Statistics on Aircraft Gas Turbine Engine Rotor Failures that Occurred in U. S. Commercial Aviation During 1982

R.A. DeLucia
J.T. Salvino

Naval Air Propulsion Center
Trenton, New Jersey

July 1988
Final Report

This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.
NOTICE

This document is disseminated under the sponsorship of the U. S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.
This report presents statistics relating to gas turbine engine rotor failures which occurred during 1982 in U.S. commercial aviation service use. One-hundred and sixty-one rotor failures occurred in 1982. Rotor fragments were generated in 88 of the failures and, of these, 16 were uncontained. The predominant failure involved blade fragments. Seven disk failures occurred and all were uncontained. Seventy percent of the 161 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 support flight safety analysis, proposed regulatory actions, certification standards, and cost benefit analyses.
ACKNOWLEDGEMENTS

We thank the following Federal Aviation Administration personnel and offices for their cooperative effort in the preparation of this report:

- Mr. Bruce Fenton, Project Manager, Engine/Fuel Safety Branch, ACT-320, for his technical assistance.

- New England Region, Burlington, MA, for providing verification of the uncontained engine rotor failure occurrences during calendar year 1982.

- Flight Standards National Field Office, Oklahoma City, OK, for providing the basic data used to prepare this report.
TABLE OF CONTENTS

EXECUTIVE SUMMARY vii
INTRODUCTION 1
RESULTS 1
DISCUSSION AND CONCLUSIONS 3
APPENDICES

A - Data of Engine Rotor Failures in U.S. Commercial Aviation for 1982

B - Distribution List

LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incidence of Engine Rotor Failures in U.S. Commercial Aviation - 1982</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>The Incidence of Engine Rotor Failures in U.S. Commercial Aviation According to Affected Engine Fleet Hours for Each Engine Model - 1982</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Component and Fragment Type Distributions for Contained and Uncontained Rotor Engine Failures (Failures that Produced Fragments) - 1982</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>The Incidence of Engine Rotor Failure in U.S. Commercial Aviation According to Engine Type Affected - 1982</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Gas Turbine Engine Failure Rates According to Engine Model and Type - 1982</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Engine Rotor Failure Cause Categories - 1982</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Flight Condition at Engine Rotor Failure - 1982</td>
<td>11</td>
</tr>
<tr>
<td>8</td>
<td>Uncontained Engine Rotor Failure Distributions According to Cause and Flight Conditions - 1976 through 1982</td>
<td>12</td>
</tr>
</tbody>
</table>
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 1982. One hundred and sixty-one rotor failures occurred in 1982. These failures accounted for approximately 9.3 percent of the 1722 shutdowns experienced by the United States commercial fleet. Rotor fragments were generated in 88 of the failures and, of these, 16 were uncontained. This represents an uncontained failure rate of 2.1 per million gas turbine engine powered aircraft flight hours, or 1.3 per million engine operating hours. Approximately 7.6 and 20.8 million aircraft flight and engine operating hours, respectively, were logged in 1982.

Turbine rotor fragment-producing failures were approximately two times greater than that of the compressor rotor fragment-producing failures (60 and 26 respectively, of the total). Fan rotor failures accounted for two of the fragment-producing failures experienced.

Blade failures were generated in 78 of the rotor failures; 8 of these were uncontained. The remaining 10 fragment-generating failures were produced by disk, rim, and seal.

Of the 102 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—41 (40.2 percent); (2) secondary causes—39 (38.2 percent); (3) design and life prediction problems—21 (20.6 percent); and (4) operational—1 (1.0 percent). One-hundred and twelve (69.6 percent) of the 161 rotor failures occurred during the takeoff and climb stages of flight. Seventy-one (80.7 percent) of the 88 rotor fragment-producing failures and 14 (87.5 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 1981 (88 in 1982 and 84 in 1981). The uncontained engine rotor failures likewise has remained constant (16 in 1982 and 1981). Interestingly, the 8-year (1975 through 1982) average of uncontained engine rotor failures has also remained constant at 16.
INTRODUCTION

This report is sponsored 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.

This report presents data on rotor failure occurrences in United States (U.S.) commercial aviation. Presented in this report are statistics on gas turbine engine failures that have occurred in U.S. commercial aviation during 1982. These statistics are based on data compiled from the Flight Standards Service Difficulty Reports that were published by the FAA. Cross-checks to other accident data sources, such as the FAA New England Region Directorate, were made to substantiate the nature of an engine failure incident (i.e., contained or uncontained). 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) 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 analyses are contained in appendix A; the results of these analyses are shown in figures 1 through 9.

Figure 1 shows that 161 rotor failures occurred in 1982. These rotor failures accounted for approximately 9.3 percent of the 1722 shutdowns experienced by the U.S. commercial gas turbine powered aircraft fleet during 1982. Rotor fragments were generated in 88 of the failures experienced and, of these, 16 (18.2 percent of the fragment-producing failures) were uncontained. This represents an uncontained failure rate of 2.1 per million gas turbine engine powered aircraft flight hours, or 1.3 per million engine operating hours.
Approximately 7.6 million aircraft flight hours and 20.8 million engine operating hours were logged by the U.S. commercial aviation fleet in 1982. 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 types 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 fragment-producing failures was approximately two times greater than that of the compressor rotor fragment-producing failures; these corresponded to 60 (68.2 percent) and 26 (29.5 percent), respectively, of the total number of rotor failures. Fan rotor failures accounted for two (2.3 percent) of the fragment-producing failures experienced.

2. Blade fragments were generated in 78 (88.6 percent) of the rotor failures; eight (10.3 percent) of these were uncontained. The remaining 10 (11.4 percent) rotor fragment failures were produced by disk, rim, and seal. While the disk and seal failures were a relatively small percentage of the total failures, all of the disk and 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 contains a compilation of engine failure rates per million engine flight hours according to engine model, engine type, and containment condition. The engine failure rates per million flight hours by engine type are turbofan--6.9, turboprop--12.1, turboshaft--58.8, and turbojet--none. Uncontained engine failure rates per million flight hours by engine type were turbofan--0.4, turboprop--2.4, and turboshaft--29.4.

