NASA Contract Report 181898

Boeing / NASA Composite Components Flight Service Evaluation

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Langley Research Center
Hampton, Virginia 23665-5225

FOREWORD

This is the tenth, and final, progress report on the service evaluation of graphite-epoxy spoilers for 737 aircraft. This effort has been conducted as a portion of NASA contract NAS1-11668, "A Study of the Effects of Long-Term Ground and Flight Exposure on the Behavior of Graphite-Epoxy Spoilers." The program is structured to gather and evaluate actual commercial service experience on a large number of graphite-epoxy spoilers and test specimens in a wide range of operating environments. This is the final report which summarizes the completion of 15 years of flight service.

This report also summarizes the flight service history of composite components developed under NASA contracts NAS1-14952, "Boeing/NASA 727 Graphite Composite Elevator," and NAS1-15025, "Boeing/NASA 737 Graphite Composite Stabilizer."

The program was administered by Langley Research Center, National Aeronautics and Space Administration. H. Benson Dexter, Materials Division, was the technical monitor and was responsible for test and evaluation of ground-based environmental exposure specimens for the program.

The program was conducted at Boeing Commercial Airplanes, New Airplane Development Structures Group, under the direction of program technical leader; Randy L. Coggeshall.

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PROGRAM SUMMARY AND STATUS

The tenth flight service report is submitted in accordance with the requirements of Contract NAS1-11668 and covers service evaluation from January 1, 1987 through June 30, 1989. Segments of data contained herein have appeared in previous documentation (refs. 1 through 11). This report also includes the service summary for the B727 composite elevators, NAS1-14952, and the B737 composite horizontal stabilizers, NAS1-15025.

The primary objective of Contract NAS1-11668 was to produce 114 graphite-epoxy B737 flight-worthy spoilers for service evaluation and testing. Four spoilers were initally installed on each of 27 airplanes representing five major airlines operating in different environmental circumstances. These spoilers (units) were monitored for 15 years. Selected units were removed periodically to evaluate their performance as a function of service time. Six environmental exposure racks were fabricated and positioned at major airport terminals of the participating airlines and at NASA-Langley Research Center to gather ground-based environmental data to support the flight data gathered from the spoilers. Material coupons were tested after 1, 3, 5, 7, and 10 years of outdoor ground-based exposure.

As of June 30, 1989, 2,593,741 spoiler flight-hours and 3,499,941 spoiler landings have been accumulated by the fleet. The high time spoiler had accumulated 42,007 flight-hours on Frontier (Continental) Airlines 737 N7386F. Seventy-four spoilers have accumulated more than 16,000 flight-hours since the beginning of the flight service program, and 19 spoilers have had uninterrupted service since their original installation.

Laboratory testing of spoilers, returned during 15 years of flight service, demonstrated adequate strength and stiffness. Several units were tested with service-induced damages. Even with damage, the units had residual strengths above design limit load.

Damage and related repair activities continued at a modest rate during this reporting period, with fifteen unscheduled spoiler removals.

The objective of the composite B727 elevator program was to produce ten graphite-epoxy elevators for service evaluation. These elevators were installed on five airplanes of one airline. The elevators have been in commercial service for nine years. As of June 30, 1989 284,402 elevator flight-hours and 137,122 elevator landings have been accumulated by the fleet. The high time elevator had accumulated 34,396 flight-hours.

During this period there have been several service-induced damage incidents. Four occurrences of lightning strike damage have been reported. In each case the units were repaired on the airplane. Two incidents of ground handling damage have been reported. In both cases the damage was significant enough to warrant removal of the elevator for repair. In both of these cases, although repaired, the units have not yet been placed back into service by the airline.

PROGRAM SCOPE

The service evaluation programs were established to place the graphite-epoxy components into a commercial service environment containing as many flight profile and climatic variables as possible. The seven actively participating airlines have 23 aircraft currently committed to the programs.

The currently participating airlines are:

B737 spoilers:		
- Air New Zealand, Limited	- Christchurch, NZ	- Four airplanes
- Deutsche Lufthansa Airlines	- Frankfurt, F.R.G.	- One airplane
- Piedmont Airlines	- Winston-Salem, NC U.S.A.	- Eight airplanes
- VASP	- Sao Paulo, Brazil	- One airplane
B727 elevators:		
- United Airlines	- San Francisco, CA, U.S.A.	- Four airplanes
B737 stabilizers:		
- Delta Airlines	- Atlanta, GA, U.S.A.	- Two airplanes
- Mark Air	- Anchorage, AK, U.S.A.	- Three airplanes

The geographic scope of the service evaluation program continues as shown in Figure 1.

Figure 1. Geographic Deployment of Participating Airlines

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The objective of the composite B737 stabilizer program was to produce and certify composite primary structure for commercial service. Ten graphite-epoxy stabilizers were installed on five airplanes of two airlines. The stabilizers have been in commercial service for five years. As of June 30, 1989 139,970 stabilizer flight-hours and 146,750 stabilizer landings have been accumulated by the fleet. The high time stabilizer had accumulated 14,541 flight-hours.

During this period there have been three service-induced damage incidents. In all of these cases the units were repaired, on the airplane, and returned to service.

The contract between Boeing and NASA for monitoring of the spoilers will expire during the fourth quarter of 1989. The remaining spoilers will be left in service and monitored by Boeing, although no further reporting, or residual testing, will be conducted. The elevator and stabilizer contracts have expired, but Boeing continues to monitor flight experience and provide sustaining engineering support.

FLIGHT EXPERIENCE

The spoiler program, in operation since July 18, 1973, has generated over 2 million flight-hours of service and over 3 million landings in over fifteen years of operation and is adding flight experience at the rate of over 17,400 hours per month.

The graphite-epoxy B727 elevator flight service evaluation program has been in operation since March 19, 1980. Nearly 300,000 flight-hours of service and over 137,000 landings have been accumulated in over nine years of operation and flight experience is being added at the rate of over 8,800 hours per month.

The graphite-epoxy B737 stabilizer flight service evaluation proram has been in operation since March 13, 1984. The program has generated over 139,000 flight-hours of service and over 146,000 landings in over five years of operation and is adding flight experience at the rate of over 2,275 hours per month.

Total flight experience through June 30, 1989 is summarized in Figure 2 by type of graphite-epoxy material. Figure 3 summarizes the same data by airline. VASP and Frontier data include only flight service experience since acquisition of their respective airplanes from PSA. A total of 74 spoilers have accumulated over 16,000 flight-hours each. Their distribution, by airline and by skin material system, is shown in Figure 4. A histogram of flight-hours and landings, for the spoilers, elevators, and stabilizers are shown in figures 5, 6, and 7 respectively. The fleet hours and landings are shown in descending order for each unit.

A computer based program was established to periodically update the service history of the component fleets. The program provides a compilation of unit service and status. The data for the components as of June 30, 1989 are shown in Appendices A, B, and C.

Spoiler material type	Net Hours	Net Landings	High Hours	High Landings
Union Carbide T300/2544	832,732	1,111,895	39,024	50,892
Narmco T300/5209	898,523	1,178,301	42,007	52,990
Hercules AS/3501	862,486	1,209,745	41,426	60,102
Total	2,593,741	3,499,941		

Elevator material type	Net Hours	Net Landings	High Hours	High Landings
Narmco T300/5208	284,402	137,122	34,396	16,550
Total	284,402	137,122		

Stabilizer material type	Net Hours	Net Landings	High Hours	High Landings
Narmco T300/5208	139,970	146,750	14,541	16,490
Total	139,970	146,750		

Figure 2. Flight Service Experience by Type of Material (as of 06-30-89)

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Airline	Number of aircraft in evaluation	Number of components in evaluation	Total component hours since installation	Total component landings since installation
PSA	0	0	29,747	51,521
Aloha	0	0	174,791	444,994
Air New Zealand	4	12	431,159	563,384
Lufthansa	1	1	524,161	638,863
Piedmont	8	20	990,585	1,323,488
VASP	1	1	342,808	372,187
Frontier/Continental	0	0	100,490	105,504
United	4	8	284,402	137,122
Mark Air	3	6	82,624	89,502
Delta	2	4	57,346	57,248
Total	23	52	3,018,113	3,783,813

Figure 3. Component Service Experience by Airline (as of 06-30-89)

U90220-3

Airline	Part Number/Material			Total
	-1 (T300/2544)	-2 (T300/5209)	-3 (AS/3501)	
PSA	0	0	0	0
Aloha	0	0	0	0
Air New Zealand	2	9	5	16
Lufthansa	4	6	8	18
Piedmont	12	6	9	27
VASP	5	3	3	11
Frontier/Continental	0	2	0	2

Figure 4. Distribution of Spoilers With 16,000 or More Flight Hours

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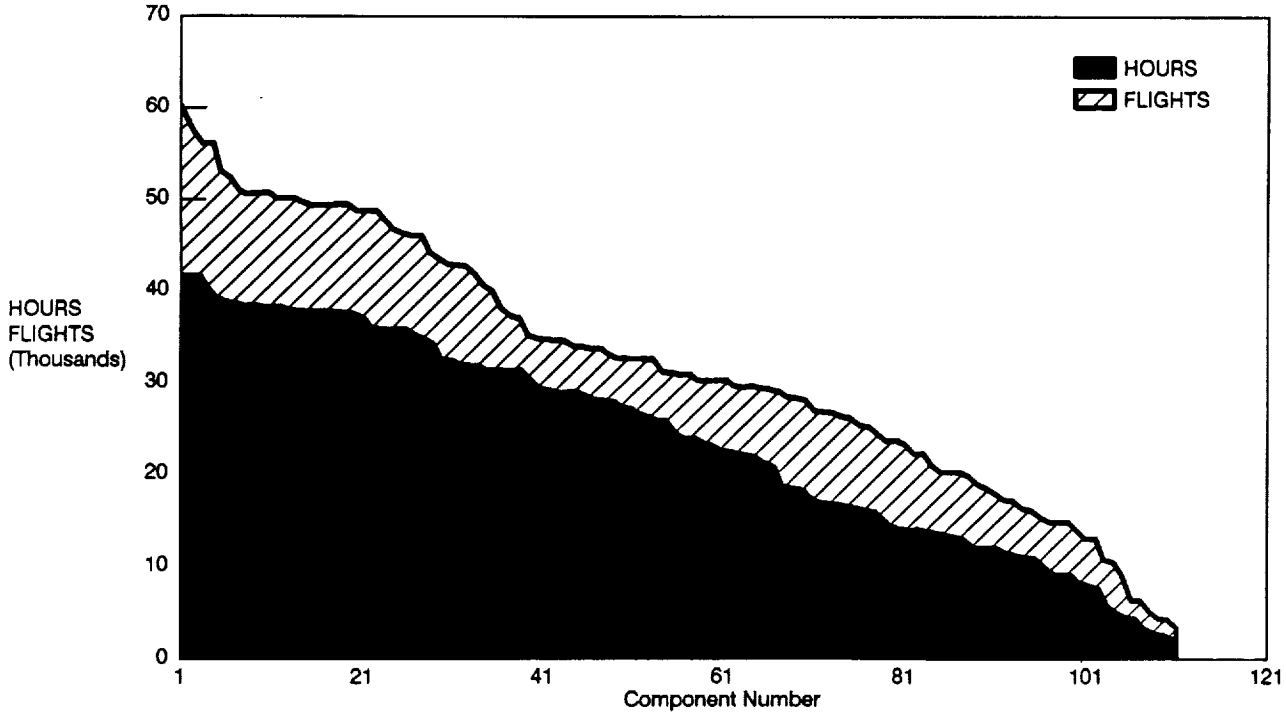

Figure 5. B737 Stabilizer Service History Data Distribution (as of 06-30-89)

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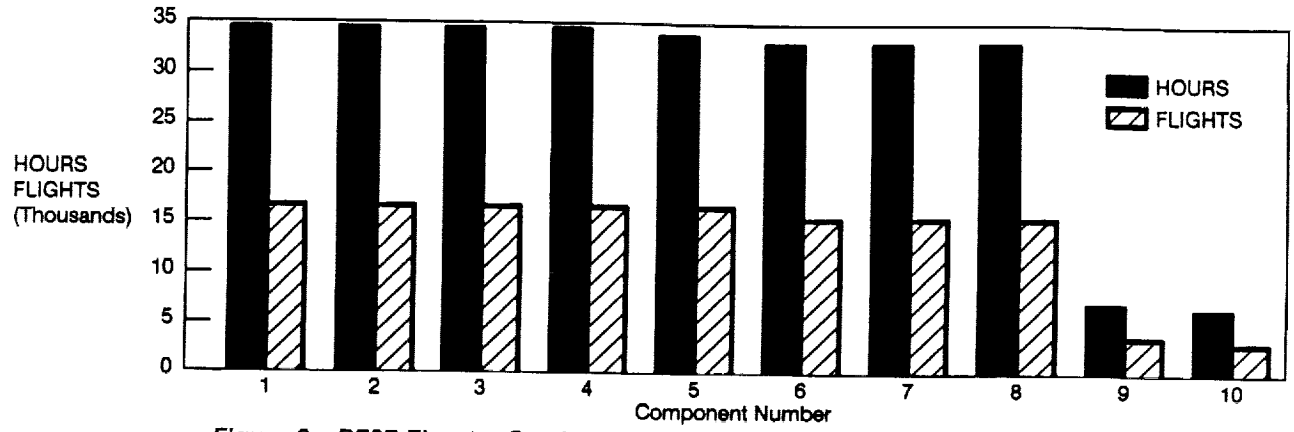

Figure 6. B727 Elevator Service History Data Distribution (as of 06-30-89)

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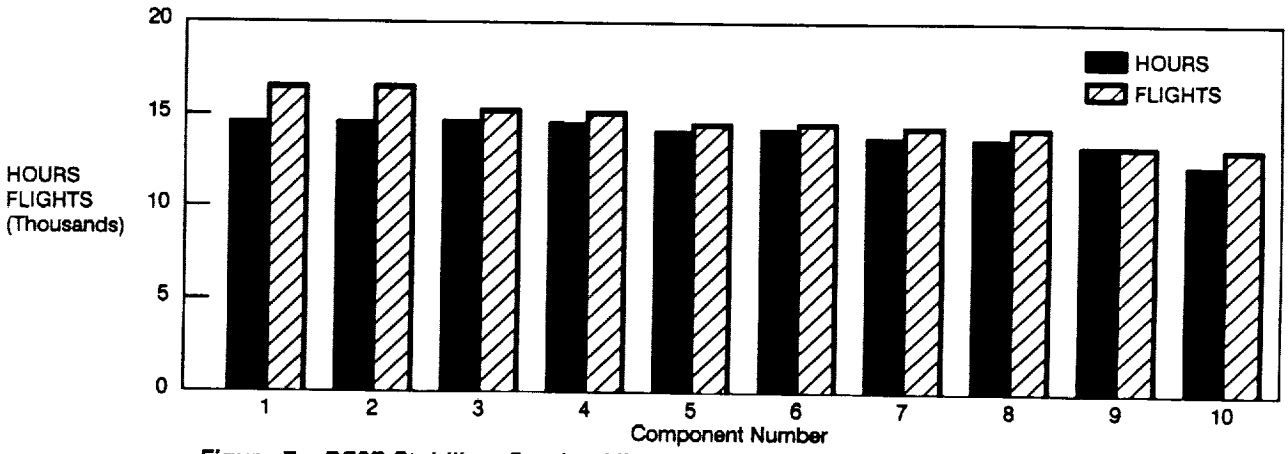

Figure 7. B737 Stabilizer Service History Data Distribution (as of 06-30-89)

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SCHEDULED SPOILER RESIDUAL TESTING

During this reporting period, three spoilers with 15 years of service were removed from the flight service program for evaluation and test. Following selection for test, the units were photographed and any damage areas were examined.

Figures 8 and 9 show the upper and lower surfaces, respectively, of spoiler S/N 0042. The overall condition of this spoiler was very good. A blister (one-half inch diameter) over the center hinge fitting was detectable as was the initiation of exfoliation corrosion at one of the spar to center hinge fitting splice details.

Figures 10 and 11 show the upper and lower surfaces, respectively, of spoiler S/N 0058. The overall condition of this spoiler was not good. There was heavy paint erosion on both surfaces. A blister (one inch diameter) over the center hinge fitting was detectable. Exfoliation corrosion was present at both of the spar to center hinge fitting splice details. The spanwise length of the corrosion was slightly less than two inches. Two and one-half inches is the maximum allowable. In addition, there was a doubler missing at one of the outboard hinge fitting points. The doubler was lost during service.

