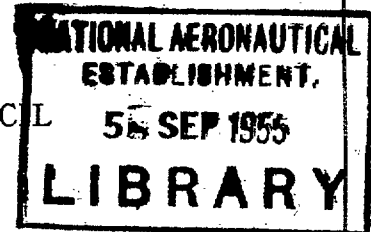




MINISTRY OF SUPPLY

AERONAUTICAL RESEARCH COUNCIL  
REPORTS AND MEMORANDA



# *V-g* Records from *Vampire* Aircraft

(March 1951—October 1951)

*By*

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and

J. R. HEATH-SMITH, B.Sc. (Eng.)

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1956

FIVE SHILLINGS NET

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COMMUNICATED BY THE PRINCIPAL DIRECTOR OF SCIENTIFIC RESEARCH (AIR),  
MINISTRY OF SUPPLY

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*Reports and Memoranda No. 2963\**

May, 1952

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*Summary.*—Four hundred and sixty-one *V-g* records covering 923 flying hours were taken from *Vampire* aircraft operating in England and Germany during the period March to October, 1951.

*V-g* boundaries expected to be exceeded once in 30, 100 and 300 hours are estimated, special consideration being given to aircraft engaged on ground-attack duties. The results confirm the general belief that more severe accelerations and higher speeds may be expected when aircraft are on ground attack duties than when they are on other duties.

1. *Introduction.*—*V-g* recorders are fitted in *Vampire* aircraft operating from two stations (Odiham and North Weald) in England and three stations (Gutersloh, Wunstorf and Celle) in Germany. The records show the maximum speeds and extreme normal accelerations reached by the aircraft in the course of their ordinary flying duties.

This analysis covers 297 records (791 flying hours) from home-based aircraft and 164 records (132 flying hours) from B.A.O.R. aircraft. Differences in the records make it necessary to treat the records from aircraft engaged on ground attack duties separately from those from aircraft on other duties.

30, 100 and 300-hour *V-g* boundaries are estimated for records from home-based aircraft covering (a) all duties, (b) duties other than ground-attack (Figs. 1 and 2). 30 and 100 hour boundaries are estimated for records from B.A.O.R. aircraft covering (a) duties other than ground attack, (b) ground attack (Figs. 3 and 4).

The *Vampire* design flight envelope is given (Fig. 5) for comparison with the estimated *V-g* boundaries.

2. *Method of Analysis.*—The *V-g* boundary which will be exceeded in  $H$  hours is drawn to satisfy the following conditions :

- (a) The maximum speed  $V_a$  is exceeded once in  $H$  flying hours.
- (b) Except when the acceleration is limited by the stall, the upper boundary of acceleration is exceeded once in time  $H$ , the probability of exceeding the boundary at any point in this range being independent of the speed.

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\* R.A.E. Tech. Note Structures 88, received 27th November, 1952.

(c) The lower boundary is to satisfy conditions similar to those for the upper boundary. The method of estimating a boundary to satisfy these conditions is described in Ref. 1.

3. *Data*.—The 461 records received from *Vampire* squadrons are divided into the following categories :

- (a) Home-based aircraft—all duties—297 records—791 flying hours.
- (b) Home-based aircraft—all duties except ground-attack—277 records—749 flying hours.
- (c) B.A.O.R. aircraft—all duties except ground-attack—109 records—93 flying hours.
- (d) B.A.O.R. aircraft—ground-attack—55 records—39 flying hours.

The 20 records from home-based aircraft engaged on ground-attack duties are too few for a separate analysis to be made. In addition, most of these records cover more than one operation, not all of which were ground-attack, so that some of the 42 flying hours covered by these records are attributable to 'other duties.' The 55 B.A.O.R. ground-attack records on the other hand cover almost exclusively ground-attack duties.

The frequency distributions for the extreme upward and downward accelerations and the maximum speeds are given in Tables 1 to 9. Accelerations are read to the nearest  $0.1g$  and speeds to the nearest 5 m.p.h., but for the purpose of analysis the results are grouped in  $0.2g$  and 10 m.p.h. intervals.

Although 8 speed-bands are shown in the tables of the frequency distributions, the number of speed-bands is taken to be 7 since the 500 to 550 m.p.h. band contains very few records.