Figure 6 shows what caused the rotor failures to occur. Of the 102 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--41 (40.2 percent); (2) secondary causes--39 (38.2 percent); (3) design and life prediction problems--21 (20.6 percent); and operational--1 (1.0 percent).

Figure 7 indicates the flight conditions that existed when the various rotor failures occurred. One-hundred and twelve (69.6 percent) of the 161 rotor failures occurred during the takeoff and climb stages of flight. Seventy-one (80.7 percent) of the rotor fragment-producing failures and 14 (87.5 percent) of the uncontained rotor failures occurred during these same stages of flight. The highest number of uncontained rotor failures, nine (56.3 percent), happened during takeoff.

Figure 8 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 1982. 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 24 and 4). For "design and life prediction problems" the number of "high" power uncontained failures was approximately three times greater than "low" power (namely 20 and 7); and for "foreign object damage," the number of uncontained failures was six times greater at "high" power than "low" power (namely 6 and 1). This tabulation also indicates that of the 111 total uncontained incidences, blade failures accounted for 72.1 percent; disks failures, 15.3 percent; rim failures, 6.3 percent; and seal/spacer failures, 6.3 percent.

Figure 9 shows the annual incidence of uncontained rotor failures in commercial aviation for the years 1962 through 1982. During 1982, the incidence of uncontained rotor failures (16) was identical to those reported the previous year, 1981. Over the past 7 years, 1976 through 1982, an average of 16 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 engine operating hours.

DISCUSSION AND CONCLUSIONS

The incidence of engine rotor fragment-producing failures has remained relatively constant when compared to 1981 (88 in 1982 and 84 in 1981). The uncontained engine rotor failures, likewise, has remained constant (16 in 1982 and 16 in 1981). Interestingly, the 8-year (1975 through 1982) average of uncontained engine rotor failures has also remained constant at 16.

Of the 16 uncontained events that occurred during 1982, 12 (75.0 percent) involved turbine rotors, three (18.7 percent) involved compressor rotors, and one (6.3 percent) involved a fan rotor.

The predominant cause of failure was attributed to foreign object damage (40.2 percent of the known failures) although no uncontained failures occurred in this category. Secondary causes (38.2 percent of known failures) and design and life prediction problems (20.6 percent of the known causes) each had two uncontained failures. The causes of the remaining 12 uncountained failures (75.0 percent) are unknown.

Uncontained failures occurred in three of the 10 flight modes; i.e., nine during takeoff (56.3 percent), five during climb (31.2 percent), and two on approach (12.5 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 prediction and verification is 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 through technology development programs. However, causes due to foreign object damage still appear to be beyond the control or scope of present technology.
86

ROTOR DAMAGED

- TOTAL FUNCTION IMPEDED

52

TURBINE

a

COMPRESSOR

23

FRAGMENTS GENERATED

CONTAINED

FUNCTION IMPEDED

TOTAL FAILURES

FIGURE 1. INCIDENCE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION - 1982
FIGURE 2. THE INCIDENCE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION ACCORDING TO AFFECTED ENGINE FLEET HOURS FOR EACH ENGINE MODEL - 1982
<table>
<thead>
<tr>
<th>ENGINE ROTOR COMPONENT</th>
<th>TYPE OF FRAGMENT GENERATED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DISK</td>
</tr>
<tr>
<td></td>
<td>TF</td>
</tr>
<tr>
<td>FAN</td>
<td>0</td>
</tr>
<tr>
<td>COMPRESSOR</td>
<td>1</td>
</tr>
<tr>
<td>TURBINE</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7</td>
</tr>
</tbody>
</table>

TF - TOTAL FAILURES
UCF - UNCONTAINED FAILURES

*FIGURE 3. COMPONENT AND FRAGMENT TYPE DISTRIBUTIONS FOR CONTAINED AND UNCONTAINED ROTOR ENGINE FAILURES (FAILURES THAT PRODUCED FRAGMENTS) - 1982*
### Figure 4: The Incidence of Engine Rotor Failures in U.S. Commercial Aviation According to Engine Type Affected - 1982