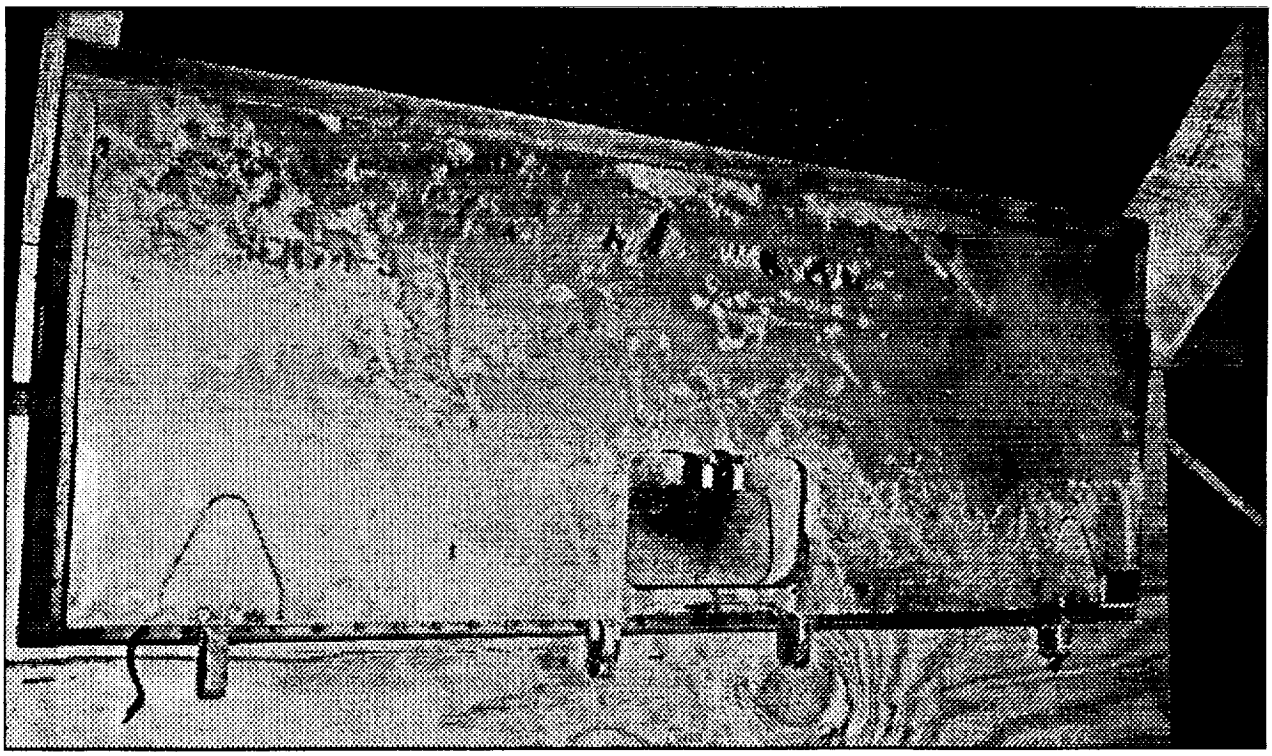

Figure 8. Lower Surface of Spoiler S/N 0042 After 15 Years of Service

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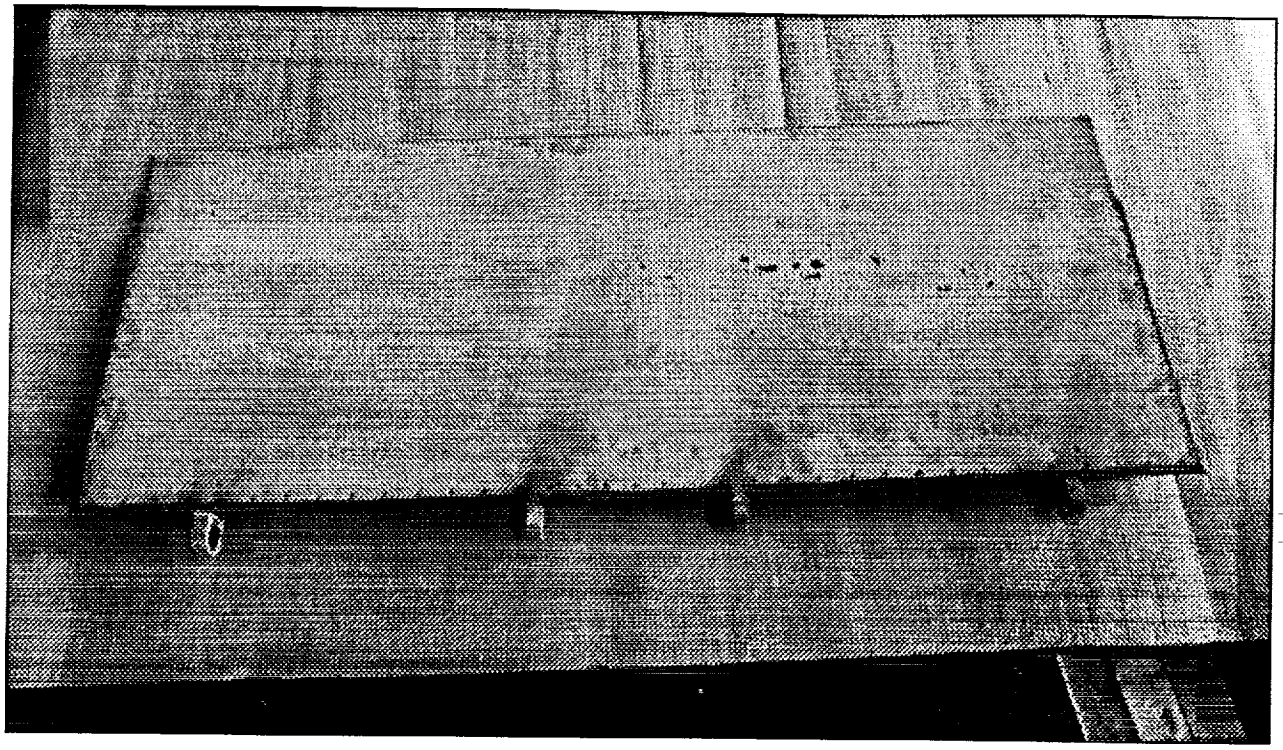

Figure 9. Upper Surface of Spoiler S/N 0058 After 15 Years of Service

10-U90220-7

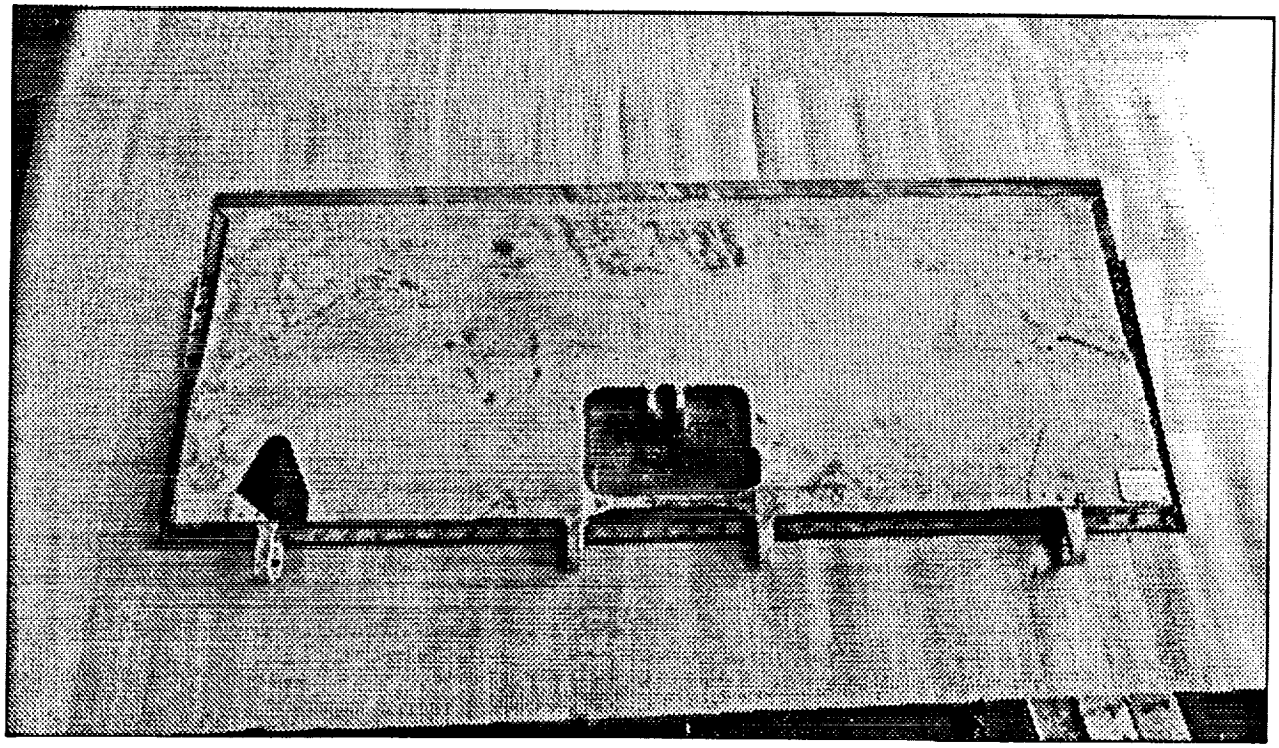

Figure 10. Lower Surface of Spoiler S/N 0058 After 15 Years of Service

10-U90220-8

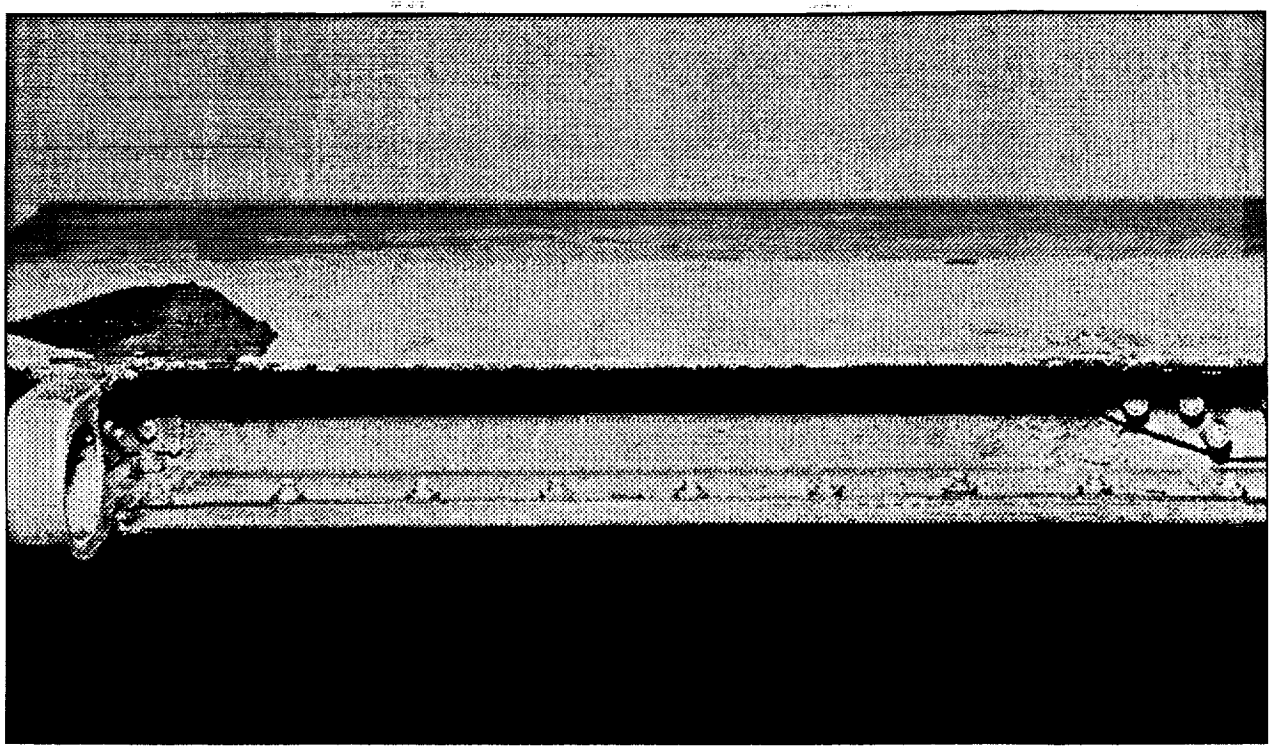

Figure 11. Damage to Lower Surface of Spoiler S/N 0058

10-U90220-9

Figures 12 and 13 show the upper and lower surfaces, respectively, of spoiler S/N 0117. The overall condition of this spoiler was excellent with no detectable damage.

Data from the tested spoilers are summarized in Figure 14. Figure 15 shows the residual static strength data accumulated for the evaluation period. Each symbol represents one test of a particular spoiler dash number (i.e. type of skin material) after a predesignated period of time. Initials near the symbols indicate the airline from which the spoiler was removed. The data are shown as a residual strength ratio, where 1.0 is the original unexposed certification test value for each material system. The scatter band for a total of 16 ultimate tests run on unexposed -2 units is shown. Although limited to one production run of only one of the three types of material, the band provides some idea of the scatter that could be expected. The limit and ultimate load requirements for each material system are also shown in the figure. Several units have been tested with significant known damage over the course of the program. The damage consisted of exfoliation corrosion blisters at spar to center hinge fitting splice locations. These units all failed above design limit load.

Tip deflection at failure for all of the spoilers as a function of exposure time is shown on Figure 16. The tip deflection correlates to panel stiffness.

Figures 17 through 19 are plots of the load-deflection data for the three fifteen year spoilers tested during this reporting period. Figure 20 shows the test setup. Load is applied to the upper surface through an

