RECORD NO.: 8405

BASIC INFORMATION

Date of Occurrence:	84/09/24	File Number	:
Location --- City :	MCCORMICK	Flight Purpose	: BUSINESS
State:	SC	Flight Plan	: NONE
Time of Accident :	1700	Weather Briefing:	
Accident During :	IN FLIGHT	CASUALTIES	
Type of Accident :	AIRFRAME FAILURE	Total Aboard:	1
Aircraft Make/Modl:	BEECH V35B	Fatalities :	1
Structural Failure:	WING, STABILIZER	Injuries :	0

ENVIRONMENTAL INFORMATION

Basic Weather (Sky Cond) :	SCATTERED	Precip Type:	
Flight Rules :	VFR	T-Storm :	
Visibility :	15 MILES	Icing :	
Wind Direction/Vel :	4 KNTS @ 40 DEG.	Turbulence :	
Weather Forcasted :		Other :	CEILING 5,000 FT.

PILOT INFORMATION

Age :	Medical Cert :	Totl Flight Hrs:
Certif:	Flight Review:	In Type Hours :
Rating:		

SUPPORTING INFORMATION

PROBABLE CAUSE(S):

CONTRIBUTING FACTORS:

NARRATIVE/REMARKS: ON SEPTEMBER 24, 1984, AT APPROXIMATELY 1700 E.D.T., A BEECH V35B, N6740Z, REGISTERED TO AIR TRAVEL SERVICES, SEPARATED IN FLIGHT WHILE ENROUTE TO ATLANTA, GA, OVER McCORMICK, SC. THE AIRCRAFT WAS BEING OPERATED UNDER VISUAL FLIGHT RULES WITH NO FLIGHT PLAN ON FILE. VISUAL METEOROLOGICAL CONDITIONS PREVAILED AT THE TIME OF THE MISHAP. THE AIRCRAFT WAS DESTROYED, AND THE PILOT AND ONLY OCCUPNAT ON BOARD THE FLIGHT WAS KILLED. THE FLIGHT DEPARTED FLORENCE, SC, AT ABOUT 1600 HOURS ON AUGUST 24, 1984. ACCORDING TO THE ONLY WITNESS, LOCATED ON THE #8 FAIRWAY AT THE COUNTRY CLUB GOLF COURSE, HE RECALLED HEARING A MUFFLED BOOM FOLLOWED BY A SHRILL SOUND OF A MOTOR RUNNING AT A HIGH SPEED. AS HE TURNED TO LOOK, HE OBSERVED WHAT APPEARED TO BE A FLOCK OF LARGE BIRDS, BUT A LARGE PIECE OF SOMETHING ABOUT 12 FEET LONG WAS FALLING FROM THE SKY. BY THIS TIME, THE WITNESS REALIZED THAT HIS ORIGINAL SIGHTING WAS AN AIRCRAFT. HE THEN PROCEEDED TOWARDS THE MISHAP AND SAW PAPER AND OTHER DEBRIS FLOATING DOWN. THE WRECKAGE WAS LOCATED IN A WOODED AREA ABOUT THREE MILES WEST OF McCORMICK. THE WRECKAGE WAS SCATTERED OVER AN AREA ABOUT 200 YARDS SQUARE. THE MAJOR STRUCTURAL COMPONENTS WERE LOCATED FOR EXAMINATION. ALL FLIGHT CONTROLS SEPARATED FROM THE NORMALLY INSTALLED POSITION EXCEPT THE RIGHT AILERON. ONLY PIECES OF THE REMAINING SURFACES WERE LOCATED. HOWEVER, THE TIP COVERS FOR BOTH RUDDERVATORS WERE FOUND IN CLOSE PROXIMITY TO EACH OTHER. BOTH THE FORWARD AND AFT WING SPARS WERE BROKEN AT THE CARRY THROUGH SPARS. BOTH STABILIZERS HAD ALSO SEPARATED FROM AIRCRAFT.

SOURCE(S): NTSB

FIGURE 6-1. TYPICAL ACCIDENT SUMMARY FORM

TABLE 6-6. MODEL "35" FATAL IN-FLIGHT AIRFRAME FAILURE SUMMARY (1947-84)