<table>
<thead>
<tr>
<th>Engine Model</th>
<th>Total No. of Engines in Use (NE)</th>
<th>No. of Rotor Failures (NF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&amp;W JT8D</td>
<td>5061</td>
<td>38</td>
</tr>
<tr>
<td>P&amp;W PT6A</td>
<td>823</td>
<td>6</td>
</tr>
<tr>
<td>P&amp;W JT3D</td>
<td>717</td>
<td>7</td>
</tr>
<tr>
<td>P&amp;W JT9D</td>
<td>641</td>
<td>1</td>
</tr>
<tr>
<td>GE CF6</td>
<td>488</td>
<td>7</td>
</tr>
<tr>
<td>ALL 501</td>
<td>429</td>
<td>1</td>
</tr>
<tr>
<td>RR RB211</td>
<td>344</td>
<td>8</td>
</tr>
<tr>
<td>ARCH TPE331</td>
<td>270</td>
<td>10</td>
</tr>
<tr>
<td>RR DART</td>
<td>214</td>
<td>1</td>
</tr>
<tr>
<td>RR SPEY</td>
<td>93</td>
<td>1</td>
</tr>
<tr>
<td>GE CF700</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>GE CJ805</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>ALL 250C</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes:**
1. Failures that produced fragments
2. Yearly avg. of aircraft in use at end of each month
3. Seal/spacer failures included in disk/rim compilation
<table>
<thead>
<tr>
<th>MODEL</th>
<th>AVG NO. IN USE</th>
<th>ENGINE FLIGHT HOURS</th>
<th>NO. OF FAILURES</th>
<th>FAILURE RATES PER 10^6 ENGINE FLIGHT HRS.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>x10^6</td>
<td>C</td>
<td>NC</td>
</tr>
<tr>
<td>TURBOFAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JT8D</td>
<td>5061</td>
<td>11.740</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>JT3D</td>
<td>717</td>
<td>1.256</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>JT9D</td>
<td>641</td>
<td>2.199</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>CF6</td>
<td>488</td>
<td>1.400</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>RB211</td>
<td>344</td>
<td>1.052</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>CF700</td>
<td>48</td>
<td>0.036</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SPEY</td>
<td>93</td>
<td>0.189</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>JT15D</td>
<td>3</td>
<td>0.001</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CFM56</td>
<td>30</td>
<td>0.064</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CJ805</td>
<td>16</td>
<td>0.004</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>7441</td>
<td>17.941</td>
<td>61</td>
<td>8</td>
</tr>
<tr>
<td>TURBOPROP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT6A</td>
<td>823</td>
<td>1.495</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>501</td>
<td>429</td>
<td>0.574</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TPE331</td>
<td>270</td>
<td>0.528</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>DART</td>
<td>214</td>
<td>0.256</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>BASTAN</td>
<td>15</td>
<td>0.018</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>250B</td>
<td>7</td>
<td>0.007</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tynes</td>
<td>15</td>
<td>0.025</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1773</td>
<td>2.903</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>TURBOSHAFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST14</td>
<td>15</td>
<td>0.025</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>250C</td>
<td>3</td>
<td>0.004</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>LTS101</td>
<td>5</td>
<td>0.005</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>23</td>
<td>0.034</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TURBOJET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JT4A</td>
<td>62</td>
<td>0.155</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CJ610</td>
<td>8</td>
<td>0.003</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AVON</td>
<td>5</td>
<td>0.002</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>75</td>
<td>0.160</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

C - CONTAINED  NC - NOT CONTAINED  N - FUNCTION IMPEDED NO FRAGMENTS GENERATED

FIGURE 5. GAS TURBINE ENGINE FAILURE RATES ACCORDING TO ENGINE MODEL AND TYPE - 1982
FOREIGN OBJECT DAMAGE
SECONDARY CAUSES
DESIGN/LIFE PREDICTION
OPERATIONAL
ASSEMBLY/INSPECTION ERR.
QUALITY CONTROL

FIGURE 6. ENGINE ROTOR FAILURE CAUSE CATEGORIES - 1982
FIGURE 7. FLIGHT CONDITION AT ENGINE ROTOR FAILURE - 1982
(1) TAKEOFF AND CLIMB ARE DEFINED AS "HIGH POWER" AND ALL OTHER CONDITIONS ARE DEFINED AS "LOW POWER."

**FIGURE 8. UNCONTAINED ENGINE ROTOR FAILURE DISTRIBUTIONS ACCORDING TO CAUSE AND FLIGHT CONDITIONS - 1976 THROUGH 1982**
APPENDIX A

Data of Engine Rotor Failures in U.S. Commercial Aviation for 1982. 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
<table>
<thead>
<tr>
<th>SDR NO.</th>
<th>SUBMITTER</th>
<th>AIRCRAFT</th>
<th>ENGINE</th>
<th>COMPONENT</th>
<th>TYPE</th>
<th>CAUSE</th>
<th>CONDITION</th>
<th>FLIGHT CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>01252036</td>
<td>AKBA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>3*</td>
</tr>
<tr>
<td>02082039</td>
<td>TWAA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>02102035</td>
<td>AALA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>02162037</td>
<td>SWAA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>03012037</td>
<td>USAA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>03022038</td>
<td>NWAA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>03042035</td>
<td>PAAA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>D</td>
<td>2</td>
<td>NC</td>
<td>3</td>
</tr>
<tr>
<td>04222031</td>
<td>UALA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>05142021</td>
<td>AALA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>05072024</td>
<td>BNFA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>05182015</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>NC</td>
<td>4</td>
</tr>
<tr>
<td>05202021</td>
<td>USAA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>05252027</td>
<td>TXIA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>05262030</td>
<td>HALA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>R</td>
<td>7</td>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>06012030</td>
<td>PAIA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>06022001</td>
<td>MIDA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>06032029</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>06182029</td>
<td>TXIA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>06282026</td>
<td>TWAA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>07012025</td>
<td>WALA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>07262033</td>
<td>AKBA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>07282032</td>
<td>HALA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>07292023</td>
<td>OZAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>08252038</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>09032026</td>
<td>ISAA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td>S</td>
<td>7</td>
<td>NC</td>
<td>3</td>
</tr>
<tr>
<td>09082027</td>
<td>REPA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>09012028</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>09172023</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>10272034</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>10132026</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>NC</td>
<td>3</td>
</tr>
<tr>
<td>11032027</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>NC</td>
<td>3</td>
</tr>
<tr>
<td>12022028</td>
<td>HALA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td>B</td>
<td>3</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>12012085</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>01063002</td>
<td>SWAA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>01043023</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>01043025</td>
<td>UALA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>01063001</td>
<td>EALA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>B</td>
<td>1</td>
<td>NC</td>
<td>3</td>
</tr>
<tr>
<td>09202030</td>
<td>PEXA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>01292038</td>
<td>JAMA</td>
<td>DC9</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>02032034</td>
<td>TAGA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>02162036</td>
<td>TWAA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>03012040</td>
<td>TAGA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>03042034</td>
<td>UALA</td>
<td>B737</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>03122033</td>
<td>TWAA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>04062030</td>
<td>AFIA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>5</td>
</tr>
</tbody>
</table>