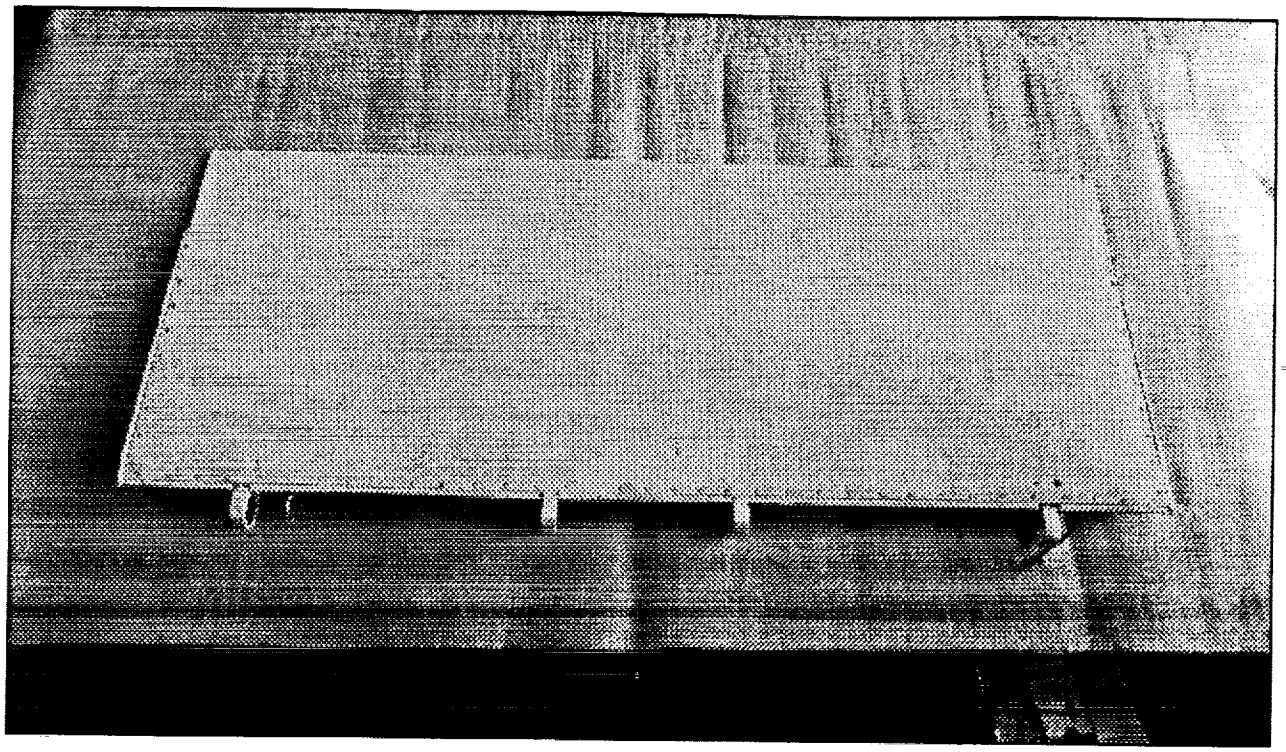

Figure 12. Upper Surface of Spoiler S/N 0117 After 15 Years of Service

10-U90220-10

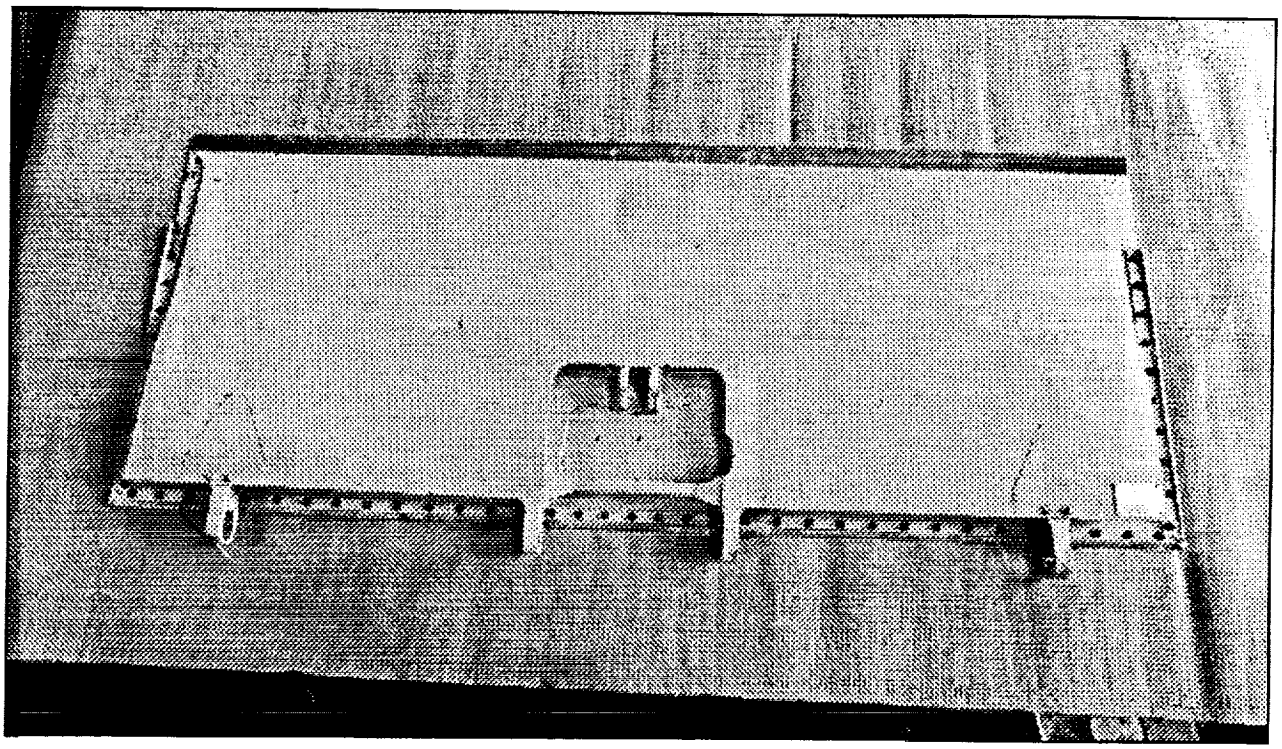

Figure 13. Lower Surface of Spoiler S/N 0117 After 15 Years of Service

10-U90220-11

Spoiler identification number	Airline	Failure load, percent DLL	Strength change, percent	Tip deflection change, percent	Time in service	Flight hours	Flight cycles
-1-0042	Frontier	269	+9	-9	188 months 30 days	42,007	46,034
-2-0058	VASP	201	-30	-31	188 months 12 days	28,572	32,549
-3-0117	Piedmont	261	+9	+12	178 months 27 days	37,994	49,468

Figure 14. Summary Data From Scheduled Spoiler Removals (15th Year)

10-U90220-12

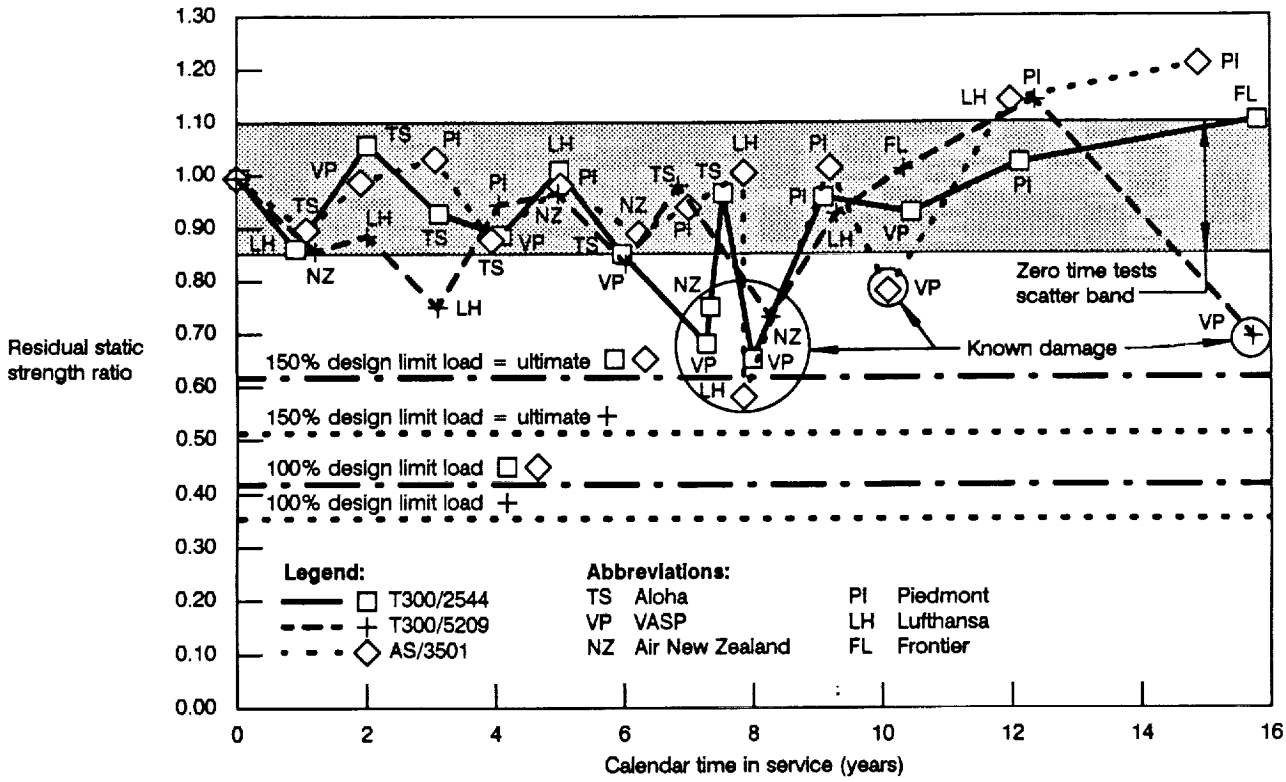

Figure 15. Summary of Residual Strength After Exposure

10-U90220-13

evener system and load pad scheme. The load is then reacted at the four hinge points and the actuator rod end.

The failure mode of spoilers S/N 0042 and S/N 0117 corresponded to a higher energy failure mode. In each case the center hinge fitting was essentially rammed through the upper surface. A lower energy, less catastrophic, failure mode was evident for S/N 0058. In this mode the failure initiates at a corrosion site and propagates to the center hinge fitting. Photographs of the spoilers after testing are shown in Figures 21 through 26.

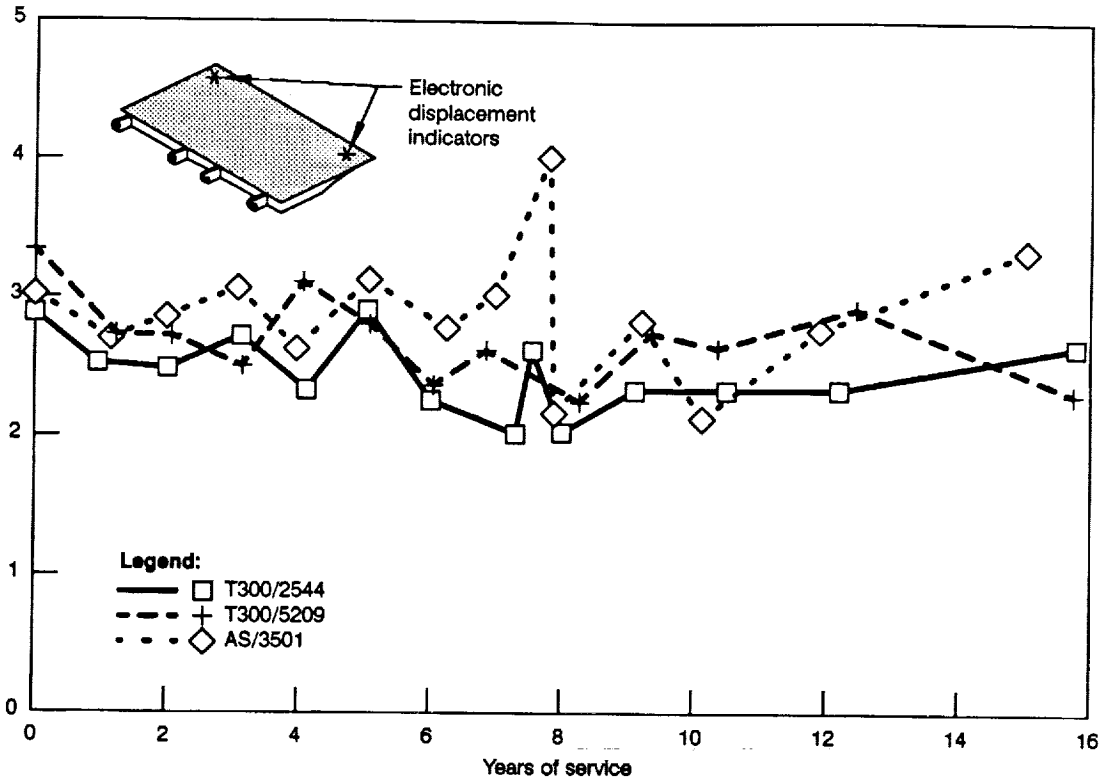

Figure 16. Summary of Spoiler Stiffness After Exposure

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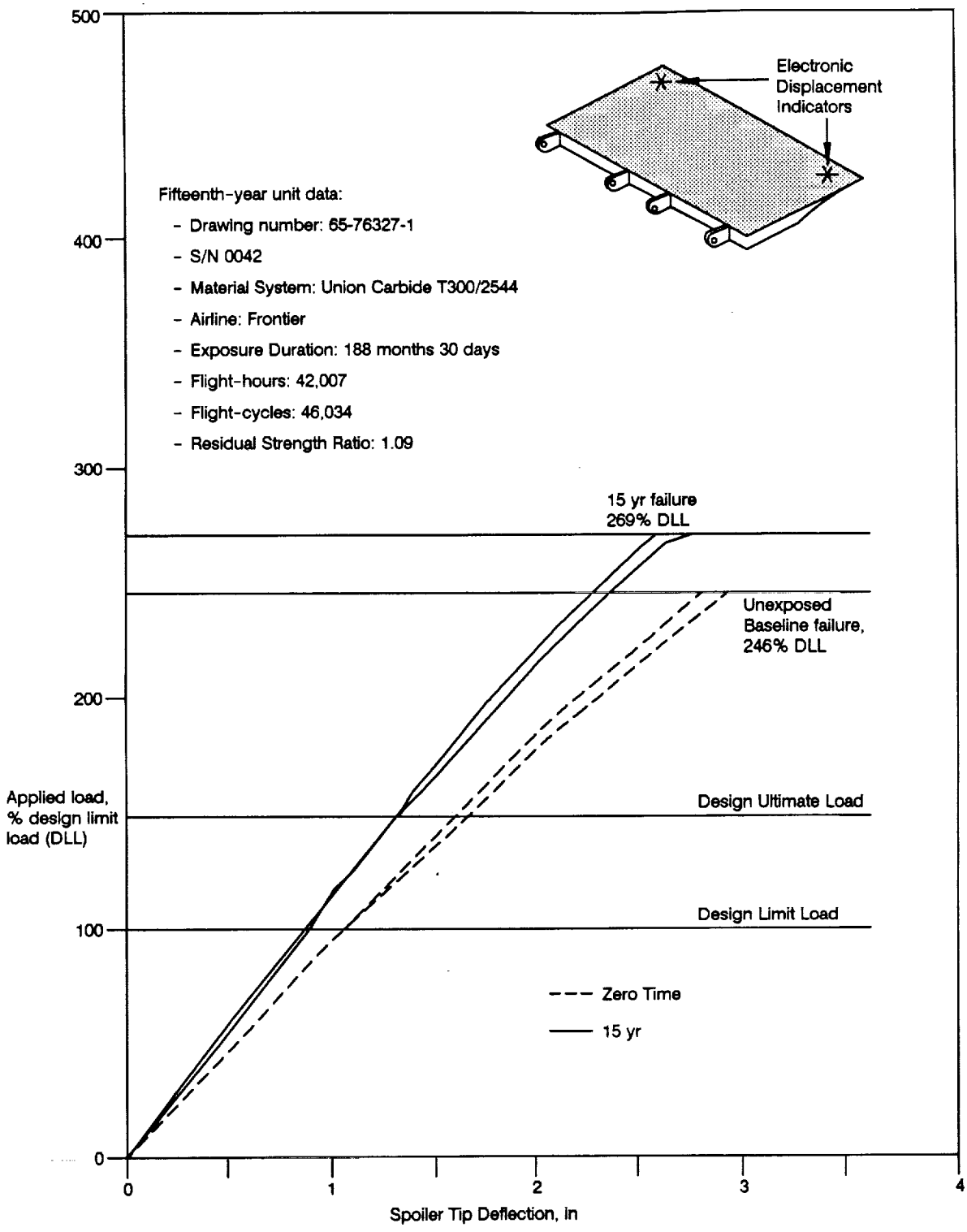