YEAR	35	A35	B35	C35	D35	E35	F35	G35	H35	J35	K35	M35	N35	P35	S35	V35	V35A	V35B	TOTAL
1947	4																		4
1948	5																		5
1949	4	1																	5
1950	8	1	2																11
1951	6	0	0	0															6
1952	3	1	0	0	0														4
1953	4	2	1	2	1	0													10
1954	2	0	0	1	0	0	0												3
1955	3	1	0	1	0	0	2	0											7
1956	1	1	1	3	1	0	0	0	0										7
1957	4	1	1	0	0	1	0	0	0	0									7
1958	1	0	0	0	2	0	0	0	0	0	0								3
1959	1	1	0	1	2	0	0	0	0	1	0	0							6
1960	0	2	0	0	2	0	0	0	0	3	0	1							8
1961	2	0	0	0	0	2	0	0	0	0	0	0	1						5
1962	4	1	0	1	0	1	0	1	2	0	0	0	0	0					10
1963	1	0	0	0	0	0	0	0	1	0	0	0	1	1					4
1964	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0				2
1965	3	2	1	1	1	0	0	0	0	0	1	1	0	0	1				11
1966	1	1	0	1	0	0	1	2	1	0	0	0	0	0	2	1			10
1967	2	2	1	0	0	1	1	0	1	0	0	0	0	0	0	0			8
1968	0	1	0	1	0	0	0	2	0	0	0	0	0	0	0	2	1		7
1969	0	0	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0		4
1970	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3
1971	0	0	0	3	0	0	0	0	0	1	0	0	0	1	1	0	0	0	6
1972	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
1973	2	0	0	1	0	3	0	1	0	0	0	0	0	1	0	1	1	0	10
1974	5	0	0	0	0	0	0	0	0	0	0	2	1	2	1	0	1	1	13
1975	2	1	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	1	11
1976	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	3
1977	1	0	0	1	1	0	0	0	0	0	0	2	0	1	1	0	1	1	9
1978	2	0	0	0	0	1	1	1	0	0	0	0	1	0	2	0	0	0	8
1979	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	3
1980	2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	5
1981	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	4
1982	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2
1983	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2
1984	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	5
TOTAL	75	19	9	20	12	10	7	10	5	7	3	10	5	12	11	6	5	8	234

Beginning in 1947, Beech initiated production of the V-tail, and to date has manufactured 10,405 Model 35's. There have been eighteen different sub-models of the V-tail and Table 6-8 provides an inventory of production of each from 1947 through 1982. The data contained in the table includes all V-tails produced including those sold to owners in foreign countries. Since the accident data available was primarily limited to domestic accidents and incidents, information relative to V-tail registration in the United States was used for determination of accident rates. Table 6-9 displays the active number of V-tails registered in the United States for each year from 1947 through 1984. Where data was incomplete, registration numbers were estimated based on extrapolation or interpolation. It is noted that 636 of the original 1500 Model 35's produced in 1947 and 1948 are still registered in the United States today and that 7207 of the total 10,405 V-tails produced to date are still registered in the United States.

The total number of FIFAF accidents for the V-tail Bonanza are shown on a bar chart in Figure 6-2 broken down by year. The early seventies stand out as the period with the largest number of FIFAF accidents. When the accident rate is computed by dividing the number of FIFAF accidents by the number of active airplanes, the earlier years stand out and there is a general trend towards a reduced rate in more recent years (Figure 6-3). The early seventies still represent an exception to the recent trend toward declining accident rates.

Because accident rates are more commonly presented in terms of flight hours rather than number of active airplanes, rates calculated both ways are presented for comparison in Figure 6-4. Even though rates are not exactly proportional from year to year, the same conclusions could generally be drawn using either approach.

TABLE 6-7. V-TAIL FLIGHT HOUR SUMMARY

YEAR	ACTIVE AIRCRAFT	NUMBER OF FLIGHT HOURS		FIFAF ACCIDENTS
		AVERAGE	TOTAL X 10^6	
1977	6801	149	1.01	9
1978	7067	139	0.98	8
1979	7158	149	1.07	3
1980	7032	164	1.15	5
1981	6980	117	0.82	4
1982	6820	106	0.72	2
1983	6849	106	0.73	2

TABLE 6-8. MODEL "35" INVENTORY OF PRODUCTION (1947-82)

YEAR	35	A35	B35	C35	D35	E35	F35	G35	H35	J35	K35	M35	N35	P35	S35	V35	V35A	V35B	TOTAL
1947	1209																		1209
1948	291																		291
1949		701																	701
1950			480																480
1951				410															410
1952				309															309
1953					298														298
1954						301													301
1955							392												392
1956								476											476
1957									464										464
1958										396									396
1959											436								436
1960												400							400
1961													280						280
1962														225					225
1963														242					242
1964															331				331
1965															328				328
1966															9	325			334
1967																297			297
1968																	273		273
1969																	197		197
1970																		141	141
1971																		77	77
1972																		104	104
1973																		147	147
1974																		149	149
1975																		129	129
1976																		132	132
1977																		121	121
1978																		110	110
1979																		124	124
1980																		51	51
1981																		29	29
1982																		21	21
TOTAL	1500	701	480	719	298	301	392	476	464	396	436	400	280	467	668	622	470	1335	10405