4. *Exceptional Records*.—The design maximum acceleration ( $6.7g$ ) was exceeded on 5 (1.8 per cent) records from home-based aircraft on duties other than ground attack, and on 2 (10 per cent) records from home-based aircraft on ground-attack duties. The corresponding figures for B.A.O.R. aircraft are nil for non-ground-attack and 7 (13 per cent) for ground-attack aircraft.

An acceleration of  $7.5g$  was exceeded on two consecutive flights by a B.A.O.R. aircraft engaged on ground-attack duties. On each occasion  $8.0g$  was recorded, and after the second flight the pilot reported momentary loss of control during a pull-out. The elevator trim tab was found to be damaged after the second flight.

The service limiting speed (525 m.p.h. I.A.S.) was reached or exceeded on only two occasions.

5. *The V-g Boundaries*.—Estimates of the 30, 100 and 300-hour *V-g* boundaries for home-based aircraft, both on all duties and on all duties except ground-attack, are given in Figs. 1 and 2. The records from B.A.O.R. aircraft are too few to make reliable estimates of the 300-hour boundaries, but 30 and 100-hour boundaries are given in Figs. 3 and 4 for aircraft on all duties except ground-attack and for aircraft on ground-attack duties. To simplify comparison, Fig. 6 shows the 100-hour boundaries for all groups of records.

The *Vampire* design flight envelope is given in Fig. 5.

6. *Comparison of V-g Boundaries*.—All the *V-g* boundaries are alike in that the estimated extreme accelerations lie in the same speed bands, namely 350 to 400 m.p.h. for upward and 300 to 350 m.p.h. for downward accelerations. The values of these extreme accelerations, however, differ: the highest and lowest accelerations and the highest speed are found on the 100-hour boundary for B.A.O.R. ground-attack aircraft (Fig. 4).

The following table gives the estimated extreme upward and downward accelerations for each boundary, together with the speed which it is expected will be exceeded once in the number of hours associated with the boundary.

Record group	Fig.	Boundary	Extreme upward acceleration (g)	Extreme downward acceleration (g)	Max. speed (m.p.h. I.A.S.)
Home-based, all duties	1	30-hr	6.9	-3.2	490
		100-hr	7.6	-4.2	515
		300-hr	8.2	-5.0	530
Home-based, all duties except ground-attack	2	30-hr	6.8	-2.8	485
		100-hr	7.4	-3.6	510
		300-hr	8.0	-4.4	525
B.A.O.R., all duties except ground-attack	3	30-hr	6.8	-2.4	505
		100-hr	7.4	-3.0	535
B.A.O.R., ground-attack	4	30-hr	8.6	-3.8	525
		100-hr	9.2	-4.8	560
<i>Vampire</i> design envelope	5	—	6.7	-3.3	550*

\* Service limiting speed is 525 m.p.h. I.A.S.

This table shows clearly that much greater accelerations are applied when the aircraft are on ground-attack duties than when on other duties. The B.A.O.R. ground-attack boundaries contain the greatest extreme upward and downward accelerations, and the inclusion of only 20 ground-attack records with the 277 records from home-based aircraft on other duties increases the estimated extreme accelerations appreciably. The speeds show the same trend, being higher for ground-attack aircraft than for aircraft on other duties.

Comparison of the 30 and 100-hour boundaries for home-based and B.A.O.R. aircraft on duties other than ground-attack, shows that the home-based aircraft reach greater downward accelerations, while the B.A.O.R. aircraft reach higher indicated speeds on the average. The extreme upward accelerations are the same.

With the exception of the boundary for B.A.O.R. ground-attack records, all the 30-hour boundaries lie mainly within the design envelope. The 100 and 300-hour boundaries exceed the design envelope at speeds between 250 and 525 m.p.h.