Figure 17. Residual Strength and Stiffness of S/N 0042 After 15 Years of Service

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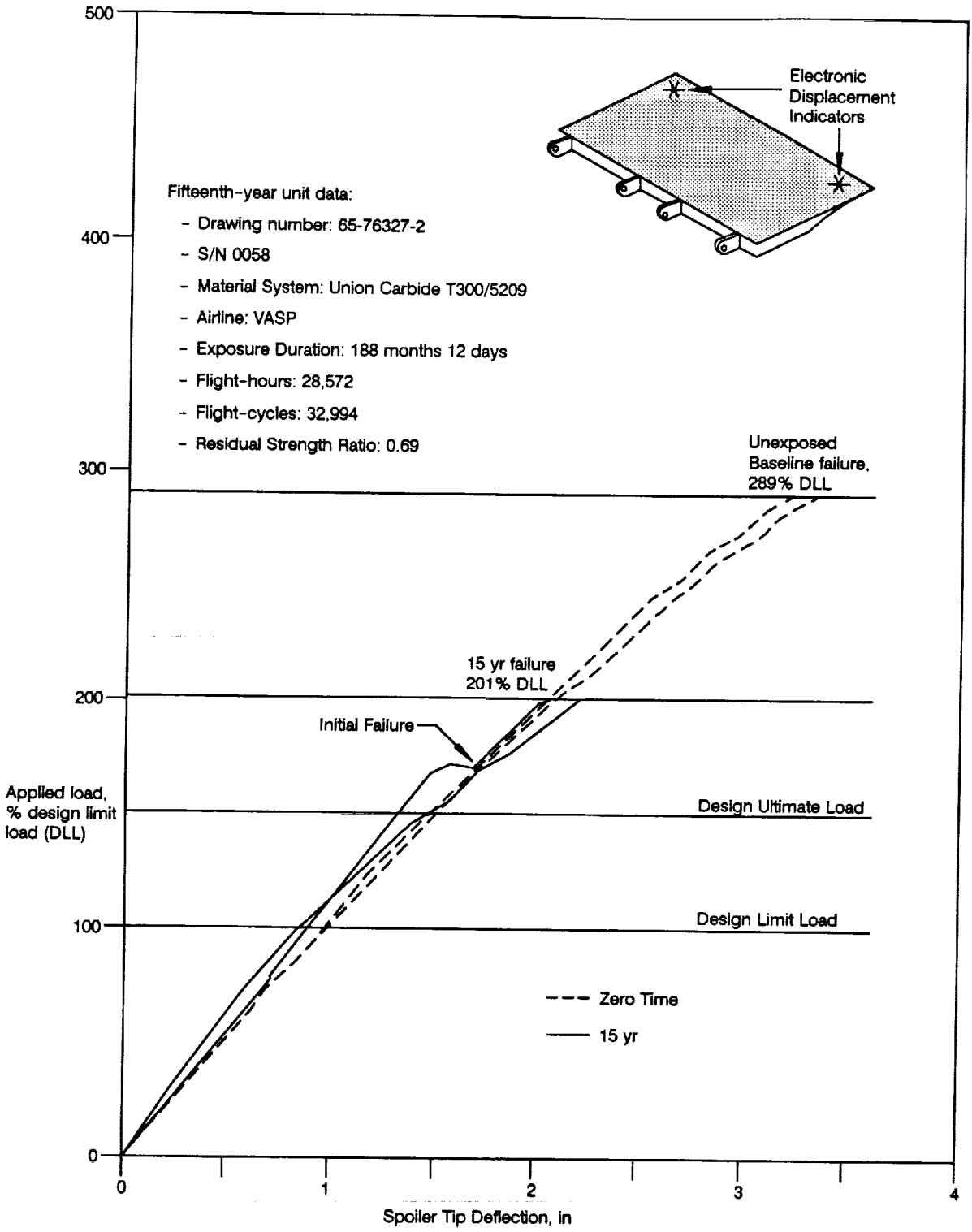

Figure 18. Residual Strength and Stiffness of S/N 0058 After 15 Years of Service

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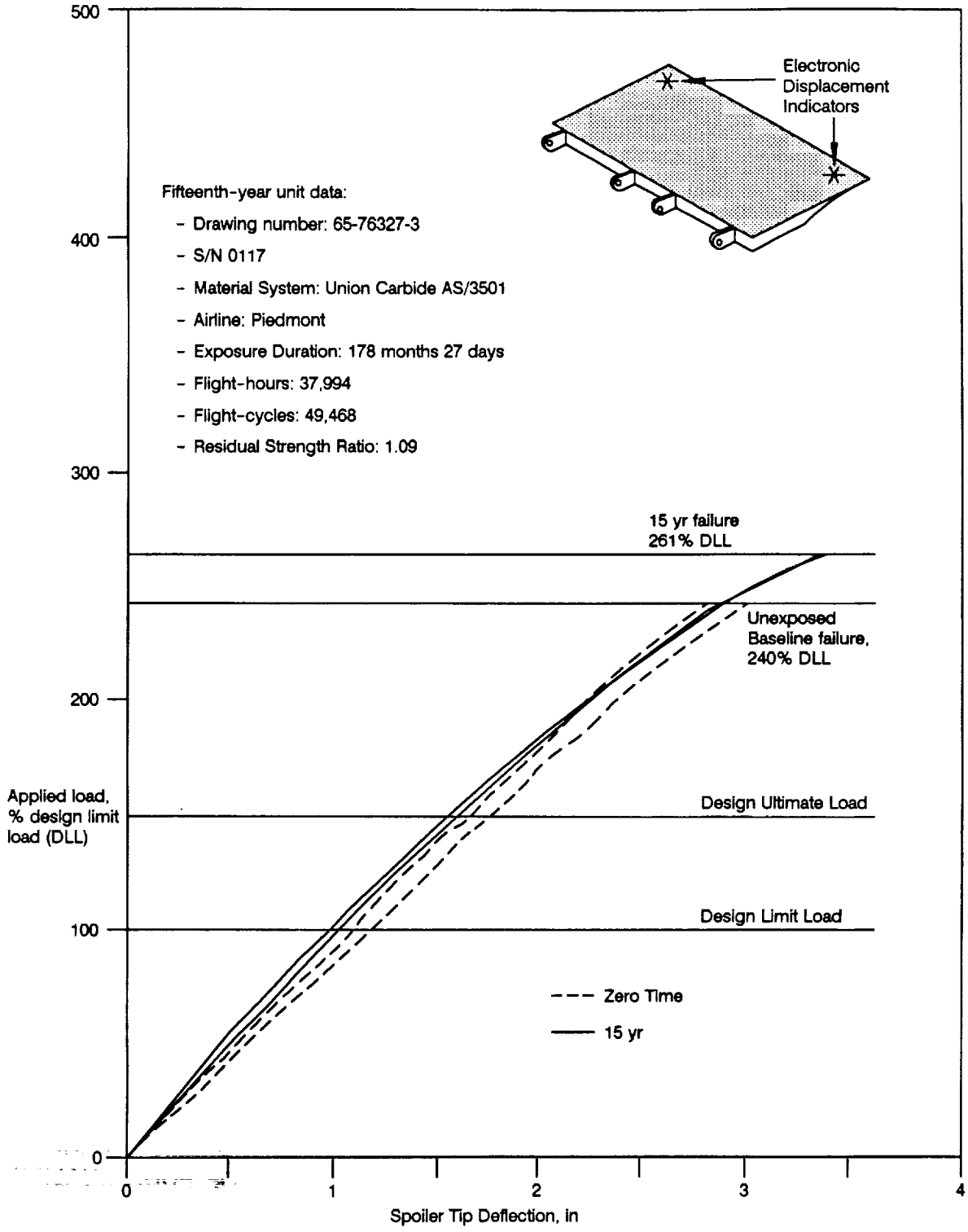

Figure 19. Residual Strength and Stiffness of S/N 0117 After 15 Years of Service

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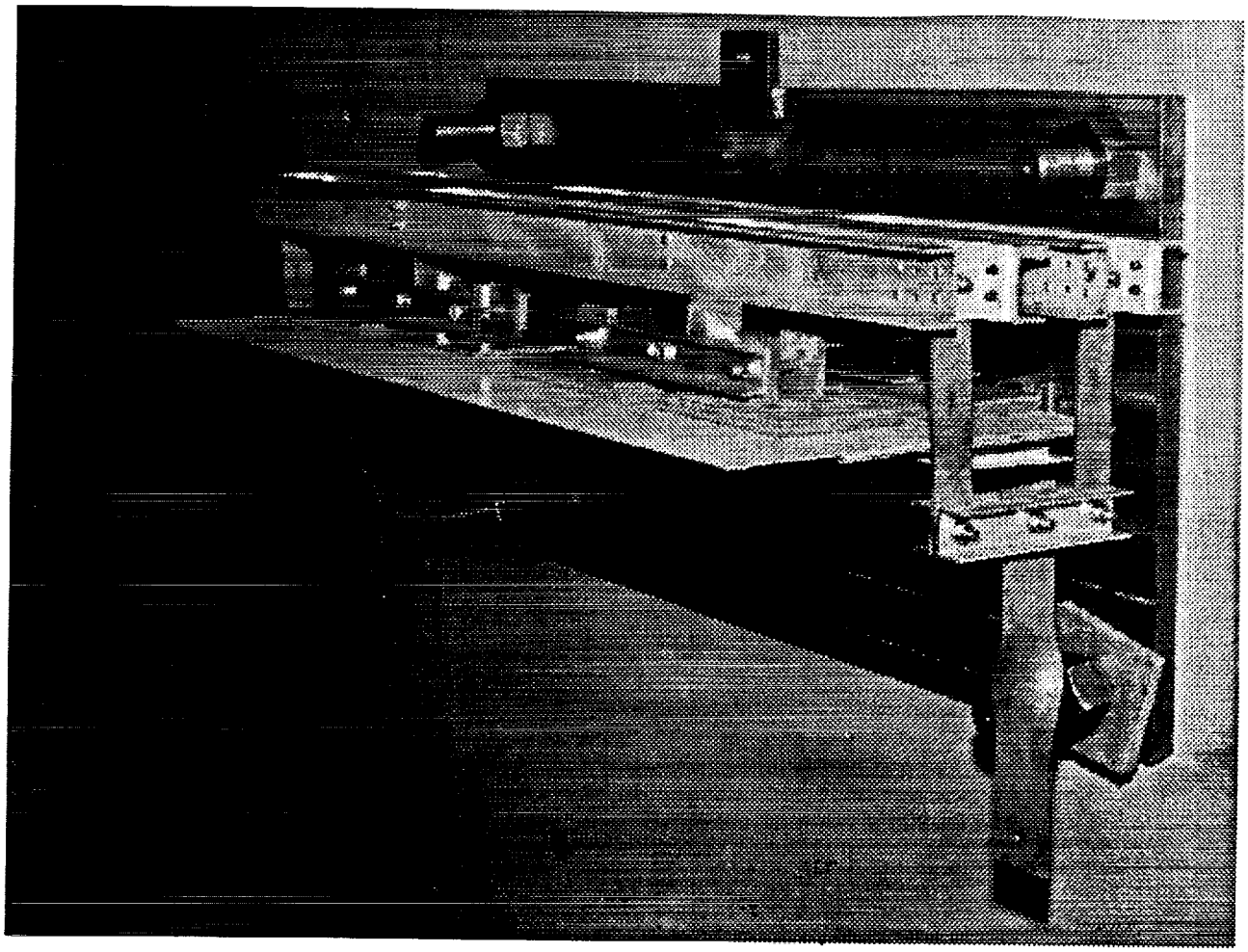

Figure 20. Spoiler Residual Strength Test Setup

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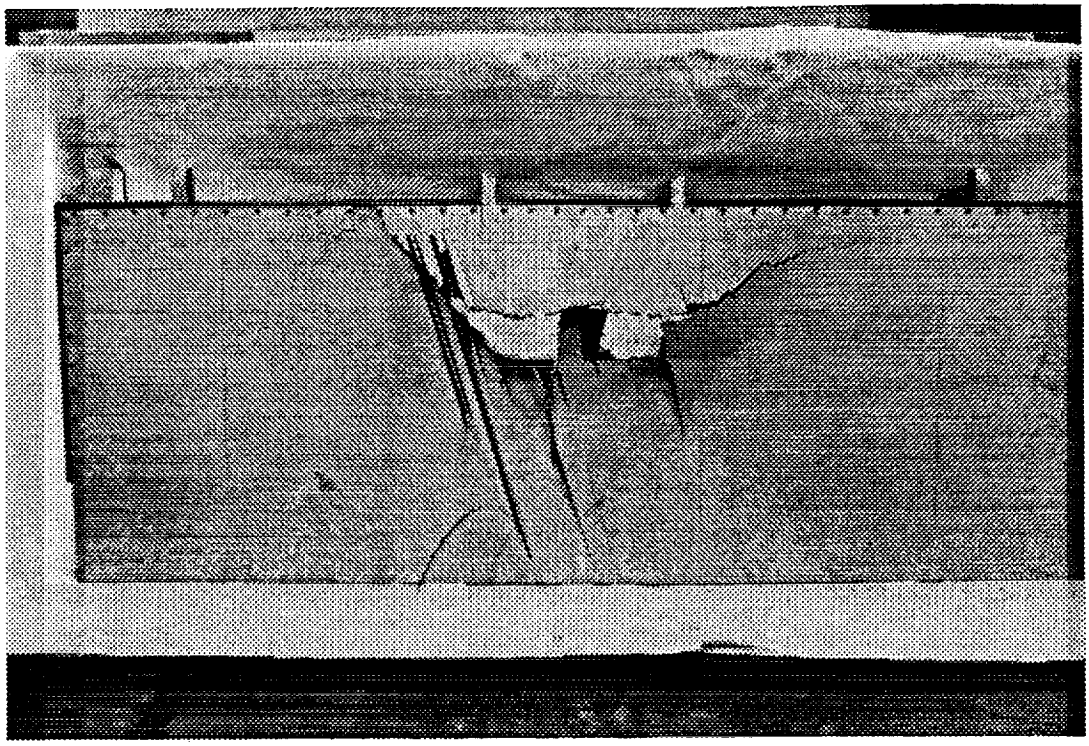

Figure 21. Upper Surface of Spoiler S/N 0042 Following Residual Strength Test

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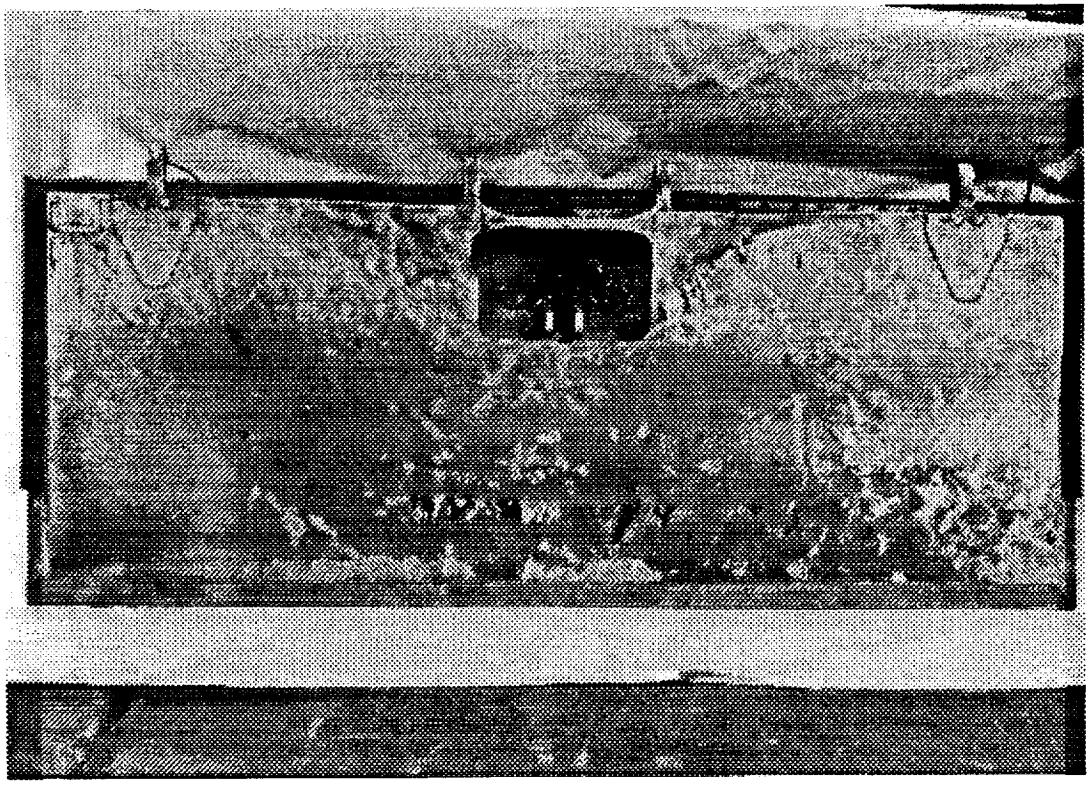