* 2 engines affected, same aircraft
<table>
<thead>
<tr>
<th>SDR NO.</th>
<th>SUBMITTER</th>
<th>AIRCRAFT</th>
<th>ENGINE</th>
<th>COMPONENT</th>
<th>TYPE</th>
<th>CAUSE</th>
<th>CONDITION</th>
<th>FLIGHT CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>04092032</td>
<td>UALA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>04212032</td>
<td>BNFA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>04222030</td>
<td>ACA</td>
<td>B737</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>06032030</td>
<td>ACA</td>
<td>B737</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>06282027</td>
<td>PSAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>1</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>08062036</td>
<td>SWAA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>07302035</td>
<td>PAIA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>7</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>08232028</td>
<td>OZAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>08312028</td>
<td>PAIA</td>
<td>B737</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>11022024</td>
<td>WALA</td>
<td>B737</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>11122025</td>
<td>JAMA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>11302020</td>
<td>SWAA</td>
<td>B737</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>12142029</td>
<td>REPA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>12142030</td>
<td>REPA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>01043024</td>
<td>OZAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>02033020</td>
<td>AAIA</td>
<td>B727</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>03032036</td>
<td>EALA</td>
<td>DC9</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>3</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>08062036</td>
<td>SWAA</td>
<td>B737</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>11102014</td>
<td>USAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>02232024</td>
<td>OZAA</td>
<td>DC9</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>07272030</td>
<td>PAAA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>10152024</td>
<td>PAIA</td>
<td>B727</td>
<td>JT8D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>09202032</td>
<td>JAMA</td>
<td>DC9</td>
<td>JT8D</td>
<td>C</td>
<td></td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>02033023</td>
<td>AAIA</td>
<td>B727</td>
<td>JT8D</td>
<td>T</td>
<td></td>
<td>7</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>07192036</td>
<td>TWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>C</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>08262037</td>
<td>NWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>C</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>08272030</td>
<td>NWAU</td>
<td>DC10</td>
<td>JT9D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>09022025</td>
<td>NWAU</td>
<td>DC10</td>
<td>JT9D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>10182020</td>
<td>FTTLA</td>
<td>B747</td>
<td>JT9D</td>
<td>T</td>
<td>B</td>
<td>2</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>10272033</td>
<td>NWAU</td>
<td>DC10</td>
<td>JT9D</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>02112036</td>
<td>PAAA</td>
<td>B747</td>
<td>JT9D</td>
<td>C</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>5</td>
</tr>
<tr>
<td>02262035</td>
<td>NWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>C</td>
<td></td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>05252028</td>
<td>TWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>F</td>
<td></td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>08242029</td>
<td>FTTLA</td>
<td>B747</td>
<td>JT9D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>09142024</td>
<td>NWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>12022027</td>
<td>NWAU</td>
<td>B747</td>
<td>JT9D</td>
<td>T</td>
<td></td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>11152024</td>
<td>UACA</td>
<td>DC8</td>
<td>JT3D</td>
<td>C</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>09242009</td>
<td>TWAU</td>
<td>B707</td>
<td>JT3D</td>
<td>C</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>09162029</td>
<td>DALA</td>
<td>DC8</td>
<td>JT3D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>03082031</td>
<td>TWAU</td>
<td>B707</td>
<td>JT3D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>01053012</td>
<td>TWAU</td>
<td>B707</td>
<td>JT3D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>10</td>
</tr>
<tr>
<td>06282025</td>
<td>TWAU</td>
<td>B707</td>
<td>JT3C</td>
<td>T</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>4</td>
</tr>
<tr>
<td>08122027</td>
<td>UALA</td>
<td>DC8</td>
<td>JT3D</td>
<td>F</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>08122030</td>
<td>CAPA</td>
<td>DC8</td>
<td>JT3D</td>
<td>C</td>
<td></td>
<td>7</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>09292019</td>
<td>UACA</td>
<td>DC8</td>
<td>JT3D</td>
<td>T</td>
<td></td>
<td>7</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>01053012</td>
<td>TWAU</td>
<td>B707</td>
<td>JT3D</td>
<td>T</td>
<td></td>
<td>7</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>09282019</td>
<td>UACA</td>
<td>DC8</td>
<td>JT3D</td>
<td>T</td>
<td></td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>10082011</td>
<td>DALA</td>
<td>DC8</td>
<td>JT3D</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>5</td>
</tr>
</tbody>
</table>
## CHARACTERISTICS OF ROTOR FAILURES - 1982