7. *Number of Hours to Exceed Specified Speeds or Accelerations.*—It should be noted that, since there are seven speed bands in each of the boundaries, and there is an equal probability of exceeding the boundary in any one of these bands, it is expected that on the average the accelerations given in any particular band will be exceeded once in seven times the number of hours associated with the boundary. Also, if the number of flying hours in which a particular acceleration is expected to be exceeded once is required, the chance that it may occur in more than one speed band must be taken into account. The probabilities in this case are not equal for all speed bands, and hence the required estimate must be made from the frequency distribution of the maximum or minimum accelerations for each record. The following table gives estimates of the number of flying hours in which maximum accelerations 6.7g and 7.5g and minimum accelerations -3.3g and -3.75g are expected to be exceeded once. The times in which the service limiting speed and the design diving speed are expected to be exceeded once are also given.

Record group	6·7g	7·5g	-3·3g	-3·75g	525 m.p.h. I.A.S.	550 m.p.h. I.A.S.
Home-based, all duties	110	460	180	300	215	1500
Home-based, all duties except ground-attack	140	630	330	500	295	2500
B.A.O.R., all duties except ground-attack	120	1070	500	1030	63	180
B.A.O.R., ground-attack	6	22	105	240	30	73

This table shows clearly that the ground-attack aircraft reach the specified accelerations and speeds more frequently than the aircraft on other duties.

8. *Conclusions.*—Although the records from ground-attack aircraft are too few to give more than approximate estimates of the  $V$ - $g$  boundaries, the differences between these boundaries and the boundaries for aircraft on other duties are clearly significant. Thus, when aircraft are engaged on ground-attack duties they may be expected to reach greater upward and downward accelerations and higher speeds than when engaged on other duties, and they will also exceed specified accelerations and speeds more frequently.

When sufficient records have been collected a further Technical Note will be issued on *Vampire* aircraft.

9. *Appreciation.*—The co-operation of all squadrons in collecting records and so making the analysis possible is much appreciated. No. 83 Squadron kindly provided the excellent photographic record of the work shown in Figs. 7 and 8.

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#### REFERENCE

<i>No.</i>	<i>Author</i>	<i>Title, etc.</i>
1	R. D. Starkey	The Analysis of $V$ - $g$ Records. Report Structures 38. A.R.C. 12,504. May, 1949.

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TABLE 1

*Frequency Distribution of the Extreme Upward Accelerations  
in Each Speed Band—Home-based, Non-ground-attack*

Speed Band	1	2	3	4	5	6	7	8
Max. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0, 1.1	2				2			
1.2, 1.3	20				2	4	1	1
1.4, 1.5	68	9			6	6	0	0
1.6, 1.7	43	14	3	4	7	8	5	0
1.8, 1.9	38	33	7	2	12	14	2	1
2.0, 2.1	41	37	14	12	9	15	7	1
2.2, 2.3	18	17	16	5	5	5	0	0
2.4, 2.5	17	29	16	10	13	4	3	0
2.6, 2.7	5	11	12	13	7	6	6	0
2.8, 2.9	10	25	24	17	11	9	7	0
3.0, 3.1	3	25	33	32	17	10	5	0
3.2, 3.3	1	16	16	12	7	7	4	0
3.4, 3.5	1	31	20	14	16	7	2	0
3.6, 3.7	1	8	18	13	8	7	4	0
3.8, 3.9		8	19	19	13	9	2	2
4.0, 4.1		9	30	25	20	11	5	0
4.2, 4.3		2	12	22	8	13	4	0
4.4, 4.5		3	15	19	13	9	3	1
4.6, 4.7			7	8	12	5	2	
4.8, 4.9			8	14	13	10	2	
5.0, 5.1			3	8	17	6	3	
5.2, 5.3			1	7	5	3	1	
5.4, 5.5			1	4	5	6	4	
5.6, 5.7			0	4	1	2	0	
5.8, 5.9			1	2	3	1	0	
6.0, 6.1			1	6	7	4	1	
6.2, 6.3				0	2	1	0	
6.4, 6.5				2	2	1	0	
6.6, 6.7				0	3	1	2	
6.8, 6.9				1	0	1	0	
7.0, 7.1				0	2	1	2	
7.2, 7.3				0		1		
7.4, 7.5				1				
Totals	268	277	277	276	248	187	77	6

TABLE 2

*Frequency Distribution of the Extreme Downward Accelerations  
in Each Speed Band—Home-based, Non-ground-attack*