Figure 22. Lower Surface of Spoiler S/N 0042 Following Residual Strength Test

10-U90220-23

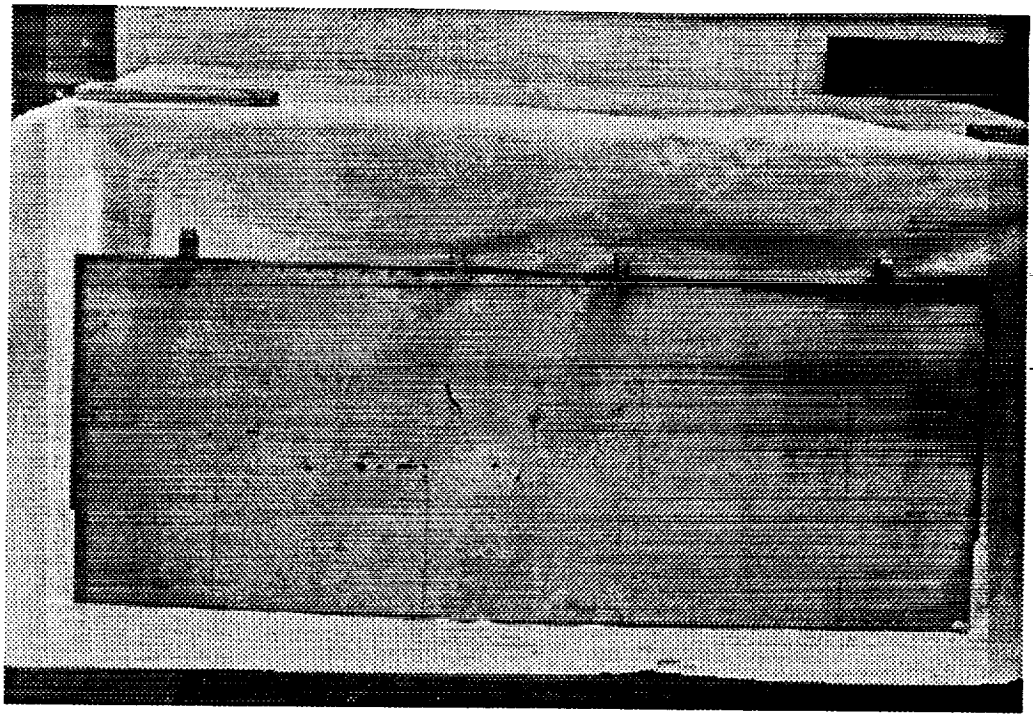

Figure 23. Upper Surface of Spoiler S/N 0058 Following Residual Strength Test

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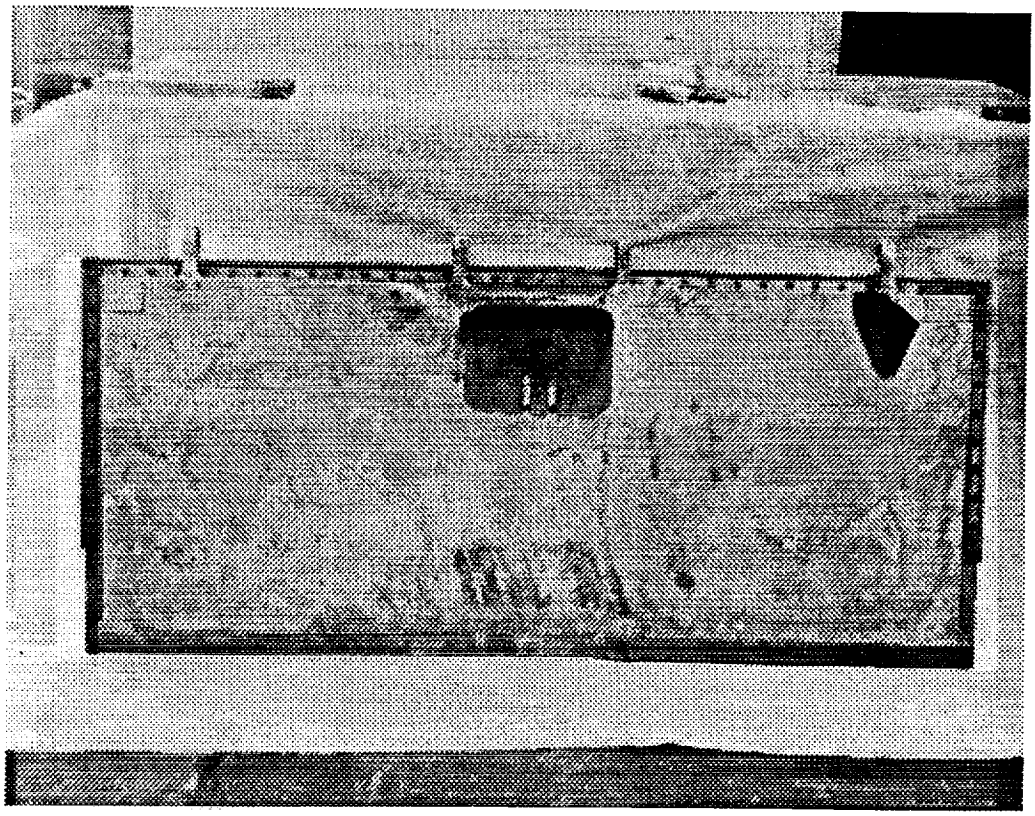

Figure 24. Lower Surface of Spoiler S/N 0058 Following Residual Strength Test

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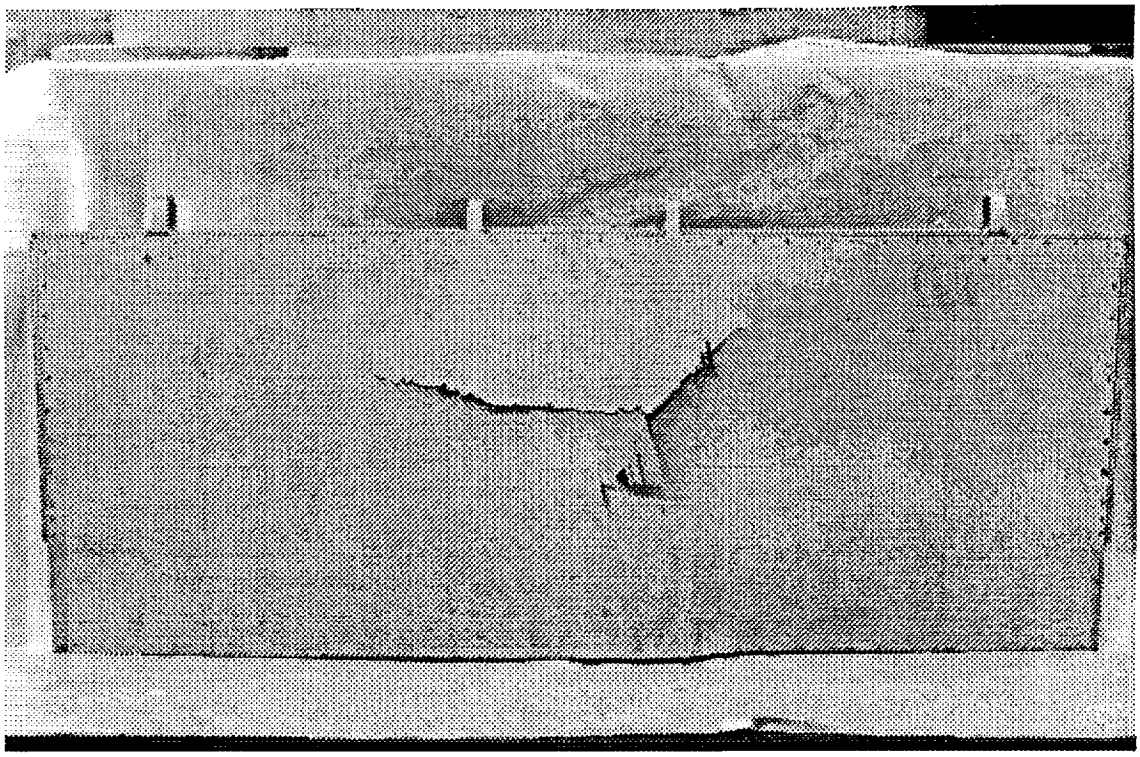

Figure 25. Upper Surface of Spoiler S/N 0117 Following Residual Strength Test

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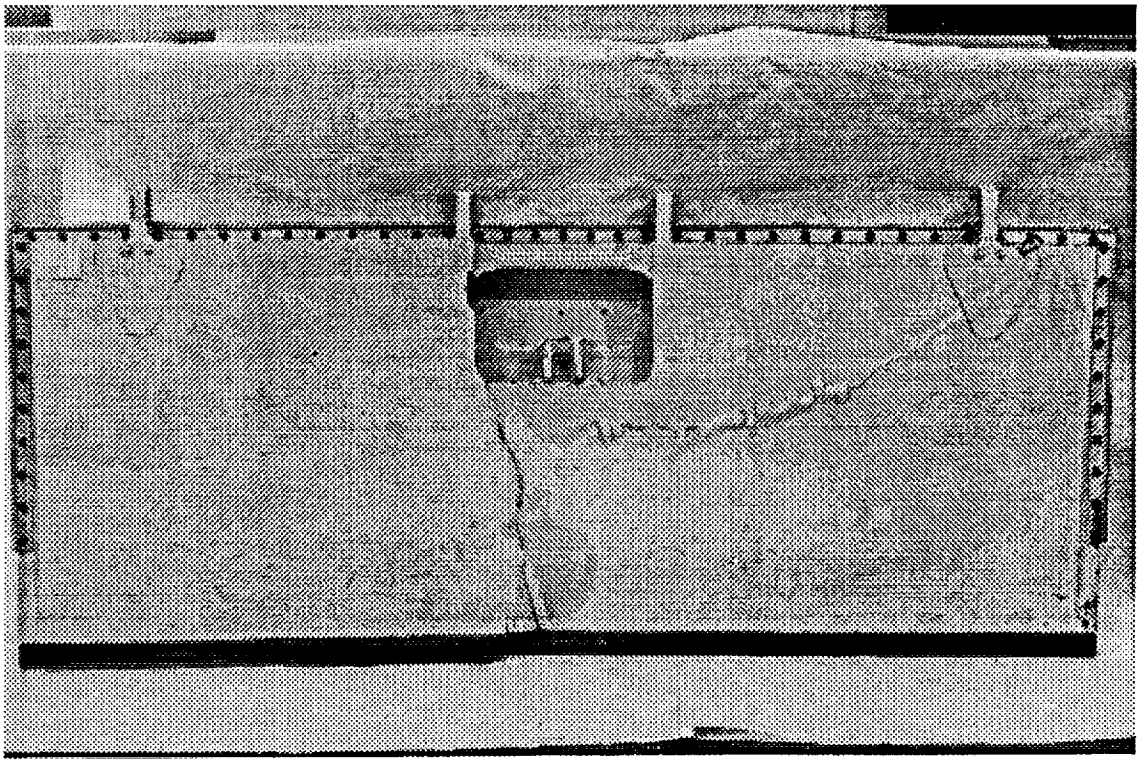

Figure 26. Lower Surface of Spoiler S/N 0117 Following Residual Strength Test

10-U90220-27

UNSCHEDULED REMOVALS AND EVALUATION

A summary of the disposition of the flight evaluation components is shown in figure 27.

B737 Spoilers: The unscheduled removal of fifteen spoilers occurred during this reporting period. Data for these spoilers are summarized in Figure 28. The damage follows a pattern of center-hinge-fitting to spar splice disbond with subsequent galvanic corrosion of the aluminum spar and the formation of upper skin disbond "blisters". The trailing edge damage incident was induced by mechanical damage of unknown origin. The disposition of ten spoilers is unknown at this time

B727 Elevators: There have been six reported damage incidents on the B727 elevator fleet. These incidents are summarized in Figure 29. Four reported cases of lightning strike damage were relatively minor and repair activities were conducted with the elevators remaining on the airplane. The de-icer strike on one of the elevators installed on N7460U resulted in skin punctures that required removal of the elevator for repair access. One elevator was damaged, with several skin punctures, during a ground handling

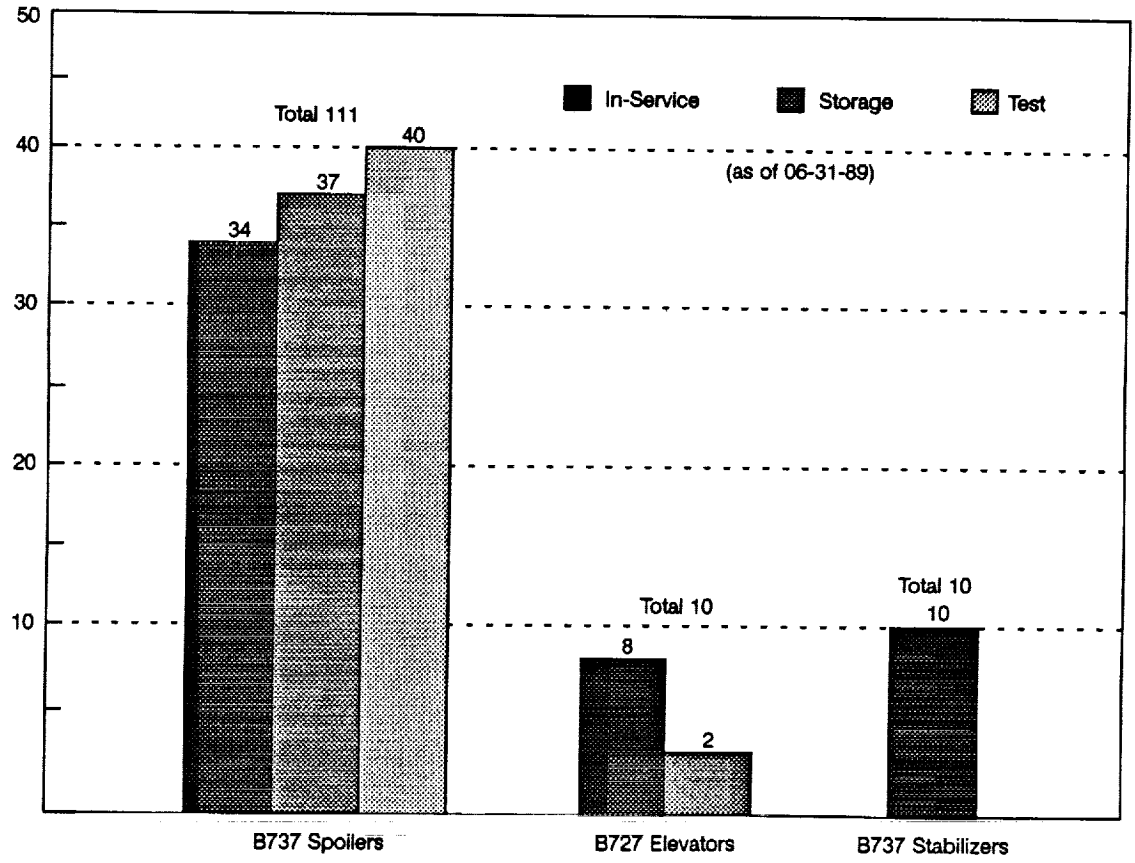

Figure 27. Component Disposition

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S/N	Airline	Date Removed	Reason for Removal	Disposition
0003	VASP	12-31-88	Unknown	Unknown
0004	VASP	12-31-88	Unknown	Unknown
0006	VASP	12-31-88	Unknown	Unknown
0007	Air New Zealand	04-07-86	Trailing Edge Damage	BCA Storage
0021	Lufthansa	12-04-85	Unknown	Unknown
0043	Air New Zealand	01-12-89	Spar Exfoliation Corrosion	ANZ Storage
0055	Lufthansa	xx-xx-87	Unknown	Unknown
0056	Lufthansa	xx-xx-87	Unknown	Unknown
0060	VASP	12-31-88	Unknown	Unknown
0061	VASP	12-31-88	Unknown	Unknown
0062	Lufthansa	12-12-86	Spar Exfoliation Corrosion	BCA Storage
0063	Lufthansa	04-28-87	Unknown	Unknown
0065	Lufthansa	12-12-86	Spar Exfoliation Corrosion	BCA Storage
0083	Lufthansa	01-28-87	Spar Exfoliation Corrosion	BCA Storage
0113	Lufthansa	04-29-86	Center Hinge Fitting Blister Unknown	Unknown

Figure 28. Unscheduled Flight Spoiler Removals

10-U90220-28

A/C	Airline	Date	Damage	Disposition
N7459U	United	10-18-83	Lightning Strike	Repaired
N7459U	United	xx-xx-80	Lightning Strike	Repaired
N7460U	United	xx-xx-80	Lightning Strike	Repaired
N7461U	United	xx-xx-81	Lightning Strike	Repaired
N7460U	United	03-07-82	De-icer Impact	Repaired/UAL Stores
N7461U	United	08-20-82	Ground Handling Impact	Repaired/UAL Stores

Figure 29. B727 Elevator Damage Incidents

10-U90220-29

incident with N7461U. This unit was also removed from the airplane for repair. These units have been repaired and are in storage awaiting reinstallation.