TABLE 6-9. MODEL "35" INVENTORY OF ACTIVE USA REGISTRATION

YEAR	35	A35	B35	C35	D35	E35	F35	G35	H35	J35	K35	M35	N35	P35	S35	V35	V35A	V35B	TOTAL
1947	464																		464
1948	1280																		1280
1949	1267	556																	1823
1950	979	520	359																1858
1951	997	479	348	268															2092
1952	912	455	375	564															2306
1953	940	472	384	580	269														2645
1954	978	494	394	595	266	288													3015
1955	937	462	378	573	259	271	370	13											3263
1956	899	449	377	566	254	263	335	452	29										3624
1957	878	437	374	557	244	263	337	400	437	111									4038
1958	832	443	374	541	240	250	324	392	373	377	56								4202
1959	781	395	335	510	235	242	310	365	369	374	395								4311
1960	820	430	365	560	255	265	345	420	415	369	390	376							5010
1961	790	415	355	549	248	259	325	397	390	365	385	372	265						5115
1962	786	412	349	542	244	253	321	390	383	360	382	368	255	222					5267
1963	735	371	325	501	241	229	301	375	365	335	353	336	235	410					5112
1964	733	368	360	495	239	225	297	374	364	334	350	335	234	440	220				5368
1965	705	359	348	472	228	216	286	362	346	325	337	321	221	412	600				5538
1966	705	359	346	470	226	216	286	362	346	325	337	321	221	420	610	210			5760
1967	700	350	344	468	225	215	280	358	340	320	335	318	219	415	590	580			6057
1968	690	335	340	460	224	212	275	345	335	315	330	313	214	400	565	545	139		6037
1969	660	310	321	455	222	211	272	342	330	310	325	308	210	378	539	524	330		6047
1970	650	325	325	465	225	215	275	345	335	315	330	313	214	400	545	530	426	100	6333
1971	680	335	340	465	225	215	275	345	335	316	330	315	215	405	560	540	426	172	6494
1972	665	333	338	464	224	214	274	344	334	315	328	314	213	403	559	539	420	254	6535
1973	671	324	325	475	220	218	285	353	342	319	339	320	215	404	566	543	415	370	6704
1974	663	323	320	475	218	222	289	357	345	316	341	322	217	401	560	537	412	485	6801
1975	650	323	310	474	217	215	287	356	344	312	333	314	207	387	549	525	402	583	6788
1976	642	323	305	474	217	214	286	355	343	312	330	311	202	384	543	519	398	681	6839
1977	619	322	285	473	216	212	275	354	341	310	319	309	197	380	537	508	374	770	6801
1978	632	327	300	478	221	216	294	358	345	318	339	316	217	387	546	517	395	862	7067
1979	634	331	300	481	224	219	298	361	344	320	341	318	215	388	540	515	392	938	7158
1980	616	321	290	472	215	213	292	351	342	312	333	310	207	380	524	499	388	968	7032
1981	607	320	285	471	214	211	284	342	341	305	328	307	202	373	524	493	380	993	6980
1982	600	299	272	455	204	202	282	333	335	296	322	302	189	362	518	479	369	1001	6820
1983	592	301	274	456	205	206	282	339	333	297	318	297	191	363	521	487	366	1021	6849
1984	636	325	289	482	221	217	297	358	349	311	333	311	203	380	542	507	378	1068	7207