Speed Band	1	2	3	4	5	6	7	8
Min. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0	1				2	7	2	1
0.9, 0.8	39		4	5	8	16	12	1
0.7, 0.6	56	2	12	2	16	19	8	1
0.5, 0.4	92	14	42	19	24	23	8	0
0.3, 0.2	39	28	41	37	29	21	4	1
0.1, 0.0	30	37	75	68	54	46	12	0
-0.1, -0.2	6	13	25	26	28	7	6	0
-0.3, -0.4	5	24	21	26	27	13	4	0
-0.5, -0.6		28	14	19	16	13	1	0
-0.7, -0.8		19	13	19	7	3	1	1
-0.9, -1.0		29	13	18	9	4	0	0
-1.1, -1.2		18	6	6	6	4	1	0
-1.3, -1.4		20	1	5	6	0	0	0
-1.5, -1.6		19	3	4	2	1	1	0
-1.7, -1.8		10	1	4	5	2	3	0
-1.9, -2.0		9	2	7	2	2	1	0
-2.1, -2.2		4	1	2	0	0	1	0
-2.3, -2.4		2	0	2	1	0	0	0
-2.5, -2.6		1	0	1	1	0	1	1
-2.7, -2.8			0	1	1	1		
-2.9, -3.0			1	1	1			
-3.1, -3.2			0	0	0			
-3.3, -3.4			0	1	0			
-3.5, -3.6			1	1	0			
-3.7, -3.8			0	1	0			
-3.9, -4.0			1	1	1			
Totals	268	277	277	276	246	182	66	6

TABLE 3

*Frequency Distribution of the Extreme Upward Accelerations  
in Each Speed Band—Home-based, Ground-attack\**

Speed Band	1	2	3	4	5	6	7	8
Max. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0, 1.1								1
1.2, 1.3	1							0
1.4, 1.5	6			1		1	1	0
1.6, 1.7	3			0		0	1	0
1.8, 1.9	3	1	1	0	1	0	1	0
2.0, 2.1	6	4	0	0	0	3	0	0
2.2, 2.3		2	1	0	0	0	2	0
2.4, 2.5		3	2	0	0	1	0	0
2.6, 2.7		4	1	0	0	0	0	0
2.8, 2.9		3	0	0	0	3	1	0
3.0, 3.1		2	0	1	1	0	1	1
3.2, 3.3		0	2	0	0	1	1	
3.4, 3.5		1	1	1	0	1	1	
3.6, 3.7			0	0	0	1	0	
3.8, 3.9			5	1	1	3	1	
4.0, 4.1			3	0	1	0	1	
4.2, 4.3			1	1	1	0	0	
4.4, 4.5			0	2	1	0	0	
4.6, 4.7			1	1	2	0	0	
4.8, 4.9			1	2	1	0	0	
5.0, 5.1			0	3	2	0	1	
5.2, 5.3			0	1	0	0	0	
5.4, 5.5			1	2	1	0	0	
5.6, 5.7				1	2	0	0	
5.8, 5.9				0	2	0	1	
6.0, 6.1				2	1	1		
6.2, 6.3				0	0	0		
6.4, 6.5				0	1	0		
6.6, 6.7				1	0	0		
6.8, 6.9					0	2		
7.0, 7.1					1			
Totals	19	20	20	20	19	17	13	2

\* These frequency distributions are added to those in Table 1 to form the distributions used when estimating the V-g boundaries for home-based aircraft, all duties.



TABLE 4

*Frequency Distribution of the Extreme Downward Accelerations  
in Each Speed Band—Home-based, Ground-attack\**