B737 Stabilizers: A planned inspection of one shipset of the stabilizers was conducted on October 10, 1986. This inspection occurred after 7000 flight-hours on Mark Air N670MA. The inspection included removal of leading and trailing edge structure to allow visual inspection of the spars and the inside of the box structure. Pulse echo non-destructive inspection was conducted on the upper and lower skin panels on both stabilizers. The inspection area was from mid-chord to the aft spar and from the side-of-body outboard to half-span. No damage was detected and the general condition of the stabilizers was deemed excellent.

There have been three reported damage incidents on the B737 horizontal stabilizers. These incidents are summarized in Figure 30. De-icer impact damage was induced on the upper surface panel of both stabilizers on N672MA. These impacts were relatively minor and damage was limited to the skin, not affecting the stiffener elements. A fan blade penetrated the lower surface of one stabilizer on N670MA. This

A/C	Airline	Date	Damage	Disposition
N672MA	Mark Air	12-16-87	De-icer Impact	Repaired
N672MA	Mark Air	12-16-87	De-icer Impact	Repaired
N670MA	Mark Air	03-16-88	Engine Fragment	Repaired

Figure 30. B737 Stabilizer Damage Incidents

10-U90220-30

penetration missed the stiffener elements and damage was limited to a small area of the skin panel. In all three cases the damage areas were repaired on site with the stabilizer on the airplane, using wet lay-up low temperature cure resin techniques according to repair procedures developed and specified by Boeing.

GROUND BASED ENVIRONMENTAL SERVICE

The ground-based environmental service portion of the spoiler program was completed in 1984, but the results are repeated here to provide a complete account of the spoiler program.

Interlaminar shear, flexure, and compression specimens were subjected to continuous outdoor exposure at five airline terminals worldwide and at the NASA-Langley Research Center. The exposure locations were as follows: Hampton, Virginia; San Diego, California; Sao Paulo, Brazil; Wellington, New Zealand; Honolulu, Hawaii; and Frankfurt, Germany. Specimens were tested after 1, 3, 5, 7, and 10 years of exposure and the results are summarized herein.

Average short-beam interlaminar shear, flexure, and compression strengths and moisture contents for the six exposure locations after 1, 3, 5, 7, and 10 years of exposure are plotted in figures 31 through 34. In addition to strength and modulus measurements, moisture content was determined for the flexure specimens after the residual strength tests were completed. The absorbed moisture content was calculated after the specimens were dried in a vacuum furnace.

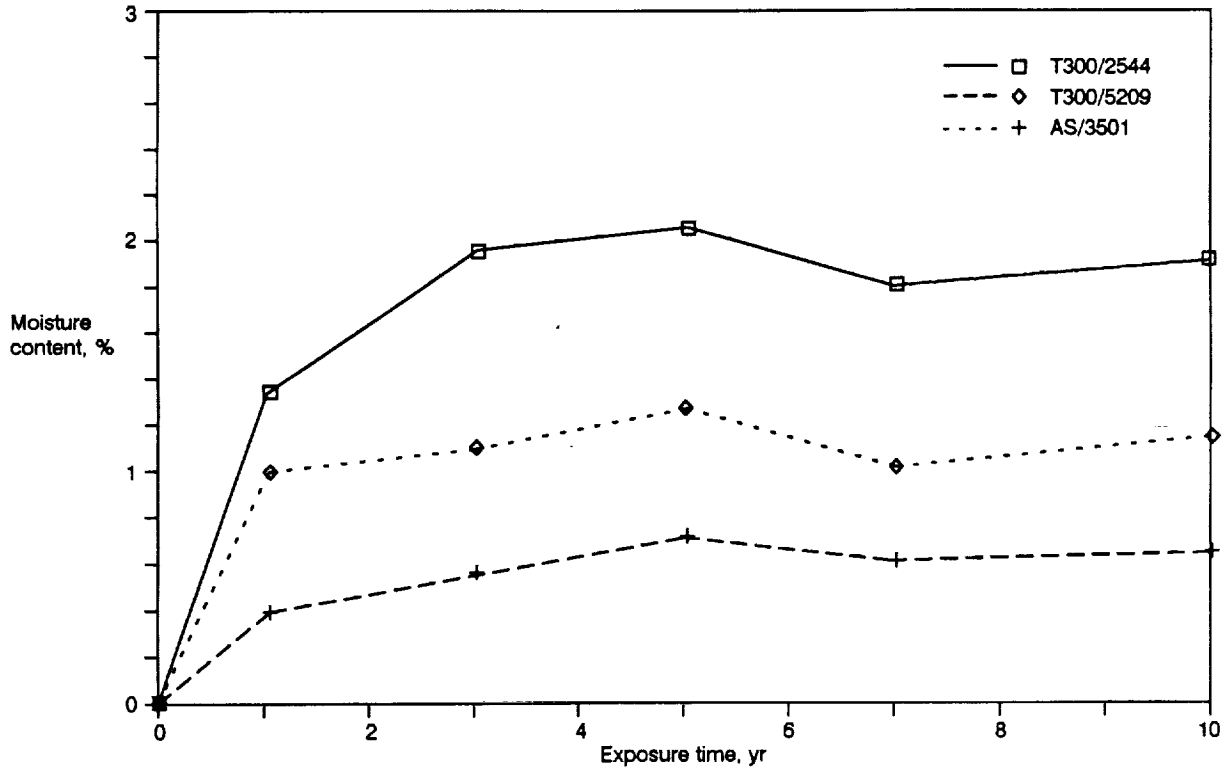

Figure 31. Average Moisture Pickup After Outdoor Exposure at Six Worldwide Locations

10-U90220-31

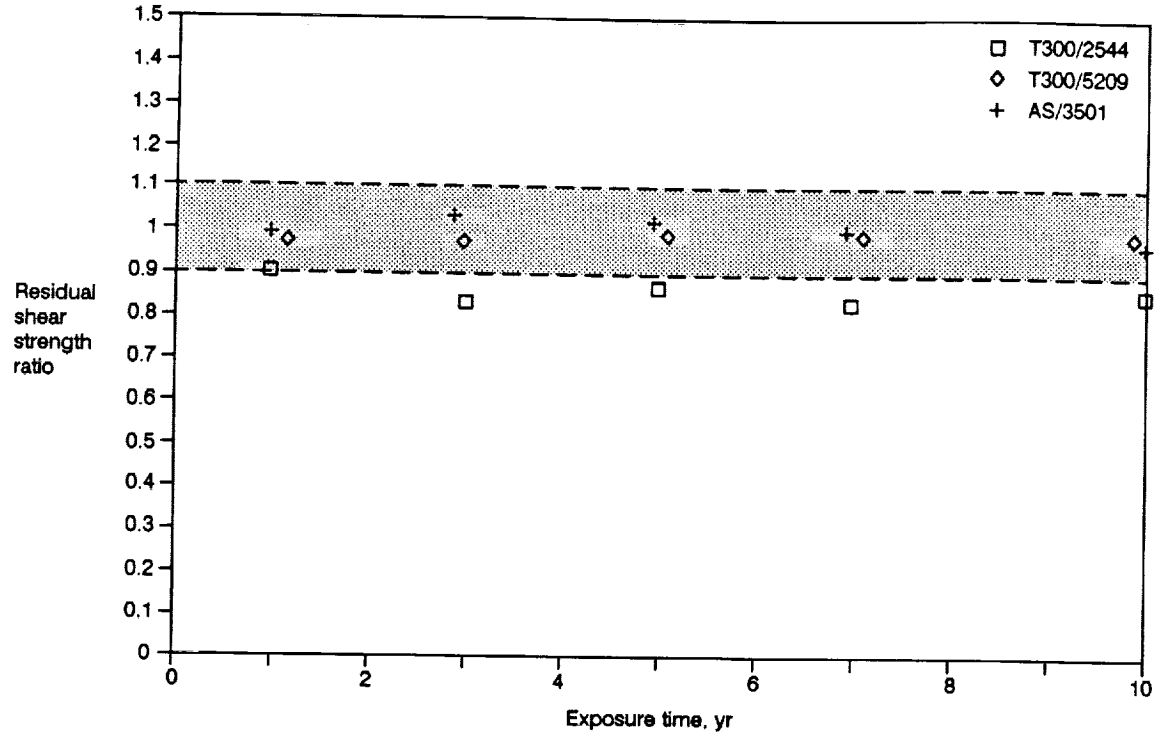

Figure 32. Average Residual Shear Strength After Outdoor Exposure at Six Worldwide Locations

10-U9020-32

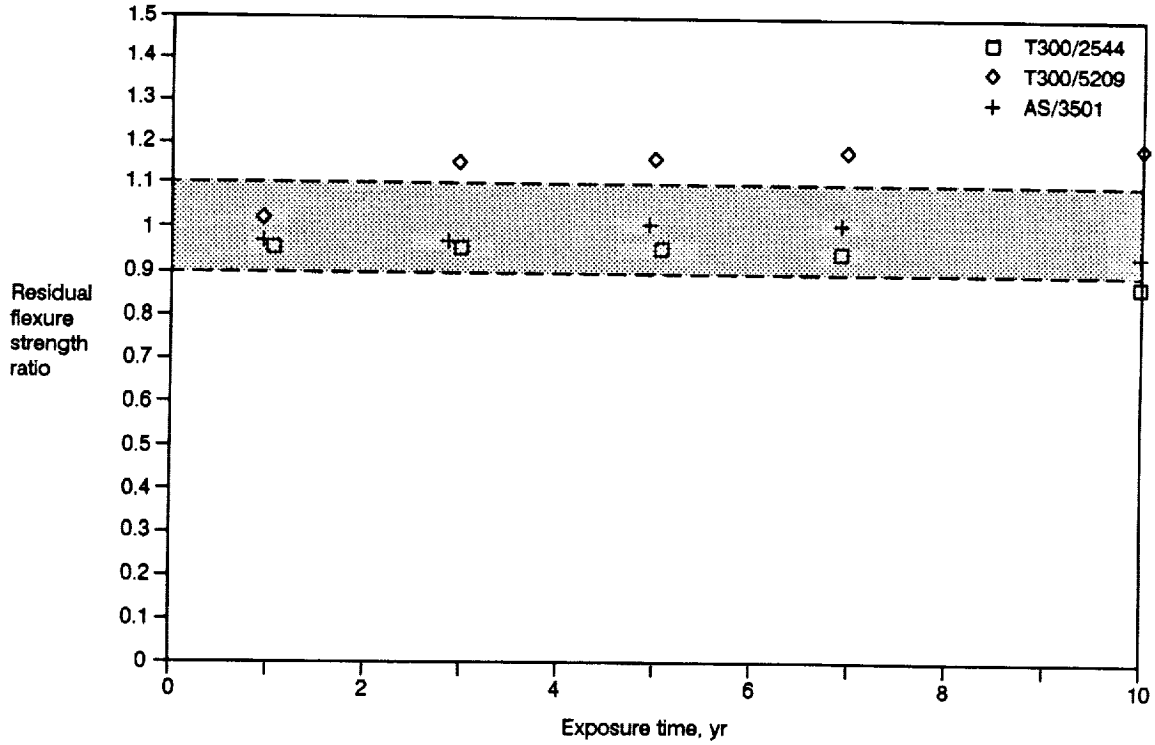

Figure 33. Average Residual Flexure Strength After Outdoor Exposure at Six Worldwide Locations

10-U9020-33

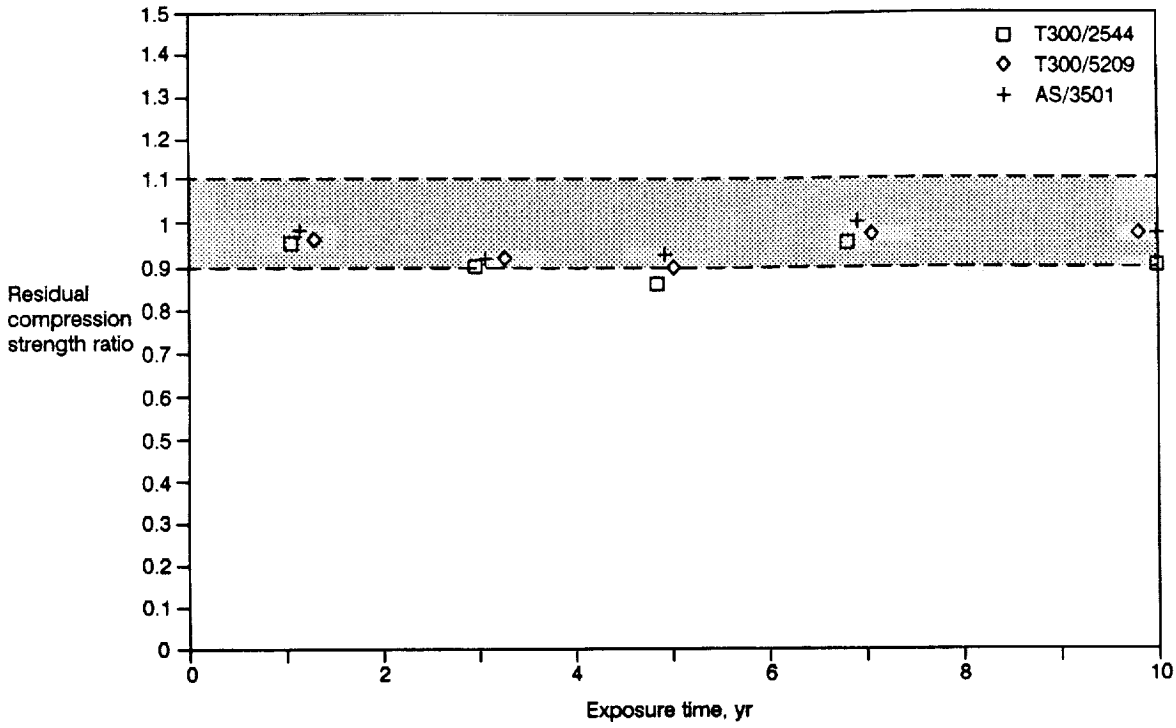

Figure 34. Average Residual Compression Strength After Outdoor Exposure at Six Worldwide Locations

10-U9020-34

The average moisture pickup for the six exposure locations is plotted in Figure 31. The T300/2544 specimens absorbed about two percent moisture, the AS/3501 specimens absorbed about one percent moisture, and the T300/5209 specimens absorbed about 0.6 percent moisture during the 10-year exposure period. Since most specimens are not painted, the outer plies of the material were degraded by ultraviolet radiation. Scanning electron micrographs indicate that all the fibers are coated with epoxy for the unexposed specimens, whereas individual fibers can be seen on the 10-year exposure specimens after the surface layer of epoxy resin was leeched away by ultraviolet radiation. Close examination of the three materials indicates that the T300/2544 material is the most susceptible to the degrading effect of ultraviolet radiation. It should be noted that a coating of polyurethane aircraft paint will protect the material from ultraviolet degradation.

The average residual strength ratios for the shear, flexure, and compression specimens are plotted in Figures 32, 33, and 34, respectively. These values represent a comparison of the average strength values for all six exposure sites with the average baseline strength value for that material system. A ± 10% bandwidth, which represents the strength scatter in the baseline specimens, is shown on each figure. The shear strength ratios are within the scatterband except for T300/2544, which is slightly below the baseline value. For the flexure specimens, Figure 33, the strength of the T300/2544 material was slightly below the scatterband after 10 years of exposure. The flexure strength for the AS/3501 material has been consistently above the baseline strength since the first year tests. These results indicate that the baseline strength may be low. To investigate this possibility, eight spare AS/3501 flexure specimens that had been stored in an office for 10 years at NASA Langley were tested. The average failure stress for these

specimens was 18 percent higher than the failure stress for the baseline specimens. These results confirm that a larger number of specimens should have been tested to establish the baseline strength. For the compression specimens, Figure 34, the strengths for all materials are within the scatterband or slightly below the scatterband.

The results of this test program indicate that graphite-epoxy composite materials can withstand a variety of outdoor environments for up to 10 years of continuous exposure with no significant strength loss. It should be emphasized that these tests were conducted at room temperature and no conclusions can be drawn as to the effect of elevated temperature exposure or elevated temperature test conditions.

CONCLUDING REMARKS

After fifteen years of service the Boeing/NASA composite components flight service evaluations are an unqualified success. Damage occurrences are at or below those for equivalent metal structure, repair techniques have proven to be effective and efficiently applied, and aircraft efficiency has improved from the lower weight of the composite structure. The most important observation relating to success is that the participating airlines remain enthusiastic about the use of composites.