<table>
<thead>
<tr>
<th>SDR NO.</th>
<th>SUBMITTER</th>
<th>AIRCRAFT</th>
<th>ENGINE</th>
<th>COMPONENT</th>
<th>TYPE</th>
<th>CAUSE</th>
<th>CONDITION</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>04142034</td>
<td>DHC6 PT6A</td>
<td>T B 7</td>
<td>C</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09142037</td>
<td>DHC6 PT6A</td>
<td>C B 7</td>
<td>C</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09142038</td>
<td>DHC6 PT6A</td>
<td>C B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01193072</td>
<td>N262 PT6A</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10222040</td>
<td>DHC6 PT6A</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06282035</td>
<td>PT6A</td>
<td>T B 7</td>
<td>C</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03042050</td>
<td>PT6A</td>
<td>T - 7</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08052048</td>
<td>DHC7102 PT6A</td>
<td>T - 2</td>
<td>-</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10292031</td>
<td>DHC6 PT6A</td>
<td>T - 2</td>
<td>-</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03102039</td>
<td>N262 PT6A</td>
<td>T - 2</td>
<td>-</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03112032</td>
<td>N262 PT6A</td>
<td>T - 3</td>
<td>-</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03302033</td>
<td>SD3-30 PT6A</td>
<td>T - 2</td>
<td>-</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08272029</td>
<td>SD3-30 PT6A</td>
<td>T - 3</td>
<td>-</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10132013</td>
<td>DC7 PT6A</td>
<td>C - 2</td>
<td>-</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11222021</td>
<td>DC7 PT6A</td>
<td>C - 3</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03042033</td>
<td>DC10 CF6</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07292022</td>
<td>DC10 CF6</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08272026</td>
<td>DC10 CF6</td>
<td>T R 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08272031</td>
<td>DC10 CF6</td>
<td>T B 5</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12212026</td>
<td>DC10 CF6</td>
<td>C B 2</td>
<td>NC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02023018</td>
<td>DC10 CF6</td>
<td>T B 7</td>
<td>C</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04282023</td>
<td>DC10 CF6</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06222014</td>
<td>DC10 CF6</td>
<td>T - 1</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09082026</td>
<td>DC10 CF6</td>
<td>C - 2</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09282008</td>
<td>DC10 CF6</td>
<td>F - 3</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10192025</td>
<td>DC10 CF6</td>
<td>C - 1</td>
<td>-</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12212024</td>
<td>DC10 CF6</td>
<td>F - 3</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12062025</td>
<td>DC10 CF6</td>
<td>C - 7</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10012026</td>
<td>MD20 CF700</td>
<td>C - 3</td>
<td>-</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01142036</td>
<td>SA226 TPE331</td>
<td>T B 7</td>
<td>NC</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04012046</td>
<td>SA226 TPE331</td>
<td>T B 1</td>
<td>NC</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04142036</td>
<td>SA226 TPE331</td>
<td>T D 7</td>
<td>NC</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11262029</td>
<td>SA226 TPE331</td>
<td>T B 7</td>
<td>C</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06032066</td>
<td>SA226 TPE331</td>
<td>T D 7</td>
<td>NC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10132091</td>
<td>SA226 TPE331</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11262029</td>
<td>SA226 TPE331</td>
<td>T D 7</td>
<td>NC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03082036</td>
<td>SA226 TPE331</td>
<td>T B 1</td>
<td>C</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07092061</td>
<td>SA226 TPE331</td>
<td>T D 7</td>
<td>NC</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01192041</td>
<td>SA226 TPE331</td>
<td>T D 7</td>
<td>NC</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01272035</td>
<td>SA226 TPE331</td>
<td>T B 7</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02102038</td>
<td>L1011 RB211</td>
<td>C B 1</td>
<td>C</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02222040</td>
<td>L1011 RB211</td>
<td>T B 1</td>
<td>C</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03152033</td>
<td>L1011 RB211</td>
<td>C B 1</td>
<td>C</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06012034</td>
<td>L1011 RB211</td>
<td>T B 1</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06212030</td>
<td>L1011 RB211</td>
<td>T B 2</td>
<td>C</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07082024</td>
<td>L1011 RB211</td>
<td>C B 2</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08102029</td>
<td>L1011 RB211</td>
<td>C B 2</td>
<td>C</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09072031</td>
<td>L1011 RB211</td>
<td>C B 2</td>
<td>C</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Characteristics of Rotor Failures - 1982

<table>
<thead>
<tr>
<th>SDR No.</th>
<th>Submitter</th>
<th>Aircraft</th>
<th>Engine</th>
<th>Component</th>
<th>Type</th>
<th>Cause</th>
<th>Condition</th>
<th>Containment</th>
<th>Flight Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>02102037</td>
<td>EALA</td>
<td>L1011</td>
<td>RB211</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>02112038</td>
<td>TWAA</td>
<td>L1011</td>
<td>RB211</td>
<td>C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>04232022</td>
<td>TWAA</td>
<td>L1011</td>
<td>RB211</td>
<td>F</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>07302037</td>
<td>TWAA</td>
<td>L1011</td>
<td>RB211</td>
<td>C</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>02122038</td>
<td>USAA</td>
<td>BAC1-11</td>
<td>506</td>
<td>C</td>
<td>B</td>
<td>1</td>
<td>C</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>04192031</td>
<td>PEAA</td>
<td>BAC1-11</td>
<td>506</td>
<td>C</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>08052035</td>
<td>PEAA</td>
<td>BAC1-11</td>
<td>506</td>
<td>C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>04282025</td>
<td>RAAA</td>
<td>YS-11A</td>
<td>542</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>NC</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>07092007</td>
<td>ABX A</td>
<td>YS-11A</td>
<td>542</td>
<td>C</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>07282031</td>
<td>MPCA</td>
<td>YS-11A</td>
<td>542</td>
<td>T</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>02023015</td>
<td>ACZA</td>
<td>F27</td>
<td>532</td>
<td>T</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>01073023</td>
<td>REPA</td>
<td>CV580</td>
<td>501</td>
<td>T</td>
<td>B</td>
<td>7</td>
<td>C</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>01253032</td>
<td>ASPA</td>
<td>STC-25</td>
<td>501</td>
<td>C</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>07062031</td>
<td>ZIAA</td>
<td>188C</td>
<td>501</td>
<td>T</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>10262025</td>
<td>TIAA</td>
<td>382</td>
<td>501</td>
<td>C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>10212020</td>
<td>TIAA</td>
<td>382</td>
<td>501</td>
<td>C</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>01063003</td>
<td>SRAA</td>
<td>382</td>
<td>501</td>
<td>T</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>05212025</td>
<td>SFIA</td>
<td>206L1</td>
<td>250C28</td>
<td>T</td>
<td>D</td>
<td>7</td>
<td>NC</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>07142125</td>
<td>ALGA</td>
<td>206L1</td>
<td>250C28</td>
<td>T</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Civil Aviation Authority (5)
Aviation House
129 Kingsway
London WC2B 6NN
ENGLAND

Embassy of Australia
Civil Air Attache
1601 Massachusetts Avenue, NW.
Washington, DC 20036

Scientific and Technical Information FAC
ATTN: NASA Representative
P.O. Box 8757 BWI Airport
Baltimore, MD 21240

Northwestern University
Trisnet Repository
Transportation Center Library
Evanston, IL 60201

DOT/Federal Aviation Administration (5)
AEU-500
American Embassy
APO New York, NY 09667

University of California
Service Department Institute of
Transportation Standard Lab
412 McLaughlin Hall
Berkeley, CA 94720