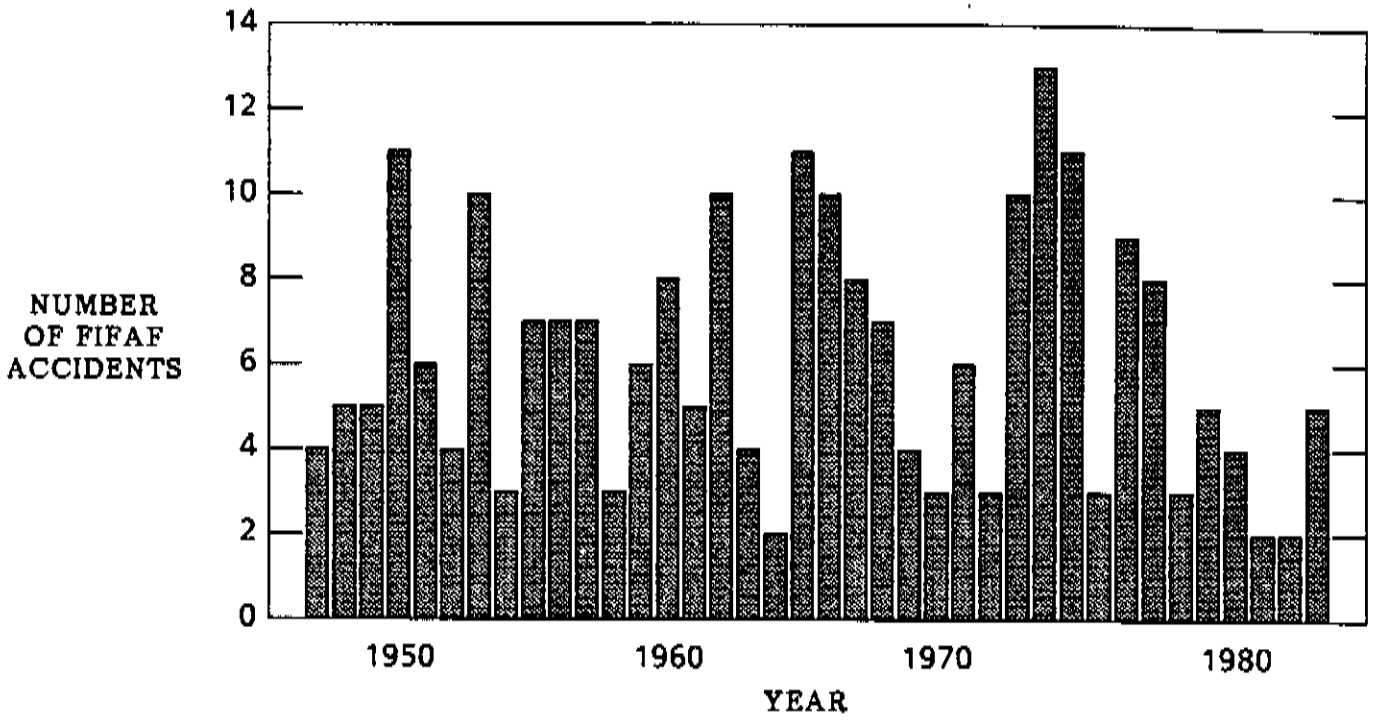

FIGURE 6-2. ANNUAL FIFAF ACCIDENTS FOR ALL V-TAILS

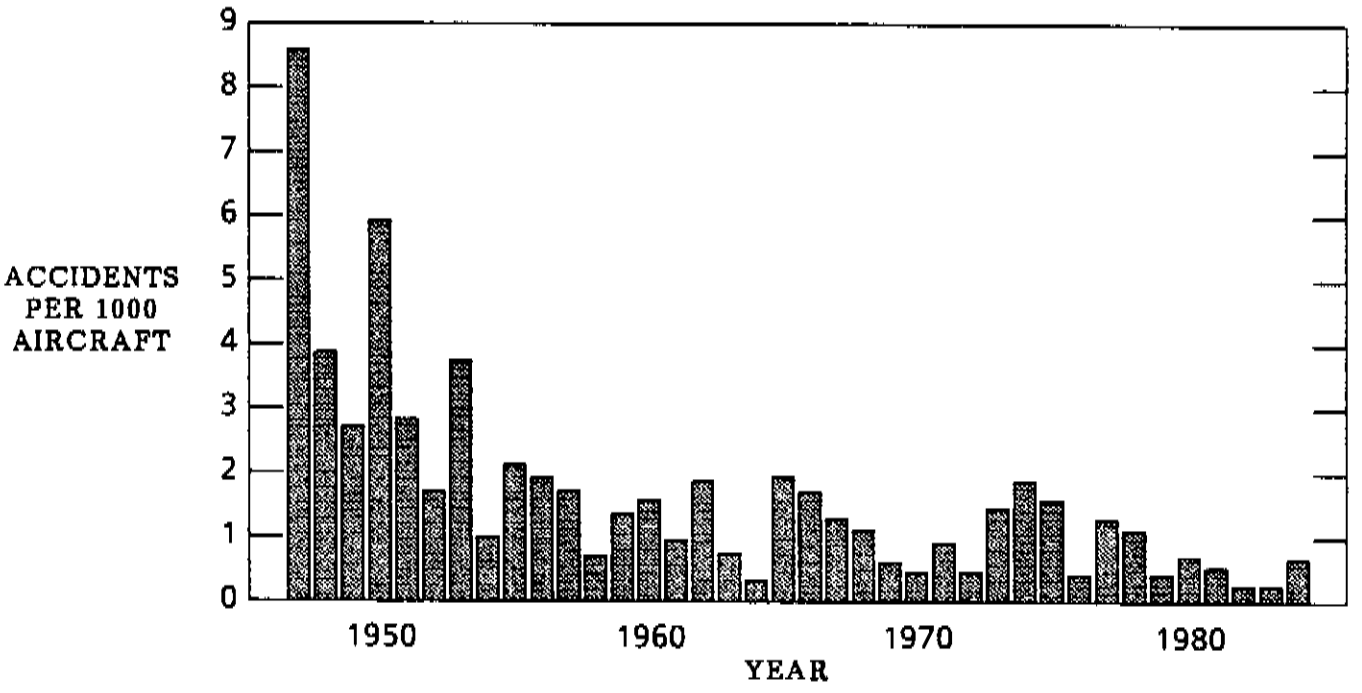

FIGURE 6-3. ANNUAL FIFAF ACCIDENT RATE FOR ALL V-TAILS

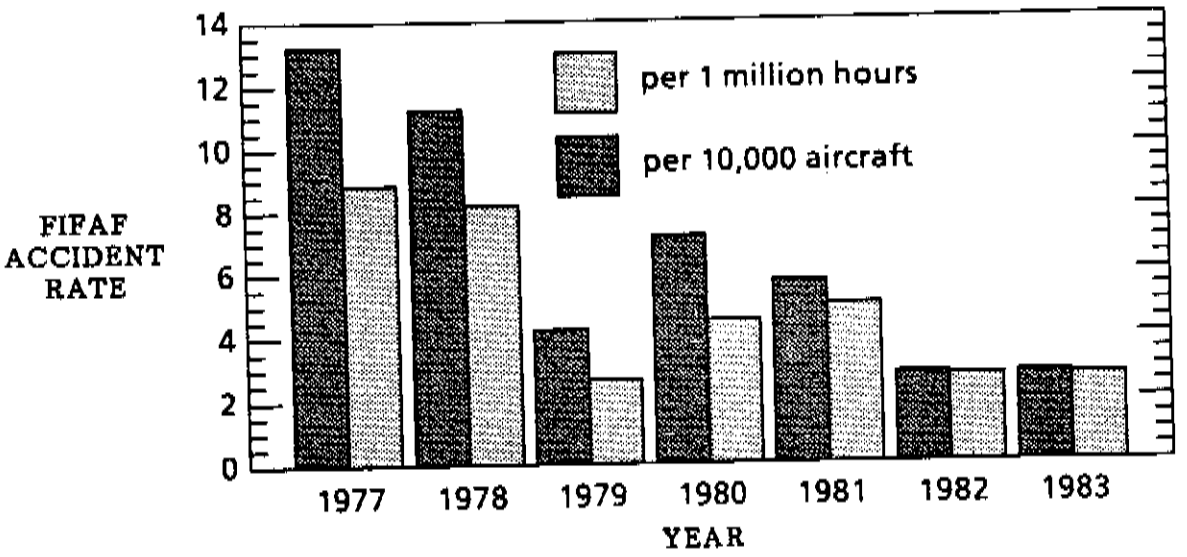

FIGURE 6-4. FIFAF ACCIDENT RATE: ACTIVE REGISTRATION vs FLIGHT HOURS

The yearly accident rate per 1000 active airplanes is sufficiently random that, a different approach was sought for comparing sub-models of the V-tail Bonanza. The cumulative accident rate after n years, CAR_n was computed from the following expression:

$$CAR_n = \frac{\sum_{i=m}^{m+n} A_i}{\sum_{i=m}^{m+n} R_i} \qquad (6\text{-}1)$$

where A_i is the number of accidents in the ith year, R_i is the number of active registered airplanes in the ith year, and "m" is the starting year. This cumulative accident rate for the V-tail Bonanza is plotted as a function of year starting with 1947 in Figure 6-5a.

A slightly different parameter, the percentage of airplanes involved in FIFAF accidents to date, PF_n is computed from the following expression:

$$PF_n = \frac{\sum_{i=m}^{m+n} A_i}{MR_{m+n}} \qquad (6\text{-}2)$$

where the numerator is identical to that in Equation 6-1 and MR_{m+n} is the maximum number of registered airplanes to date. This parameter PF_n, is plotted in Figure 6-5b for the V-tail Bonanza.

Figures 6-2 through 6-5 illustrate different ways of computing and presenting accident statistics. For comparison of V-tail sub-models and for comparing the Model 35 with Models 33 and 36, the parameter PF_n, the percentage of active airplanes involved in FIFAF accidents, will be used extensively but not exclusively. This parameter has the advantage of tending to increase which facilitates comparison of the accident rates for different models. It also has the advantage that the percentage of airplanes that have experienced FIFAF accidents is not in any sense an abstract quantity.