The knowledge base created as a result of this program has been instrumental in the advancement of composite material technology. Every aspect of developing and maintaining the composite components in an airline environment provided experience applicable to subsequent programs. The design, analysis, production, and certification activities presented many new challenges that are met. The years of flight service provided a good understanding of the type and frequency of damage events occurring in a variety of service environments. The service experience provided information on durability and damage tolerance and required the development of new inspection and repair methods.

An example of the application of the service experience gained is the method of dealing with galvanic corrosion potential. The spoiler program established the need to be concerned about sealing moisture paths between dissimilar materials and techniques to prevent galvanic interaction. These techniques have proven successful in commercial applications.

The residual testing of spoilers and ground based exposure coupons have shown good environmental durability for the composite materials. This leads to improved confidence for further applications and provides a more thorough understanding of the material behavior in a real service environment.

The components currently in service will remain in service indefinitely. This should provide valuable information about composite materials long term behavior well into the next century.

APPENDIX A

CURRENT SPOILER FLIGHT HOURS AND LANDING DATA AS OF 06/30/89

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	LANDINGS	CURRENT OR REMOVE DATE	HOURS	LANDINGS	NET HOURS	LANDINGS	REMARKS
0			DEMONSTRATION UNIT AT NASA LANGLEY					00	00	6
0		0	0	0		0	0	0	0	0
1	06-27-74	5	5681	3056	--------	43745	52706	38064	49650	2
2			CERTIFICATION STATIC TEST UNIT					00	00	4
3	07-18-73	7	8095	12842	05-17-74	9018	14379	923	1537	0
3	05-17-74	6	9018	14379	12-31-88	36618	45344	27600	30965	3
4	07-28-73	7	8161	12965	05-17-74	9018	14379	857	1414	0
4	05-17-74	6	9018	14379	12-31-88	36618	45344	27600	30965	3
5	07-18-73	7	8095	12842	05-17-74	9018	14379	923	1537	0
5	05-17-74	6	9018	14379	04-08-78	18112	24432	9094	10053	0
5	02-15-79	6	20212	26856	04-24-80	23294	30267	3082	3411	0
5	08-06-82	2	29534	40417	09-01-84	33223	45292	3689	4875	0
5	04-01-85	2	34405	46864	04-04-86	41175	54738	6770	7874	0
5	08-26-86	2	5588	7383	--------	7949	10420	2361	3037	2
6	07-28-73	7	8161	12965	05-17-74	9018	14379	857	1414	0
6	05-17-74	6	9018	14379	12-31-88	36618	45344	27600	30965	3
7	09-15-73	2	10861	15053	04-07-86	25715	38975	14854	23922	1
8	09-15-73	2	10861	15053	09-27-78	21603	29443	10742	14390	0
8	08-06-79	2	23465	31977	11-06-81	27997	38179	4532	6202	3
9	09-15-73	2	10861	15053	02-04-76	16147	22112	5286	7059	0
9	09-27-78	2	21603	29443	06-25-81	27258	37151	5655	7708	1
10	09-15-73	2	10861	15053	06-25-81	27258	37151	16397	22098	1
11	08-26-73	4	11274	15681	08-21-77	20307	26924	9033	11243	0
11	03-24-78	4	21658	28554	02-27-81	28562	36655	6904	8101	1
12	08-26-73	4	11274	15681	03-04-75	14694	19964	3420	4283	0
12	06-13-75	4	15148	20528	09-18-75	15793	21324	645	796	0
12	09-18-75	4	15940	21518	07-03-78	22297	29334	6357	7816	0
12	10-19-78	4	22954	30142	05-12-80	26719	34534	3765	4392	0
12	09-02-81	4	17	6	--------	17906	20650	17889	20644	2
13	08-26-73	4	11274	15681	05-06-78	21938	28901	10664	13220	0
13	10-06-78	4	20532	25040	10-20-78	20636	25143	104	103	0
13	10-25-78	4	22987	30176	02-27-81	28562	36655	5575	6479	1
14	08-26-73	4	11274	15681	07-29-74	13329	18216	2055	2535	3
15	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
15	05-17-74	6	9399	14936	05-13-75	11689	17594	2290	2658	0
15	01-31-76	6	13411	19607	04-30-81	25917	33732	12506	14125	3
16	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
16	05-17-74	6	9399	14936	09-04-77	17147	23719	7748	8783	3
17	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0
17	05-17-74	6	9399	14936	09-21-75	12432	18474	3033	3538	0
17	01-31-76	6	13411	19607	12-09-78	20050	26978	6639	7371	0
17	03-15-80	6	23355	30689	10-03-84	34329	43357	10974	12668	3
18	08-02-73	7	8651	13711	05-17-74	9399	14936	748	1225	0

18	05-17-74	6	9399	14936	05-13-75	11689	17594	2290	2658	0
18	01-31-76	6	13411	19607	10-03-84	34329	43357	20918	23750	3
19	10-02-73	4	11200	14884	01-01-82	29951	37516	18751	22632	0
19	02-11-82	4	29488	33283	06-16-85	38302	41701	8814	8418	1
20	10-02-73	4	11200	14884	09-27-78	22678	29128	11478	14244	3
21	10-02-73	4	11200	14884	03-29-75	14653	19211	3453	4327	0
21	08-02-75	4	15425	20178	10-12-78	22772	29241	7347	9063	0
21	08-10-79	4	24739	31517	01-01-82	29951	37516	5212	5999	0
21	02-23-82	4	12	4	12-04-85	9699	8868	9687	8864	1
22	10-02-73	4	11200	14884	10-12-78	22772	29241	11572	14357	0
22	08-10-79	4	24739	31517	8-10-79	24739	31517	0	0	1
23	8-18-73	1	9207	24932	4-20-78	17722	48181	8515	23249	1
24	8-18-73	1	9207	24932	7-11-74	10974	29694	1767	4762	0
24	2-25-75	1	12071	32691	3-13-80	21114	57325	9043	24634	3
25	8-18-73	1	9207	24932	8-18-75	12964	35165	3757	10233	3
26	8-18-73	1	9207	24932	2-25-75	12071	32691	2864	7759	0
26	5-16-75	1	8287	14823	11-11-76	10395	20494	2108	5671	3
27	4-23-74	5	12329	20204	5-30-77	20488	32576	8159	12372	0
27	12-13-77	5	21916	34744	------	51353	70771	29437	36027	2
28	2-28-74	5	13747	22449	2-24-75	16387	26396	2640	3947	0
28	6-17-75	5	17201	27670	------	52427	73341	35226	45671	2
29	4-23-74	5	12329	20204	05-20-83	35762	53974	23433	33770	3
30	2-28-74	5	13747	22449	------	52427	73341	38680	50892	2
31	2-28-74	5	13747	22449	8-11-79	27973	43614	14226	21165	0
31	04-14-82	5	34475	52801	--------	52427	73341	17952	20540	2
32	4-23-74	5	12329	20204	1-28-75	14411	23348	2082	3144	0
32	6-3-75	5	15259	24624	10-08-86	44521	64057	29262	39433	3
33	2-28-74	5	13747	22449	02-21-82	34111	52266	20364	29817	3
34	4-23-74	5	12329	20204	------	51353	70771	39024	50567	2
35	6-27-74	5	5681	3056	4-18-75	7673	5964	1992	2908	0
35	8-15-75	5	8542	7300	------	43745	52706	35203	45406	2
36	6-27-74	5	5681	3056	4-16-75	7663	5945	1982	2889	0
36	8-15-75	5	8542	7300	--------	43745	52706	35203	45406	2
37	6-27-74	5	5681	3056	------	43745	52706	38064	49650	2
38	10-25-74	1	11340	30745	05-09-82	24088	65685	12748	34940	3
39				DOES NOT EXIST						5
40				DOES NOT EXIST						5
41				CERTIFICATION STATIC TEST UNIT				00	00	4
42	7-26-73	7	5003	8092	9-30-75	9600	16525	4597	8433	0
42	9-30-75	3	9600	16525	05-07-89	47010	54126	37410	37601	3
43	7-25-73	7	4993	8068	9-30-75	9600	16525	4607	8457	0
43	9-30-75	3	9600	16525	6-26-80	23912	31825	14312	15300	0
43	05-10-82	2	28784	39210	04-04-85	34407	46881	5623	7671	0

43	05-25-85	2	34687	47278	01-04-86	40378	55018	5691	7740	0
43	07-23-86	2	26100	35200	01-12-89	30542	39254	4442	4054	3
44	7-26-73	7	5003	8092	9-30-75	9600	16525	4597	8433	0
44	9-30-75	3	9600	16525	12-29-76	13201	20370	3601	3845	0
44	8-3-77	3	15025	22485	06-25-84	35164	43974	20139	21489	3
45	7-25-73	7	4993	8068	7-14-74	6895	11280	1902	3212	0
45	1-15-76	3	10064	16998	4-24-78	17369	24969	7305	7971	0
45	4-9-79	2	22504	30331	3-19-81	26488	35711	3984	5380	1
46	8-8-73	1	6447	9087	1-11-78	13058	26664	6611	17577	0
46	1-11-78	1	20014	30447	5-16-79	22540	37358	2526	6911	0
46	10-15-80	1	22118	59759	2-26-81	22613	61420	495	1661	0
46	2-26-81	1	6391	17574	03-21-82	8167	22328	1776	4754	1
47	8-8-73	1	6447	9087	1-7-76	10256	19089	3809	10002	0
47	8-16-76	3	14728	16350	1-9-78	19153	21328	4425	4978	0
47	4-24-78	3	17409	25010	4-20-81	26282	34352	8873	9342	0
47	04-08-83	2	30525	41316	06-01-86	39000	48835	8475	7519	0
47	07-24-86	2	0	0	12-18-87	3200	3940	3200	3940	0
47	12-23-87	2	2643	3382	--------	7812	10241	5169	6859	2
48	8-8-73	1	6447	9087	2-25-75	9103	16022	2656	6935	0
48	5-16-75	1	8287	14823	8-17-77	11473	23389	3186	8566	0
48	8-17-77	1	15912	36880	10-26-81	23575	50737	7663	13857	1
49	8-8-73	1	6447	9087	4-13-77	12050	23911	5603	14824	0
49	1-11-78	1	20014	30447	4-2-80	23688	40420	3674	9973	0
49	4-8-80	1	19905	53977	3-10-81	21413	58105	1508	4128	3
50	7-23-73	2	10539	14075	1-28-76	15771	21303	5232	7228	0
50	09-29-78	2	21534	29018	06-01-82	28962	39171	7428	10153	1
51	07-23-73	2	10539	14075	10-18-77	19444	26204	8905	12129	0
51	4-3-78	2	20435	27564	04-18-82	28671	38763	8236	11199	3
52	7-23-73	2	10539	14075	2-27-75	14057	18964	3518	4889	0
52	6-8-75	2	14707	19835	11-16-78	21757	29355	7050	9520	0
52	2-28-80	2	24447	32979	06-20-86	30000	40000	5553	7021	0
52	07-24-86	2	0	0	12-21-87	3345	4326	3345	4326	0
52	04-27-88	2	2060	2371	--------	17044	20494	14984	18123	2
53	7-23-73	2	10539	14075	9-24-74	13138	17747	2599	3672	3
54	9-6-73	4	11152	15328	9-6-76	17899	23824	6747	8496	3
55	9-6-73	4	11152	15328	08-28-81	29501	37306	18349	21978	0
55	11-22-81	4	311	333	XX-XX-87	13000	15000	12689	14667	1
56	9-6-73	4	11152	15328	08-28-81	29501	37306	18349	21978	0
56	10-05-81	4	12	3	XX-XX-87	13000	15000	12988	14997	1
57	9-6-73	4	11152	15328	9-7-75	15633	20997	4481	5669	3
58	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
58	5-17-74	6	9402	15241	04-01-89	37048	46193	27646	30952	3
59	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
59	5-17-74	6	9402	15241	1-14-75	10900	17164	1498	1923	0
59	1-31-76	6	13181	19621	9-1-80	24475	31957	11294	12336	3
60	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
60	5-17-74	6	9402	15241	9-2-76	14715	21102	5313	5861	0
60	11-17-77	6	17529	24227	12-31-88	37048	46193	19519	21966	3
61	8-6-73	7	8476	13644	5-17-74	9402	15241	926	1597	0
61	5-17-74	6	9402	15241	12-31-88	43915	53303	34513	38062	3

62	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
62	02-23-82	4	12	3	12-12-86	12273	11155	12261	11152	1
63	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
63	02-23-82	4	12	3	04-28-87	13000	12000	12988	11997	1
64	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
64	02-05-82	4	29488	33283	04-09-82	29908	33654	420	371	0
64	04-20-82	4	1271	1408	05-26-83	3820	4355	2549	2947	3
65	10-23-73	4	11450	15759	10-27-81	30083	38179	18633	22420	0
65	02-23-82	4	12	3	12-12-86	12273	11155	12261	11152	1
66	9-29-73	2	10787	14648	2-27-75	14184	19120	3397	4472	0
66	6-7-75	2	14602	19678	10-28-77	19605	26654	5003	6976	0
66	4-6-78	2	20556	27959	5-2-79	22584	30603	2028	2644	0
66	11-14-80	2	25702	34889	05-10-82	28784	39210	3082	4321	0
66	06-08-82	2	28959	39446	08-01-83	30925	42208	1966	2762	0
66	11-30-84	2	29041	40481	03-20-86	32000	43000	2959	2519	0
66	08-18-86	2	0	0	12-21-87	3183	4103	3183	4103	0
66	12-23-87	2	2643	3382	--------	7812	10241	5169	6859	2
67	9-29-73	2	10787	14648	9-15-78	21231	28840	10444	14192	3
68	9-29-73	2	10787	14648	6-16-80	25009	33910	14222	19262	0
68	08-04-82	2	29217	39803	07-10-84	32904	44872	3687	5069	0
68	01-12-85	2	33991	46309	04-04-86	35895	48931	1904	2622	0
68	08-29-86	2	5588	7383	--------	7949	10420	2361	3037	2
69	9-29-73	2	10787	14648	06-16-81	26913	36522	16126	21874	1
70	3-4-74	5	13908	22649	3-6-81	31634	49004	17726	26355	0
70	04-21-82	5	34592	53159	--------	52214	73285	17622	20126	2
71	3-4-74	5	13908	22649	3-6-78	24332	38438	10424	15789	3
72	3-4-74	5	13908	22649	3-11-79	26978	42326	13070	19677	0
72	6-28-79	5	27721	43379	11-05-86	45699	66408	17978	23029	3
73	8-15-74	5	15070	24630	----	52643	73947	37573	49317	2
74	3-4-74	5	13908	22649	4-27-76	19600	31548	5692	8899	0
74	8-16-76	3	14728	16350	1-9-78	19153	21328	4425	4978	0
74	4-11-79	2	22467	30441	5-2-79	22584	30603	117	162	0
74	2-23-81	2	26378	35804	02-04-86	36195	49342	9817	13538	0
74	06-23-86	2	5932	7757	--------	8018	10291	2086	2534	2
75	8-15-74	5	15070	24630	----	52643	73947	37573	49317	2
76	8-15-74	5	15070	24630	----	52643	73947	37573	49317	2
77	8-15-74	5	15070	24630	----	52643	73947	37573	49317	2
78	10-17-73	1	9343	25410	10-24-74	11340	30728	1997	5318	0
78	2-25-75	1	9103	16022	1-11-78	13058	26664	3955	10642	0
78	1-11-78	1	20014	30447	4-2-80	23688	40420	3674	9973	0
78	04-08-80	1	19905	53977	11-01-82	23349	63296	3444	9319	0
78	04-08-83	2	30525	41316	04-01-86	35667	48155	5142	6839	0
78	07-24-86	2	0	0	11-10-87	3500	3974	3500	3974	0
78	12-13-87	2	0	0	12-27-87	99	111	99	111	0
78	12-31-87	2	2690	3427	--------	7812	10241	5122	6814	2
79			DOES NOT EXIST							5
80			DOES NOT EXIST							5
81			CERTIFICATION STATIC TEST UNIT					00	00	4