British Embassy
Civil Air Attache ATS
3100 Massachusetts Avenue, NW.
Washington, DC 20008

DOT/Federal Aviation Administration (5)
ASO-52C4
P.O. Box 20636
Atlanta, GA 30320

DOT/Federal Aviation Administration (5)
APS-13, Nigro
800 Independence Avenue, SW.
Washington, DC 20591

DOT/Federal Aviation Administration (5)
AEU-500
American Embassy
APO New York, NY 09667

Northwestern University
Trisnet Repository
Transportation Center Library
Evanston, IL 60201

Scientific and Technical Information FAC
ATTN: NASA Representative
P.O. Box 8757 BWI Airport
Baltimore, MD 21240

British Embassy
Civil Air Attache ATS
3100 Massachusetts Avenue, NW.
Washington, DC 20008

DOT/Federal Aviation Administration (5)
ASO-52C4
P.O. Box 20636
Atlanta, GA 30320

DOT/Federal Aviation Administration (5)
APS-13, Nigro
800 Independence Avenue, SW.
Washington, DC 20591

Department of Transportation (5)
Office of the Secretary
M-493.2, Building 10A
400 7th Street, SW.
Washington, DC 20590

DOT/Federal Aviation Administration (5)
AEU-500
American Embassy
APO New York, NY 09667

Northwestern University
Trisnet Repository
Transportation Center Library
Evanston, IL 60201

Scientific and Technical Information FAC
ATTN: NASA Representative
P.O. Box 8757 BWI Airport
Baltimore, MD 21240

British Embassy
Civil Air Attache ATS
3100 Massachusetts Avenue, NW.
Washington, DC 20008

DOT/Federal Aviation Administration (5)
ASO-52C4
P.O. Box 20636
Atlanta, GA 30320

DOT/Federal Aviation Administration (5)
APS-13, Nigro
800 Independence Avenue, SW.
Washington, DC 20591
DOT/FAA National Headquarters
AWS-120
800 Independence Avenue, SW.
Washington, DC 20591

DOT/FAA National Headquarters
APO-1
800 Independence Avenue, SW.
Washington, DC 20591

DOT/FAA Great Lakes Region
Mr. R. Prather, ACE-140C
O'Hare Office Center
2300 East Devon Avenue
Des Plaines, IL 60018

DOT/FAA Great Lakes Region
ACE-140
O'Hare Office Center
2300 East Devon Avenue
Des Plaines, IL 60018

DOT/FAA Great Lakes Region
AGL-200
O'Hare Office Center
2300 East Devon Avenue
Des Plaines, IL 60018

DOT/FAA Central Region
ACE-100
601 East 12th Street
Federal Building
Kansas City, MO 64106

DOT/FAA Central Region
Mr. Oscar Ball, ACE-100
601 East 12th Street
Federal Building
Kansas City, MO 64106

DOT/FAA Central Region
ACE-200
601 East 12th Street
Federal Building
Kansas City, MO 64106

DOT/FAA Eastern Region
AEA-200
JFK International Airport
Fitzgerald Federal Building
Jamaica, NY 11430

DOT/FAA New England Region
ANE-100
12 New England Executive Park
Burlington, MA 01803

DOT/FAA New England Region
ANE-110
12 New England Executive Park
Burlington, MA 01803

DOT/FAA New England Region
ANE-140
12 New England Executive Park
Burlington, MA 01803

DOT/FAA New England Region
ANE-141
12 New England Executive Park
Burlington, MA 01803

DOT/FAA New England Region
ANE-142
12 New England Executive Park
Burlington, MA 01803

DOT/FAA Northwest Mountain Region
ANM-100
17900 Pacific Highway South
C-68966
Seattle, WA 98168

DOT/FAA Northwest Mountain Region
ANM-110
17900 Pacific Highway South
C-68966
Seattle, WA 98168

DOT/FAA Northwest Mountain Region
ANM-200
17900 Pacific Highway South
C-68966
Seattle, WA 98168
Federal Aviation Administration
Los Angeles ACO
P.O. Box 92007
Worldway Postal Center
Hawthorne, CA 90009

Federal Aviation Administration
New York ACO
Room 202
181 South Franklin Avenue
Valley Stream, NY 11581

Federal Aviation Administration
Seattle ACO
17900 Pacific Highway South
C-68966
Seattle, WA 98168

Federal Aviation Administration
Wichita ACO, Mid Continent Airport
FAA Building, Room 100
1891 Airport Road
Wichita, KS 67209

Mr. A. Allcock
Department of Industry
Abell House, Room 643
John Islip Street, London, SW14 LN
ENGLAND

Dr. S. J. Armour
Defense Research Establishment
Suffield
Ralston, Alberta
CANADA, TOJ 2NO

Captain Ralph Cantrell
University of Bridgeport
U.S. Army ROTC Department
Bridgeport, CT 06601

Mr. George A. Coffinberry
General Electric Company
1 Neumann Way
Mail Drop E-186
Cincinnati, OH 45215

Mr. J. Donald Collier
Air Transport Association
of America
1709 New York Avenue, NW.
Washington, DC 20006

Captain Ralph Combariati
Port Authority of NY and NJ
JFK International Airport
Jamaica, NY 11430

Mr. Edward Conklin
Sikorsky Aircraft
North Main Street
Stratford, CT 06602

Mr. Dick Coykendall
United Airlines
San Francisco International Airport
San Francisco, CA 94128

Mr. David M. Blake
General Electric Company
Aircraft Engine Field Operations
1515 Market Street
Philadelphia, PA 19102

Mr. Terence Dixon
Boeing Aerospace Corporation
P.O. Box 3999
M/S 87-93
Seattle, WA 98124

Mr. Thomas F. Donohue
General Electric Company
1 Neumann Way, Mail Drop H-44
P.O. Box 156301
Cincinnati, OH 45215-6301