Comparison of the various sub-models in terms of FIFAF accident rate is shown in Figure 6-6 where the parameter PF_n is shown on a bar chart for the fifteenth year of each model. In order to more clearly see the trends in accident rates, the models are grouped according to structural similarity as discussed in Section 2 (see Table 2-3). The number of groups summarized in Table 6-10 is reduced from eight to six by combining groups with relatively minor structural differences.

The history of the accident records for the structural groupings is presented in Figure 6-7. The original 35 stands out as expected with 6.3 percent of the 1280 originally registered having been involved in FIFAF accidents. Because the exposure for the structural groups ranges from 15 to 38 years, the records at the end of 28 years provide the most meaningful comparison of five of the six groups. The most recent group which includes Models S35 through V35B has only 21 years of history and therefore is excluded from the 28 year comparison. This comparison is presented on a bar chart in Figure 6-8. This plot emphasizes the higher rate of failure for the original 35. It shows a marked improvement for the next structural grouping, sub-models A35 and B35. This could have been expected by the upgrading of the certification from Normal Category to Utility Category. The next group begins with sub-model C35 and has the highest FIFAF accident rate of all groups except for the original 35. This group is characterized by the increased tail chord and the replacement of ribs with corrugated skin. The FIFAF accident rates for the remaining groups continue to improve with the improvements in the structural characteristics. It is acknowledged that the experience level of pilots, V-tail accident publicity, improved training techniques and weather education could also contribute to improved accident rates.

