	B	7	C	5
860721026	CHQA	SD330	PT6A	T	B	7	C	10
861103072	CAIA	SD330	PT6A	T	N	7	N	4
860915064	HALA	DHC7	PT6A	T	B	2	C	7
860321073	CLTA	B1900C	PT6A	T	B	7	C	3
860404054	BHAA	B1900C	PT6A	C	N	2	N	1
860411012	RIOA	B1900C	PT6A	T	B	1	C	4
860425019	CLTA	B1900C	PT6A	T	B	2	C	4
860707031	RIOA	B1900C	PT6A	T	N	2	N	1
860123054	PIOA	SA227	TPE331	C	N	3	N	10
860123075	PIOA	SA227	TPE331	C	N	3	N	3
861112071	MALA	SA227	TPE331	C	N	3	N	3
860226117	MAAA	SA227	TPE331	T	B	7	C	5
860522010	QXEA	SA227	TPE331	T	B	7	C	5
860912127	QXEA	SA227	TPE331	T	B	7	C	4
861006169	EALA	A300	CF6-50	T	B	5	C	4
860103181	EALA	A300	CF6-50	T	N	2	N	5
860411014	EALA	A300	CF6-50	T	B	2	C	4
860824024	EALA	A300	CF6-50	C	N	2	N	4
860310025	EALA	A300	CF6-50	F	N	7	N	4

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SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860121051	EALA	A300	CF6-50/NO.1	T	B	2	NC	4
861017003	CALA	DC10	CF6-6	T	N	7	N	1
860926024	WRLA	DC10	CF6-6	F	N	3	N	3
860519004	CALA	DC10	CF6-6	C	B	7	C	3
861205025	UALA	DC10	CF6-6	C	B	1	C	3
861107062	CALA	DC10	CF6-6	C	B	7	C	3
860926112	CALA	DC10	CF6-6	T	N	1	N	1
860922069	AALA	DC10	CF6-6/NO.3	T	B	7	NC	4
860103178	FDEA	DC10	CF6-6	C	N	3	N	3
860425032	CMDF	DC10	CF6-50	C	N	7	N	7
860512053	CMDF	DC10	CF6-50	F	N	3	N	6
860714084	EALA	DC10	CF6-50	F	N	3	N	4
861027061	CALA	DC10	CF6-50	T	N	1	N	1
860620012	FDEA	DC10	CF6-50	T	N	3	N	1
861215029	LLLA	BAE146-1	ALF502	T	B	7	C	4
860929029	LLLA	BAE146-1	ALF502	T	N	7	N	6
860707028	PSAA	BAE146-2	ALF502	T	N	2	N	4
860701015	WPIA	B206L-1	250C/NO.1	T	D	6	NC	9
860910062	SW62	S76A	250C/NO.1	T	D	7	NC	5
860210112	AMTA	L1011	RB211	T	N	7	N	5
860404072	EALA	L1011	RB211	F	N	7	N	4
860528054	EALA	L1011	RB211	C	N	2	N	3
861031036	EALA	L1011	RB211	C	N	2	N	2
860623003	EALA	L1011	RB211	F	N	7	N	4
860103011	EALA	L1011	RB211	F	N	3	N	5
860117037	EALA	L1011	RB211	F	N	7	N	5
860902048	DALA	L1011	RB211	C	B	2	C	3
860509011	TWAA	L1011	RB211	C	B	2	C	5
860616001	TAEA	L1011	RB211	C	N	7	N	4
860623005	EALA	L1011	RB211	F	N	7	N	5
860902043	HALA	L1011	RB211	T	B	1	C	4
860630113	TWAA	L1011	RB211	T	B	4	C	4
860902041	HALA	L1011	RB211	T	B	3	C	3
860502031	EALA	L1011	RB211	T	N	7	N	4
860922104	TAEA	L1011	RB211	C	N	7	N	5
860425007	TWAA	L1011	RB211	C	B	1	C	5
860620004	BWIA	L1011	RB211	C	N	3	N	3
860210116	WRNA	CL44	TYNE515	C	N	3	N	1
860418012	WRNA	CL44	TYNE515	C	N	3	N	3
861117141	REPA	STCAPJC	501-D13	C	N	3	N	4
860616045	ASPA	STCAPJC	501-D13	T	B	2	C	5
860824011	REPA	STCAPJC	501-D13	C	N	3	N	3
860926069	GATA	STCAPJC	501-D13	C	N	3	N	4
860218031	TIAA	L382G	501-D22	C	N	3	N	6
860228095	SRAA	L382B	501-D22	C	N	3	N	3
860902014	TIAA	L382G	501-D22	C	N	3	N	4
860228102	MRKA	L382G	501-D22	T	B	7	C	4

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SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
860131073	ARWA	DC8	JT3D	C	B	1	C	5
860616022	FWTA	B707	JT3D	C	N	3	N	4
860527003	FWTA	B707	JT3D	T	B	2	C	4
860620010	SRAA	B707	JT3D	C	N	3	N	1
860114016	WPOI	NR	JT3D/NR	C	B	7	NC	3
861031077	UALA	DC8	CFM56-2	C	B	1	C	5
860825086	ACLA	B737	CFM56-3	F	N	3	N	3
861117062	ACLA	B737	CFM56-3	F	N	3	N	3
861221010	SWAA	B737	CFM56-3	F	N	3	N	4
860926147	PAIA	B737	CFM56-3	F	N	3	N	4
861121059	PAIA	B737	CFM56-3	F	N	3	N	3
860808030	DALA	B757	PW2037	F	B	3	C	3
860310016	DALA	B757	PW2037	T	B	6	C	4
860210119	NWAA	B757	PW2037	F	N	3	N	4
860828011	AIRTX	B222	LTS101	T	B	1	C	5