Speed Band	1	2	3	4	5	6	7	8
Min. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0					2			
0.9, 0.8	4			1	0		2	
0.7, 0.6	2	3		0	0	1	2	
0.5, 0.4	7	4	2	1	0	2	1	
0.3, 0.2	4	5	3	0	1	0	1	1
0.1, 0.0	2	6	4	1	1	0	3	1
-0.1, -0.2		2	1	1	2	3	1	
-0.3, -0.4			1	2	1	2	1	
-0.5, -0.6			1	1	0	3	0	
-0.7, -0.8			0	0	0	2	1	
-0.9, -1.0			1	2	1	1	1	
-1.1, -1.2			0	0	1	0		
-1.3, -1.4			1	0	1	0		
-1.5, -1.6			3	0	0	0		
-1.7, -1.8			1	1	0	1		
-1.9, -2.0			0	2	4	0		
-2.1, -2.2			0	1	0	0		
-2.3, -2.4			0	1	1	0		
-2.5, -2.6			0	0	0	0		
-2.7, -2.8			0	1	0	1		
-2.9, -3.0			0	3	2	1		
-3.1, -3.2			0	0	0			
-3.3, -3.4			0	0	2			
-3.5, -3.6			0	0				
-3.7, -3.8			1	0				
-3.9, -4.0			0	1				
-4.1, -4.2			0	0				
-4.3, -4.4			1	0				
-4.5, -4.6				1				
Totals	19	20	20	20	19	17	13	2

\* These frequency distributions are added to those in Table 2 to form the distributions used when estimating the  $V$ - $g$  boundaries for home-based aircraft, all duties.

TABLE 5

*Frequency Distribution of the Extreme Upward Accelerations  
in Each Speed Band—B.A.O.R., Non-ground-attack*

Speed Band	1	2	3	4	5	6	7	8
Max. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0, 1.1	6	1		1			1	
1.2, 1.3	17	1	2	1	2	2	0	
1.4, 1.5	40	5	4	3	4	2	3	
1.6, 1.7	22	23	4	4	4	1	0	
1.8, 1.9	10	11	7	5	5	5	2	
2.0, 2.1	9	30	7	5	9	5	1	
2.2, 2.3	1	9	10	4	2	1	1	
2.4, 2.5	2	4	8	5	5	2	0	1
2.6, 2.7	1	7	10	3	3	2	0	1
2.8, 2.9	0	5	9	6	1	1	1	2
3.0, 3.1	0	6	16	8	6	3	2	
3.2, 3.3	0	1	5	4	2	3	0	
3.4, 3.5	1	3	6	10	4	0	1	
3.6, 3.7		2	2	8	3	1	1	
3.8, 3.9		1	6	7	4	2	2	
4.0, 4.1			6	9	7	2	3	
4.2, 4.3			3	6	4	1	0	
4.4, 4.5			1	4	3	2	0	
4.6, 4.7			1	4	4	3	0	
4.8, 4.9			1	3	3	2	0	
5.0, 5.1			1	3	4	3	1	
5.2, 5.3				2	0	2	1	
5.4, 5.5				0	3	1	1	
5.6, 5.7				0	0	0		
5.8, 5.9				1	2	0		
6.0, 6.1					1	1		
6.2, 6.3					0			
6.4, 6.5					1			
Totals	109	109	109	106	86	47	21	4

TABLE 6

*Frequency Distribution of the Extreme Downward Accelerations  
in Each Speed Band—B.A.O.R., Non-ground-attack*

Speed Band	1	2	3	4	5	6	7	8
Min. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0	9	4	2	3	2	3	1	
0.9, 0.8	44	25	11	7	8	4	4	
0.7, 0.6	35	31	27	12	15	6	1	1
0.5, 0.4	9	27	27	19	12	7	4	0
0.3, 0.2	8	9	14	18	14	3	3	3
0.1, 0.0	2	6	15	23	13	9	1	
-0.1, -0.2	0	3	3	7	7	4	0	
-0.3, -0.4	0	2	2	5	4	6	2	
-0.5, -0.6	0	1	3	4	4	1	1	
-0.7, -0.8	0	0	2	1	1	0	1	
-0.9, -1.0	1	0	0	2	4	0	0	
-1.1, -1.2		0	0	2	0	0	0	
-1.3, -1.4		0	0	0	1	0	0	
-1.5, -1.6		1	2	1	1	0	0	
-1.7, -1.8			1	0		1	0	
-1.9, -2.0				1		0	0	
-2.1, -2.2				0		0	1	
-2.3, -2.4				0		1		
-2.5, -2.6				0				
-2.7, -2.8				0				
-2.9, -3.0				1				
Totals	108	109	109	106	86	45	19	4

TABLE 7

*Frequency Distribution of the Extreme Upward Accelerations  
in Each Speed Band—B.A.O.R., Ground-attack*