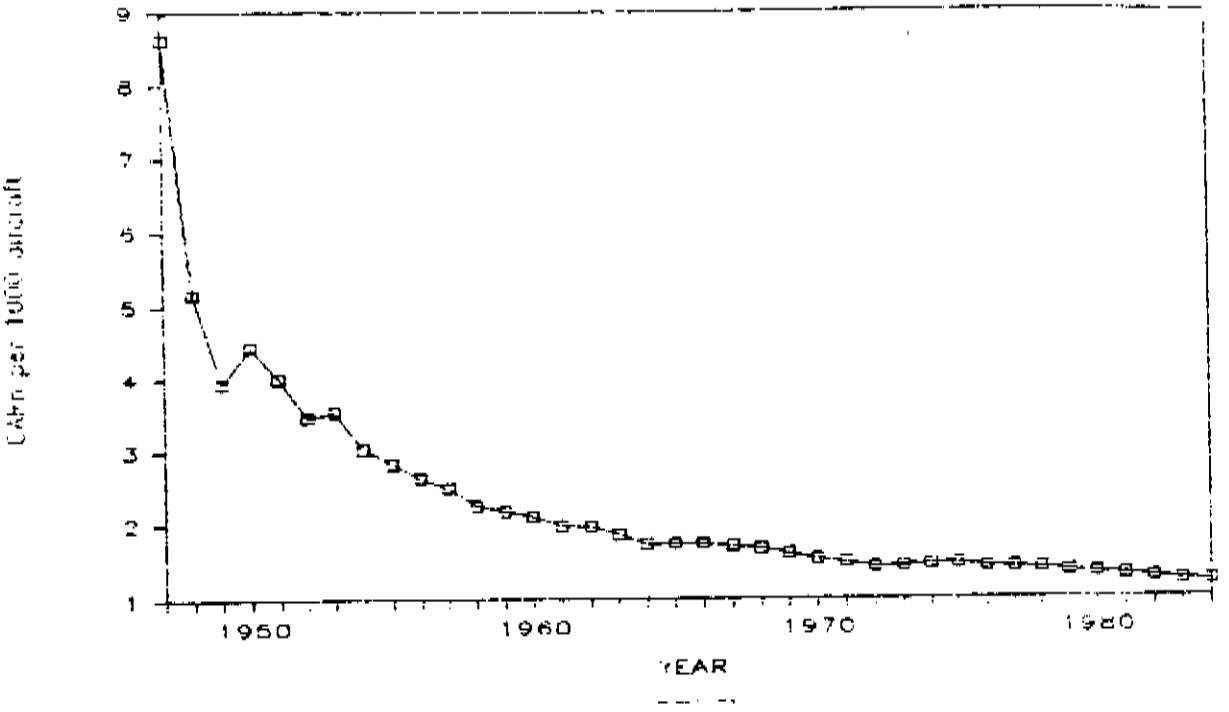

FIGURE 6-5a. CAR_n FIFAF ACCIDENT RATE FOR ALL V-TAILS

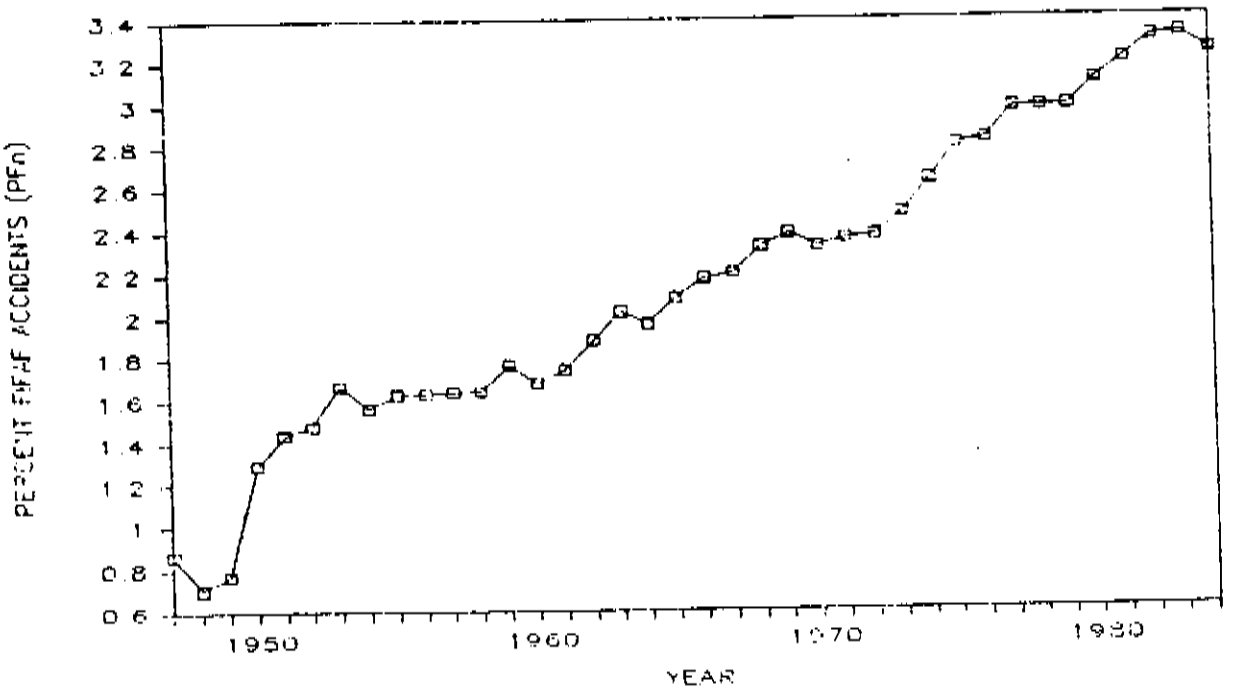

FIGURE 6-5b. PF_n FIFAF ACCIDENT RATE FOR ALL V-TAILS

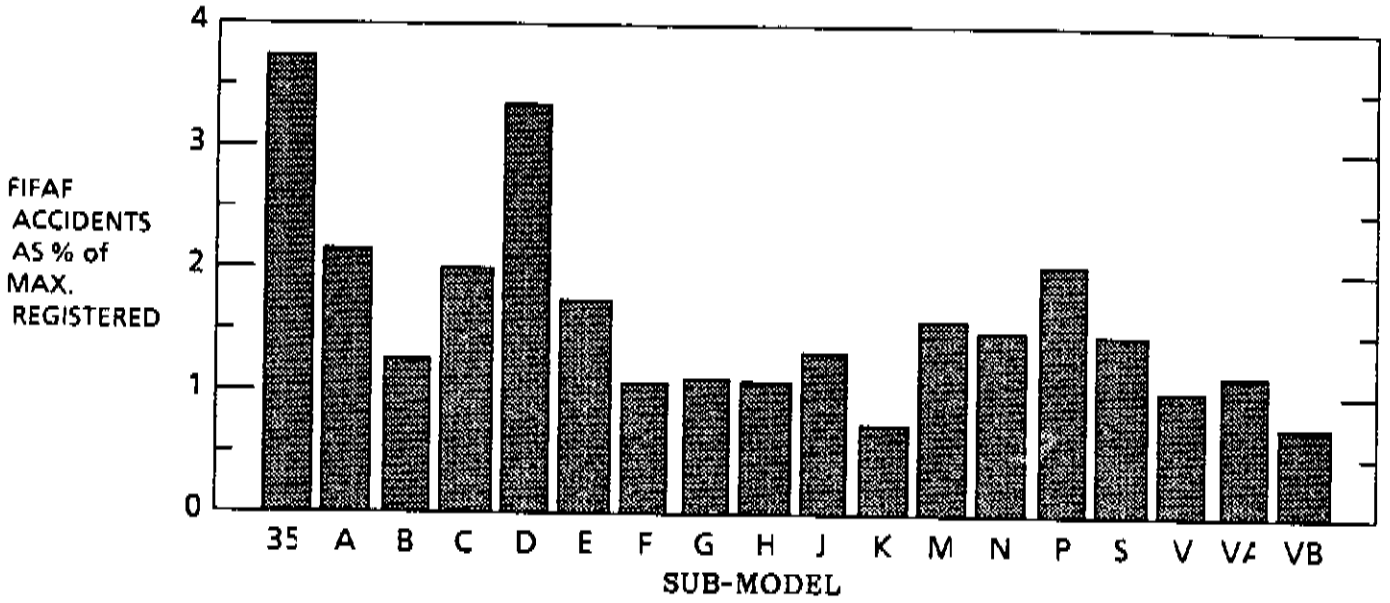

FIGURE 6-6. FIFAF ACCIDENT RATE FOR ALL SUB-MODELS (YEAR 15)

TABLE 6-10. SUMMARY OF V-TAIL STRUCTURAL GROUPS

FIRST YEAR	MODELS	STRUCTURAL CHANGE
1947	35	Original 35 is Normal Category
1949	A35, B35	Changed to Utility Category; increased wing strength
1951	C35, D35, E35	14.4% increase in tail chord; replaced torque box ribs with beads
1955	F35, G35	Strengthened wing; increased gages of the stabilizer rear spar
1957	H35, J35, K35, M35, N35, P35	Strengthened wing; strengthening of stabilizer and ruddevator
1964	S35, V35, V35A, V35B	Increased gages of stabilizer spars; new elevator balance horn

