WINDSHIELD PROBLEMS ON UK OPERATED TRANSPORT SIZED JET AIRCRAFT 1976 to 1982

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Abstract

The paper reviews windshield problems reported between 1976 and 1982 on UK operated transport sized jet aircraft. The paper shows that external causes such as hail (four cases) and birds or lightning (one case each) are outweighed by problems with the windshield itself (157 cases).

The total flying hours are 4.9 million, giving an average failure rate of one in 30,000 hours. There have been no cases of sudden loss of cabin pressure due to failure of both panes. For individual aircraft types the aircraft with the highest windshield failure rates are the Boeing 747 closely followed by Concorde and BAC1-11. By contrast there has not been a single reported problem on any of the McDonnell Douglas DC8, DC9 and DC10 aircraft or on the A300B Airbus. This is in spite of considerable flying hours on the DC10. On some aircraft types there are almost as many problems with the DV windows as with the windshield. Where the information is available it appears that on the majority of aircraft the problems are with the outer pane, however, the Boeing 707 has an above average proportion of inner pane problems. The type of failure has been divided into shattered cracked/crazed, delaminated or arcing. The Boeing 747 is most prone to shattering and delamination while the BAC1-11 and Boeing 707 are more prone to cracking/crazing. There are indications that windshield heat controllers may be a troublesome area on the Boeing 747 and Lockheed 1011.

1. Introduction

At the beginning of 1976 the UK introduced the mandatory reporting of occurrences hazarding the safety of an aircraft. Data from 1976 - 1982 has been examined in relation to windshield problems on UK operated transport sized jet aircraft. Turboprop - which are generally of older design and with lower cabin differential pressures, have been excluded, as have jet aircraft now out of service such as the Comet and the VC10.

2. Discussion of Data

(a) Problem Cause

From Table 1 it can be seen that problems within the windshield far outweigh any external causes. Hail damage accounts for any four reports, with bird and lightning damage and volcanic ash erosion accounting for one occurrence each. These outside causes have been excluded from the remainder of the Tables which concentrate on the windshield. There have been no cases at all of loss of cabin pressure or failure of both inner and outer panes. There has been one case of the whole windscreen departing from the aircraft.

(b) Aircraft Rates (Table 2)

It is surprising that there have been no reports of any windshield problems on McDonnell Douglas DC8, DC9 and DC10 aircraft, or on the A300B Airbus. This in in spite of considerable flying hours on the DC10. Of the other aircraft types the highest failure rate is on the Boeing 747 closely followed by the Concorde and BAC1-11. It could be argued that flights (i.e. cycles) should be the main criterion, however, for convenience flying hours have been used.

The data indicates that the windshield failure rate is around 30 per million flying hours. It is interesting that hail damage is about

3. Conclusions

3.1. Windshield problems are rarely a result of outside causes such as hail or birds.

3.2. From UK airline experience a windshield failure rate of about one in every 30,000 hours can be expected.

3.3. There have been no cases of windshield failure resulting in sudden de-compression.

3.4. There have been no reports at all of windshield problems on McDonnell Douglas and A300B aircraft.

3.5. The highest rate of windshield failure is on the Boeing 747, Concorde and BAC1-11 aircraft.

3.6. On most aircraft the outer pane is more likely to fail but the Boeing 707 has a higher proportion of inner pane failures.

3.7. Shattering and delamination are more prevalent on Boeing 747 aircraft while cracking/crazing are more prevalent on the BAC1-11 and Boeing 707.

3.8. There are indications that windshield heat controllers may be a troublesome area on the Boeing 747 and Lockheed 1011.

Table 1 - Problem Causes

Problem Cause	Number of cases
Windshield & Windshield Heat Problems	157
Hail Damage*	4
Bird Damage*	1
Volcanic Ash Damage*	1
Lightning Damage*	1
Crew Procedures	1

* Excluded from the remainder of the paper

Table 2 - Aircraft Rates

Aircraft Type	Transparency Manufacturer	Number of Occurrences	Flight Hours	Rate per 100,000 hours
A300B Airbus	Triplex	0	7,484	0
BAC 1-11	Nesa, Pittsburg Glass, Triplex	56	1,052,933	5.3
Boeing 707/720	NESA	29	746,172	3.8
" 727	PPG (Nesa)	5	156,746	3.2
" 737	Nesa	5	888,525	0.6
" 747	Sierracin, Triplex	42	755,580	5.5
Concorde	Triplex	2	36,909	5.4
HSA Trident	Triplex	10	641,959	1.5
Lockheed L1011	Sierracin	8	239,453	3.3
McDonnell Douglas DC8		0	47,260	0
" " DC9		0	33,774	0
" " DC10	Douglas (Pittsburg)	0	295,155	0
TOTAL	-	157	4,901,950	3.2

Table 3 - Problem Area

Aircraft Type	Part of Windshield		Windshield Layer		
	Windshield	DV Window	Outer	Inner	Unknown
BAC 1-11	54	2	18	2	36
B707/720	25	4	7	7	15
B727	3	2	2	-	3
B737	3	2	3	-	2
B747	42	-	29	1	12
Concorde	2	-	1	-	1
L1011	8	-	5	-	3
Trident	7	3	2	-	8
TOTAL	144	13	67	10	80

Table 4 - Type of Failure

Aircraft	Type of Failure				Windshield Heat Controller		
	Shattered	Cracked/ Crazed	Delam- inated	Arcing	Failed	Wiring	Switch Failure
BAC 1-11	3	44	2	8	-	2	-
B707	5	21	-	5	4	2	-
B727	1	3	-	2	2	1	-
B737	-	5	-	1	2	2	-
B747	12	10	20	6	15	-	1
Concorde	-	2	-	-	-	-	-
L1011	2	2	3	1	3	-	-
Trident	4	3	2	2	1	1	-
TOTAL	27	90	27	25	27	8	1

Table 5 - Phase of Flight

Aircraft	Ground	Climb	Cruise	Descent	Approach	Unknown
BAC 1-11	2	8	43	2	-	1
B707/720	-	2	20	2	1	4
B727	-	-	2	2	1	1
B737	-	-	4	-	-	-
B747	-	4	33	3	-	2
Concorde	1	1	-	-	-	-
L1011	2	-	5	-	1	-
Trident	1	3	4	1	1	-
TOTAL	6	18	111	10	4	8

References

1. CAA Paper 77008 Analysis of Bird Strikes Reported by European Airlines 1972-1975.