Mr. John H. Enders
Flight Safety Foundation
5510 Columbia Pike
Arlington, VA 22204

Dr. Allen E. Fuhs
Department of Aeronautics
Naval Post Graduate School
Monterey, CA 93940

Y. Funatsu
All Nippon Airways
1-6-6, Tokyo International Airport
Ohta-KU, Tokyo 144
JAPAN
Henry A. Gill  
Lockheed California Company  
Building 88, B-6  
P.O. Box 551  
Burbank, CA 91520

Mr. David J. Goldsmith  
Eastern Airlines  
Miami International Airport  
Miami, FL 33148

Mr. Stanley Gray  
Mechanical Technology Inc.  
968 Albany Shaker Road  
Latham, NY 12110

G. Haigh  
Air Canada  
Air Canada Base, Montreal  
International Airport  
Quebec, CANADA H4Y 1 C2

M. Hardy  
United Airlines  
SFOEG, MOC  
San Francisco International Airport  
California 94128

W. Hock  
Grumman Aerospace Corporation  
B 14 035  
111 Stewart Avenue  
Bethpage, NY 11714

LCDR William Holland  
Department of the Navy  
NAVAIR 518  
Naval Air Systems Command  
Washington, DC 20361

Major Hudson  
Air Force Inspection and Safety  
SEDM  
Norton Air Force Base, CA 92499

Mr. J. P. Jamieson  
National Gas Turbine Establishment  
Pyestock, Farnborough  
Hants GU14 OLS  
ENGLAND

Dr. C. W. Kauffmann  
The University of Michigan  
Gas Dynamics Laboratories  
Aerospace Engineering Building  
Ann Arbor, MI 48109

FAA National Headquarters  
Mr. H. Branting, AWS-120  
800 Independence Avenue, SW.  
Washington, DC 20591

Mr. Richard J. Linn  
American Airlines  
MD 4H14  
P.O. Box 61616  
Dallas/Fort Worth Airport, TX 75261

Captain A. S. Mattox, Jr.  
Allied Pilots Association  
12723 Brewster Circle  
Woodbridge, VA 22191

Mr. Charles McGuire  
Department of Transportation  
400 7th Street, SW. (P-5)  
Washington, DC 20590

Harold Marthinsen  
Airline Pilots Association  
Accident Investigation Department  
P.O. Box 1169  
Herndon, VA 22070

Dean Oliva  
Lockheed  
Department 7475/Building 229A  
P.O. Box 551, Plant 2  
Burbank, CA 91520

Dr. Robert C. Oliver  
Institute for Defense Analyses  
1801 North Bauregard Street  
Alexandria, VA 22311

Mr. George Opdyke  
AVCO Lycoming Division  
550 South Main Street  
Stratford, CT 06497
Mr. Ronald G. Jackson
Product Support
Rolls-Royce, Inc.
1895 Phoenix Boulevard
Atlanta, GA 30349

Mr. Kenneth M. Johnson, Jr.
Williamsport Division
Avco Lycoming
652 Oliver Street
Williamsport, PA 17701

Mr. Alan J. Lea, 01MD4
Pratt and Whitney Canada, Inc.
P.O. Box 10
Longueuil, Quebec J4K4X9
CANADA

Mr. Martyn Hexter
Pratt and Whitney Canada, Inc.
90 Dundas Street West
Mississauga, Ontario L5A 3Q4
CANADA

Mr. Richard Ainsworth
Stratford Division
Avco Lycoming
550 South Main Street
Stratford, CT 06497

Mr. John T. Moehring
General Electric Company
Flight Safety Section, Mail Drop J60
One Neuman Way
Cincinnati, OH 45215

Mr. Glenn Pittard
Garrett Turbine Engine Company
111 South 34th Street
P.O. Box 5217
Phoenix, AZ 85010

Mr. A. B. Wassell
Rolls-Royce Ltd.
P.O. Box 31
Derby DE2 8BJ
ENGLAND

Mr. T. Dickey
Stratford Division
Avco Lycoming
550 South Main Street
Stratford, CT 06497

Dr. John R. Fagan, M.S. T15
Allison Gas Turbine Division
General Motors Corporation
P.O. Box 420
Indianapolis, IN 46210-0420

Mr. Brad Stumpke
Mail Drop 34511
General Electric Company
1000 Western Avenue
Lynn, MA 01910

Mr. Richard Barnard
Sikorsky Aircraft Division
United Technologies Corporation
North Main Street
Stratford, CT 06602

Mr. Chet Lewis
Boeing Commerical Airplane Company
Mail Stop 9W-61
P.O. Box 3707
Seattle, WA 98124

Mr. Frank M. Shallene
Bell Helicopter Textron
P.O. Box 482
Fort Worth, TX 76101

Mr. Peter Dahn
Helicopter and Transport Division
Messerschmitt-Bolkon-Blohm GmbH
P.O. Box 801140 DX2, 8000 Munich 80
FEDERAL REPUBLIC OF GERMANY

Mr. James B. Harbison
Boeing Vertol Company
MS 32-17
P.O. Box 16858
Philadelphia, PA 19142

Mr. Richard H. Johnson
Department E80, MC 36-41
Douglas Aircraft
3855 Lakewood Boulevard
Long Beach, CA 90846

Mr. John M. Kowalonek
Sikorsky Aircraft Division
United Technologies Corporation
North Main Street
Stratford, CT 06602
Dr. Kenneth M. Rosen  
Sikorsky Aircraft Division  
United Technologies Corporation  
North Main Street  
Stratford, CT 06601

Mr. Emmett A. Witmer  
Massachusetts Institute  
of Technology  
Cambridge, MA 02139

Mr. P. B. Gardner  
Industrial Ceramics Division  
Norton Company  
One New Bond Street  
Worcester, MA 01606

Mr. Jack A. Mitteer  
Product Support  
McDonnell Douglas Helicopter Company  
5000 East McDowell Road  
Mesa, AZ 85205