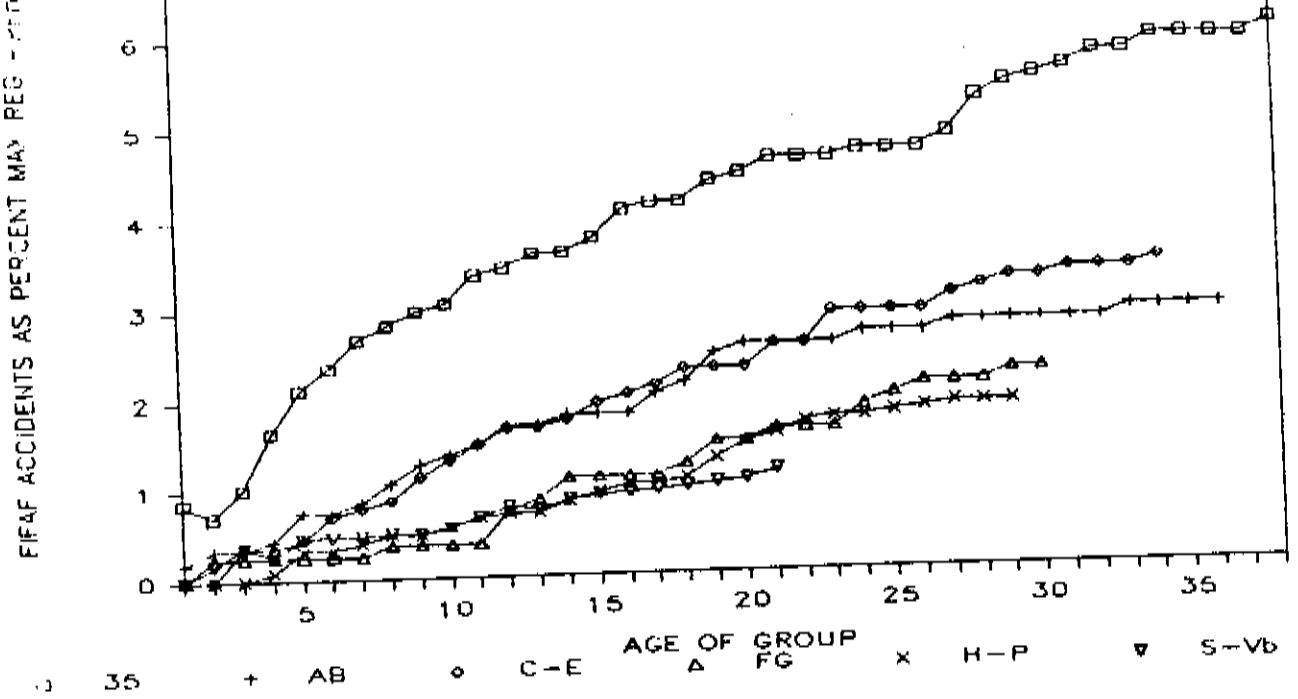

FIGURE 6-7. ACCIDENT HISTORY OF GROUPS

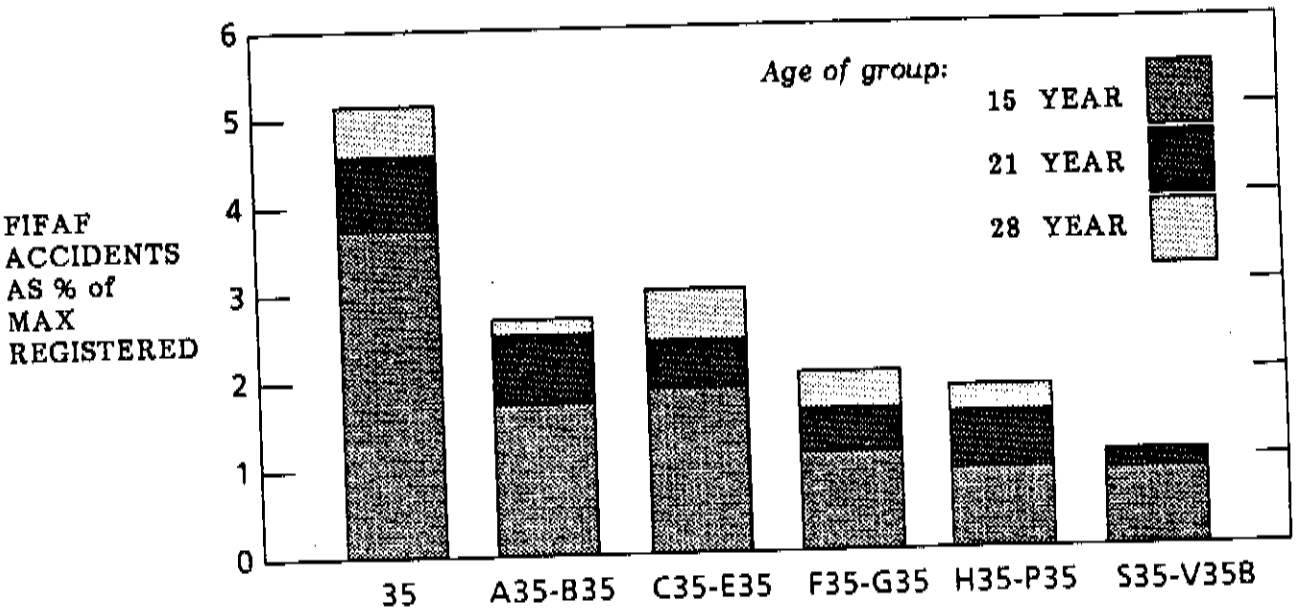

FIGURE 6-8. FIFAF ACCIDENT RATE FOR YEARS 15, 21, 28