82	9-12-73	4	11560	16962	07-20-81	29680	46880	18120	29918	3
83	9-12-73	4	11560	16962	5-17-75	15286	22013	3726	5051	0
83	9-12-76	4	16901	26080	07-20-81	29680	46880	12779	20800	0
83	09-02-81	4	17	6	01-28-87	12504	14588	12487	14582	1
84	9-12-73	4	11560	16962	5-17-75	15286	22013	3726	5051	0
84	12-19-75	4	16576	25672	07-20-81	29680	46880	13104	21208	0
84	08-24-81	4	11	3	04-26-83	3920	4447	3909	4444	1
85	9-12-73	4	11560	16962	9-4-75	15896	23901	4336	6939	0
85	2-12-76	4	16901	26080	07-20-81	29680	46880	12779	20800	0
85	09-02-81	4	17	6	02-02-82	1016	1117	999	1111	3
86	9-22-73	2	5587	8565	11-30-84	29041	40481	23454	31916	0
86	03-29-85	2	34269	46270	04-10-86	35667	48155	1398	1885	0
86	03-30-87	2	0	0	11-04-87	1500	1803	1500	1803	0
86	11-30-87	2	3240	3778	--------	17044	20494	13804	16716	2
87	9-22-73	2	5587	8565	6-11-75	9516	13797	3929	5232	0
87	12-19-75	2	10647	15393	6-16-80	20322	28691	9675	13298	3
88	9-22-73	2	5587	8565	6-11-75	9516	13797	3929	5232	0
88	12-19-75	2	10647	15393	11-22-76	12556	18020	1909	2627	0
88	9-9-77	2	14149	20361	9-24-80	20796	29307	6647	8946	1
89	9-22-73	2	5587	8565	6-21-74	7272	10794	1685	2229	0
89	2-13-75	2	8771	12820	11-22-76	12556	18020	3785	5200	0
89	9-9-77	2	14149	20361	2-12-78	15100	21677	951	1316	0
89	2-14-79	2	17400	24707	06-11-81	22003	30940	4603	6233	0
89	07-21-81	2	22218	31229	03-20-86	31263	43449	9045	12220	0
89	08-28-86	2	0	0	11-04-87	4000	3606	4000	3606	0
89	11-30-87	2	3240	3778	--------	17044	20494	13804	16716	2
90	8-15-73	1	5623	7992	5-2-74	6788	10937	1165	2945	0
90	10-24-74	1	11334	30728	4-4-79	19300	52783	7966	22055	1
91	8-15-73	1	5623	7992	5-16-75	8287	14823	2664	6831	0
91	8-18-75	1	12964	35165	12-18-75	13572	36811	608	1646	0
91	12-18-75	1	13572	36811	12-13-78	18925	51459	5353	14648	0
91	12-12-79	1	20693	56210	2-26-81	22613	61420	1920	5210	0
91	2-26-81	1	6391	17574	04-02-82	8185	22377	1794	4803	0
91	01-12-85	2	33991	46309	04-07-86	36584	49836	2593	3527	0
91	05-25-86	2	0	0	03-30-88	4240	5735	4240	5735	0
91	05-04-88	2	1716	2199	--------	7949	10420	6233	8221	2
92	8-15-73	1	5623	7992	8-18-77	11480	23406	5857	15414	0
92	8-18-77	1	15916	36893	10-26-81	23575	50737	7659	13844	0
92	05-06-83	2	30532	41749	01-12-85	33991	46309	3459	4560	0
92	04-01-85	2	34450	46920	04-20-86	35895	48931	1445	2011	0
92	06-06-86	2	0	0	11-04-87	4000	4355	4000	4355	0
92	12-27-87	2	3055	3516	--------	17044	20494	13989	16978	2
93	3-20-74	5	13879	22839	4-1-75	16461	26759	2582	3920	0
93	8-3-75	5	17333	28122	3-30-77	21797	34851	4464	6729	0
93	2-8-78	5	24051	38238	----	52398	73400	28347	35162	2
94	3-20-74	5	13879	22839	4-1-75	16461	26759	2582	3920	0
94	8-3-75	5	17333	28122	----	52398	73400	35065	45278	2
95	3-20-74	5	13879	22839	----	52398	73400	38519	50561	2
96	3-20-74	5	13879	22839	3-20-79	26988	42537	13109	19698	3
97	12-21-77	1	16360	38058	10-26-81	23575	50737	7215	12679	1
98	9-25-73	1	9244	25150	05-12-82	24093	65702	14849	40552	0

98	05-20-83	2	25906	36352	03-20-86	31263	43449	5357	7097	0
98	06-04-86	2	0	0	11-04-87	4500	4405	4500	4405	0
98	11-30-87	2	0	0	04-27-88	1179	1407	1179	1407	0
98	01-18-88	2	2900	3600	--------	7812	10241	4912	6641	2
99	3-21-74	5	10290	15517	----	51716	71681	41426	56164	2
100	4-11-74	5	12641	20584	----	48105	66305	35464	45721	2
101	3-21-74	5	10290	15517	----	51716	71681	41426	56164	2
102	3-21-74	5	10290	15517	06-08-83	33885	49939	23595	34422	3
103	4-11-74	5	12641	20584	4-17-80	28250	43515	15609	22931	1
104	9-25-73	1	9244	25150	10-25-74	11340	30745	2096	5595	3
105	9-25-73	1	9244	25150	10-17-73	9343	25410	99	260	0
105	6-7-74	1	6916	11247	5-16-75	8287	14823	1371	3576	1
106	8-15-73	1	5623	7992	8-17-77	11473	23389	5850	15397	0
106	8-17-77	1	15912	36880	10-26-81	23575	50737	7663	13857	1
107	9-25-73	1	9244	25150	8-17-77	16527	45144	7283	19994	3
108	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
108	5-17-74	6	9568	15160	11-17-76	15342	21726	5774	6566	0
108	11-21-77	6	17818	24525	10-04-84	34228	42895	16410	18370	3
109	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
109	5-17-74	6	9568	15160	7-29-75	12174	18313	2606	3153	3
110	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
110	5-17-74	6	9568	15160	----	44599	41681	35031	26521	2
111	9-1-73	7	8621	13711	5-17-74	9568	15160	947	1449	0
111	5-17-74	6	9568	15160	7-29-75	12174	18313	2606	3153	0
111	1-31-76	6	13369	19647	4-10-78	18669	25467	5300	5820	0
111	12-14-78	6	20304	27301	10-04-84	34228	42895	13924	15594	3
112	11-13-73	4	11587	16011	6-20-75	15179	20569	3592	4558	0
112	12-18-75	4	16309	21974	03-02-81	28405	36410	12096	14436	0
112	08-24-81	4	11	3	XX-XX-87	14000	15500	13989	15497	1
113	11-13-73	4	11587	16011	03-02-81	28405	36410	16818	20399	0
113	08-24-81	4	11	3	04-29-86	10941	12406	10930	12403	1
114	11-13-73	4	11587	16011	3-9-75	14601	19849	3014	3838	0
114	6-20-75	4	15179	20569	9-30-80	27495	35391	12316	14822	0
114	08-02-82	4	2189	2488	05-23-85	8654	10331	6465	7843	1
115	11-13-73	4	11587	16011	11-9-76	18322	24487	6735	8476	0
115	3-26-77	4	19208	25567	03-02-81	28405	36410	9197	10843	0
115	08-24-81	4	11	3	09-11-86	11716	13247	11705	13244	3
116	3-21-74	5	10290	15517	04-4-77	18529	28010	8239	12493	3
117	4-11-74	5	12641	20584	03-19-89	50635	70052	37994	49468	1
118	4-11-74	5	12641	20584	5-18-76	18147	29062	5506	8478	0
118	12-17-76	5	19709	31351	11-11-81	32570	49333	12861	17982	3

AIRLINE CODE: ALOHA=1, AIR NEW ZEALAND=2, FRONTIER=3, LUFTHANSA=4, PEIDMONT=5, VASP=6, PSA=7
REMARKS CODE: 0=OLD DATA,1=NO LONGER ACTIVE,2=CURRENTLY ACTIVE,3= OUT FOR REPAIR OR EVALUATION
4= CERTIFICATION STATIC TEST,5= DOES NOT EXIST,6= DEMO. UNIT AT NASA

TOTAL NET HOURS: ALOHA = 174791 TOTAL NET LANDINGS: ALOHA = 44994
TOTAL NET HOURS: AIR NZ = 431159 TOTAL NET LANDINGS: AIR NZ = 563384
TOTAL NET HOURS: FRONTIER = 100490 TOTAL NET LANDINGS: FRONTIER = 105504
TOTAL NET HOURS: LUFTHANSA = 524161 TOTAL NET LANDINGS: LUFTHANSA = 638863
TOTAL NET HOURS: PIEDMONT = 990585 TOTAL NET LANDINGS: PEIDMONT = 1323488
TOTAL NET HOURS: VASP = 342808 TOTAL NET LANDINGS: VASP = 372187
TOTAL NET HOURS: PSA = 29747 TOTAL NET LANDINGS: PSA = 51521

TOTAL NET HOURS: SPOILERS 1 THRU 38 = 832732 TOTAL NET LANDINGS: SPOILERS 1 THRU 38 = 1111895
TOTAL NET HOURS: SPOILERS 41 THRU 78 = 898523 TOTAL NET LANDINGS: SPOILERS 41 THRU 78 = 1178301
TOTAL NET HOURS: SPOILERS 81 THRU 118= 862486 TOTAL NET LANDINGS: SPOILERS 81 THRU 118 = 1209745

TOTAL NET HOURS = 2,593,741 TOTAL NET LANDINGS = 3,499,941

SPOILER FLIGHT HOURS AND LANDINGS

S/N	HOURS	LANDINGS
1	38064	49650
2	0	0
3	28523	32502
4	28457	32379
5	25919	30787
6	28457	32379
7	14854	23922
8	15274	20592
9	10941	14767
10	16397	22098
11	15937	19344
12	32076	37931
13	16343	19802
14	2055	2535
15	15544	18008
16	8496	10008
17	21394	24802
18	23956	27633
19	27565	31050
20	11478	14244
21	25699	28253
22	11572	14357
23	8515	23249
24	10810	29396
25	3757	10233
26	4972	13430
27	37596	48399
28	37866	49618
29	23433	33770
30	38680	50892
31	32178	41705
32	31344	42577
33	20364	29817
34	39024	50567
35	37195	48314
36	37185	48295
37	38064	49650
38	12748	34940
39	0	0
40	0	0
41	0	0
42	42007	46034
43	34675	43222
44	28337	33767
45	13191	16563
46	11408	30903
47	33951	42640
48	13505	29358
49	10785	28925
50	12660	17381
51	17141	23328
52	34450	43879

53	2599	3672
54	6747	8496
55	31038	36645
56	31337	36975
57	4481	5669
58	28572	32549
59	13718	15856
60	25758	29424
61	35439	39659
62	30894	33572
63	31621	34417
64	21602	25738
65	30894	33572
66	26787	34656
67	10444	14192
68	22174	29990
69	16126	21874
70	35348	46481
71	10424	15789
72	31048	42706
73	37573	49317
74	22137	30111
75	37573	49317
76	37573	49317
77	37573	49317
78	26933	52990
79	0	0
80	0	0
81	0	0
82	18120	29918
83	28992	40433
84	20739	30703
85	18114	28850
86	40156	52320
87	13604	18530
88	12485	16805
89	37873	47520
90	9131	25000
91	25405	50621
92	36409	57162
93	35393	45811
94	37647	49198
95	38519	50561
96	13109	19698
97	7215	12679
98	30797	60102
99	41426	56164
100	35464	45721
101	41426	56164
102	23595	34422
103	15609	22931
104	2096	5595
105	1470	3836
106	13513	29254
107	7283	19994
108	23131	26385
109	3553	4602
110	35978	27970
111	22777	26016
112	29677	34491
113	27748	32802
114	21795	26503
115	27637	32563
116	8239	12493
117	37994	49468
118	18367	26460

APPENDIX B

CURRENT ELEVATOR FLIGHT HOURS AND LANDING DATA AS OF 06/30/89

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
0		0	0	0		0	0	0	0	0
1	03-19-80	1	0	0	--------	34382	16550	34382	16550	2
2	03-19-80	1	0	0	--------	34382	16550	34382	16550	2
3	03-27-80	1	0	0	03-07-82	6201	3013	6201	3013	1
4	03-27-80	1	0	0	03-07-82	6201	3013	6201	3013	0
4	08-20-82	1	6678	3353	--------	33844	16436	27166	13083	2
5	04-25-80	1	0	0	--------	33844	16436	33844	16436	2
6	04-25-80	1	0	0	08-20-82	6678	3353	6678	3353	1
7	04-30-80	1	0	0	--------	34396	16454	34396	16454	2
8	04-30-80	1	0	0	--------	34396	16454	34396	16454	2
9	06-01-80	1	0	0	--------	33378	16108	33378	16108	2
10	06-01-80	1	0	0	--------	33378	16108	33378	16108	2

UNITED=1
REMARKS CODE:
0=OLD DATA, 1=IN STORES, 2=CURRENTLY ACTIVE, 3= OUT FOR REPAIR OR EVALUATION

TOTAL NET HOURS= 284402 TOTAL NET LANDINGS= 137122

ELEVATOR FLIGHT HOURS AND LANDINGS

S/N	HOURS	LANDINGS	AIRCRAFT
1	34382	16550	N7459U
2	34382	16550	N7459U
3	6201	3013	STORES
4	33367	16096	N7461U
5	33844	16436	N7461U
6	6678	3353	STORES
7	34396	16454	N7462U
8	34396	16454	N7462U
9	33378	16108	N7466U
10	33378	16108	N7466U

APPENDIX C

CURRENT STABILIZER FLIGHT HOURS AND LANDING DATA AS OF 06/30/89

S/N	DATE	AIRLINE	INSTALL OR REINSTALL HOURS	INSTALL OR REINSTALL LANDINGS	CURRENT OR REMOVE DATE	CURRENT OR REMOVE HOURS	CURRENT OR REMOVE LANDINGS	NET HOURS	NET LANDINGS	REMARKS
0		0	0	0		0	0	0	0	0
1	03-13-84	1	0	0	--------	14540	14483	14540	14483	2
2	03-13-84	1	0	0	--------	14540	14483	14540	14483	2
3	03-16-84	1	0	0	--------	14133	14141	14133	14141	2
4	03-16-84	1	0	0	--------	14133	14141	14133	14141	2
5	05-11-84	2	0	0	--------	14541	16490	14541	16490	2
6	05-11-84	2	0	0	--------	14541	16490	14541	16490	2
7	06-22-84	2	0	0	--------	13177	13137	13177	13137	2
8	06-22-84	2	0	0	--------	13177	13137	13177	13137	2
9	08-18-84	2	0	0	--------	13594	15124	13594	15124	2
10	08-18-84	2	0	0	--------	13594	15124	13594	15124	2

DELTA=1, MARKAIR=2, AMERICAN WEST=3
REMARKS CODE:
0=OLD DATA, 1=NO LONGER ACTIVE, 2=CURRENTLY ACTIVE, 3= OUT FOR REPAIR OR EVALUATION

TOTAL NET HOURS= 139970 TOTAL NET LANDINGS= 146750

STABILIZER FLIGHT HOURS AND LANDINGS

S/N	HOURS	LANDINGS	AIRCRAFT
1	14540	14483	N314DL
2	14540	14483	N314DL
3	14133	14141	N307DL
4	14133	14141	N307DL
5	14541	16490	N670MA
6	14541	16490	N670MA
7	13177	13137	N671MA
8	13177	13137	N671MA
9	13594	15124	N672MA
10	13594	15124	N672MA

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15. Supplementary Notes

Use of commercial products or names of manufacturers in this report does not constitute official endorsement of such products or manufacturers, either expressed or implied, by the National Aeronautics and Space Administration.

Langley Technical Representative: H. Benson Dexter - Tenth Report

16. Abstract

This tenth and final flight service report was prepared in compliance with the requirements of Contract NAS1-11668. It covers the flight service experience of 111 graphite/epoxy spoilers on 737 transport aircraft after 15 years of worldwide service. As of June 30, 1989, a total of 2,593,741 spoiler flight hours and 3,499,941 spoiler landings have been accumulated by the fleet. The high time spoiler had 42,007 flight hours. Results of 15 years of residual strength tests conducted on selected spoilers are reported. This report also summarizes the flight service history of composite elevators and stabilizers developed under NASA contracts NAS1-14952 and NAS1-15025, respectively.

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