Captain Edwin R. Arbon  
Flight Operations Safety  
Flight Safety Foundation, Inc.  
5510 Columbia Pike  
Arlington, VA 22204-3194

Mr. Donald F. Thielke  
Vice President, Safety Engineering  
Flight Engineers' International Assoc.  
905 16th Street, NW.  
Washington, DC 20006

Mr. Barry Scott  
P.O. Box 25  
Moffett Field, CA 94035

Mr. A. T. Weaver, M.S. 165-30  
Pratt and Whitney Aircraft  
Airworthiness Engineering Division  
400 Main Street  
East Hartford, CT 06108

Mr. Steve Clark  
Rolls-Royce Inc.  
1895 Phoenix Boulevard  
Atlanta, GA 30349

Mr. William Burcham  
Propulsion Branch, Code OFV  
NASA Ames – Dryden  
P.O. Box 273  
Edwards, CA 93523

Mr. Ralph E. Kesler  
Delta Air Lines, Inc.  
Hartsfield Atlanta International  
Airport  
Atlanta, GA 30320

Commander  
Naval Air Systems Command  
AIR-330  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-330A  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-5017A  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-536  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-5360  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-5361  
Department of the Navy  
Washington, DC 20361

Commander  
Naval Air Systems Command  
AIR-5362  
Department of the Navy  
Washington, DC 20361
Rolls-Royce Limited
ATTN: S. Cox, Bristol Engine Division
P.O. Box 3 Filton House
Bristol BS12 7QE
ENGLAND

Northrop Corporation
Aircraft Division
3901 West Broadway
Hawthorne, CA 90250

Pan American World Airways
Pan American Building
ATTN: Mr. John G. Borger
Chief Engineer
New York, NY 10017

North American Rockwell Corporation
Aerospace and Systems Group
ATTN: Technical Library
6633 Canoga Avenue
Canoga Park, CA 91304

British Aircraft Corporation, Ltd.
GPO Box 77, Filton House
ATTN: J. Wallin, Chief Prop. Engineer
Bristol BS99 7AR
ENGLAND

DOT/Federal Aviation Administration
Mike Monroney Aeronautical Center
AFS-581
P.O. Box 25082
Oklahoma City, OK 73125

National Transportation Safety Board
Bureau of Aviation Safety
Engineering Division
ATTN: Mr. Martyn V. Clarke, Asst Chief
Washington, DC 20591

British Aerospace PLC
ATTN: M. A. Laceby, Civil Aircraft Div
GPO Box 77, Filton House
Bristol BS99 7AR
ENGLAND

Civil Aviation Authority
ATTN: L. R. Wilson
Brabazon House
Redhill, Surrey
ENGLAND

Hawker Siddley Aircraft
ATTN: Technical Library
Hawsidair, Hatfield
ENGLAND

Ministry of Defense
W. J. Moschini, Engines T1, Room 151
St. Giles Court 1-13
St. Giles High St., London WC2H 8LD
ENGLAND

Bristol Siddeley Engines, Ltd.
Aero Division
ATTN: Mr. Geoffrey Morris
Filton Bristol
ENGLAND

Director
Naval Research Laboratory
ATTN: Library, Code 2029 (ONRL)
Washington, DC 20390

Office of Naval Research
ATTN: N. Basdekas
Washington, DC 20360

Commander
Naval Air Systems Command
AIR-954
Department of the Navy
Washington, DC 20361

NASA Langley Research Center
ATTN: Library
Langley Station
Hampton, VA 23365

The Boeing Company
Commercial Airplane Group
ATTN: Technical Library
Seattle, WA 98124
Avco Corporation
Lycoming Division
ATTN: Technical Library
550 Main Street
Stratford, CT 06497

GM Corporation
Allison Division
ATTN: Technical Library
340 White Rover Parkway
Indianapolis, IN 46296

GM Corporation
Manufacturing Division
Materials and Structures Laboratory
ATTN: Technical Library
Warren, MI 48090

Goodyear Aerospace Corporation
Aero-Structures Marketing
ATTN: Technical Library
Akron, OH 44305

Goodyear Aerospace Corporation
Arizona Division
ATTN: Technical Library
Litchfield Park, AZ 85340

Lockheed California Company
Division of Lockheed Aircraft Corporation
ATTN: Technical Library
Burbank, CA 91503

Massachusetts Institute of Technology
ATTN: Aero Library
Aeroelastic and Structures Research Lab
Cambridge, MA 02139

University of Notre Dame
ATTN: L. H. N. Lee
Department of Aeromechanical Engineering
Notre Dame, IN 46556

The Pennsylvania State University
ATTN: B. W. McCormick
Department of Aerospace Engineering
233 Hammond
University Park, PA 16802

Battelle Memorial Institute
Columbus Laboratory
ATTN: Technical Library
505 King Avenue
Columbus, OH 43201

Beech Aircraft Corporation
ATTN: Technical Library
9709 East Central
Wichita, KS 67201

Aeronautical Research Association of Princeton
ATTN: Technical Library
50 Washington Road
Princeton, NJ 08540

Garrett Turbine Engine Company
ATTN: Technical Library
402 South 36th Street
Phoenix, AZ 85034

University of West Virginia
ATTN: Technical Library
College of Engineering
Morgantown, WV 26505

Garrett Turbine Engine Company
ATTN: K. K. Sorenson
Starters and Air Turbine Motors
402 South 36th Street
Phoenix, AZ 85034

Garrett Turbine Engine Company
ATTN: D. G. Furst
Auxiliary Power Units
402 South 36th Street
Phoenix, AZ 85034

Garrett Turbine Engine Company
ATTN: Mr. Alvin R. Finklestein
402 South 36th Street
Phoenix, AZ 85034

Marquardt Corporation
ATTN: Technical Library
16555 Saticoy Street
Van Nuys, CA 91405