Speed band	1	2	3	4	5	6	7	8
Max. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0, 1.1	3							
1.2, 1.3	13	2						
1.4, 1.5	17	5	2					
1.6, 1.7	12	6	0	1		1		
1.8, 1.9	7	8	1	0		0		
2.0, 2.1	3	8	4	2		0		
2.2, 2.3		10	3	0		1		
2.4, 2.5		8	7	0		0	1	
2.6, 2.7		5	3	1		0	0	
2.8, 2.9		3	10	2	1	0	1	
3.0, 3.1			8	4	2	1	1	
3.2, 3.3			5	5	1	2	0	
3.4, 3.5			4	4	2	2	0	
3.6, 3.7			3	2	0	1	0	
3.8, 3.9			2	3	2	1	1	
4.0, 4.1			1	6	2	2	0	
4.2, 4.3			1	3	8	2	1	
4.4, 4.5			0	6	2	3	1	
4.6, 4.7			0	0	3	3	0	
4.8, 4.9			0	4	3	1	2	
5.0, 5.1			1	2	5	1	2	
5.2, 5.3				0	4	2	1	
5.4, 5.5				4	3	2	0	1
5.6, 5.7				1	2	0	0	
5.8, 5.9				0	1	0	0	
6.0, 6.1				2	3	0	1	
6.2, 5.3				0	1	0	0	
6.4, 6.5				0	2	0	0	
6.6, 6.7				1	2	0	0	
6.8, 6.9				0	0	1	1	
7.0, 7.1				2	0	1		
7.2, 7.3					0	1		
7.4, 7.5					0	1		
7.6, 7.7					0			
7.8, 7.9					0			
8.0, 8.1					2			
Totals	55	55	55	55	51	29	13	1

In addition one aircraft reached 5.2g in the band 550—600 m.p.h.

TABLE 8

*Frequency Distribution of the Extreme Downward Accelerations  
in Each Speed Band—B.A.O.R., Ground-attack*

Speed band	1	2	3	4	5	6	7	8
Min. acceleration in band (g)	Band limits (m.p.h.)							
	150—200	200—250	250—300	300—350	350—400	400—450	450—500	500—550
1.0	1	3					2	
0.9, 0.8	28	8	8	2	2		0	
0.7, 0.6	13	18	7	6	1	3	2	
0.5, 0.4	6	9	14	6	7	4	1	
0.3, 0.2	5	8	6	5	4	1	2	
0.1, 0.0	2	8	12	12	12	7	2	
-0.1, -0.2			1	7	5	2	1	
-0.3, -0.4			2	3	6	2	0	
-0.5, -0.6			1	1	5	3	2	1
-0.7, -0.8			1	1	3	2	1	
-0.9, -1.0			1	0	2	0		
-1.1, -1.2			0	2	0	1		
-1.3, -1.4			0	0	0	1		
-1.5, -1.6			1	2	0	0		
-1.7, -1.8			1	2	0	1		
-1.9, -2.0				2	2			
-2.1, -2.2				3	0			
-2.3, -2.4				0	1			
-2.5, -2.6				1	1			
Totals	55	54	55	55	51	27	13	1

In addition one aircraft reached 0.7g in the band 550—600 m.p.h.

TABLE 9

*Frequency Distributions of the Maximum Indicated Airspeed  
on Each Record for Each Group*

Maximum speed (m.p.h. I.A.S.)	Home-based non-ground- attack*	Home-based ground- attack*	B.A.O.R. non-ground- attack	B.A.O.R. ground- attack
275, 280	1			
285, 290	0		1	
295, 300	0		2	
305, 310	3	1	1	
315, 320	2	0	1	
325, 330	6	0	6	1
335, 340	2	0	4	1
345, 350	14	0	8	2
355, 360	8	1	6	1
365, 370	8	0	11	3
375, 380	13	1	12	6
385, 390	9	0	4	5
395, 400	24	0	5	8
405, 410	20	0	3	2
415, 420	20	1	11	4
425, 430	31	0	7	3
435, 440	17	2	2	0
445, 450	22	1	4	6
455, 460	10	4	5	2
465, 470	18	1	4	2
475, 480	16	3	4	6
485, 490	11	1	3	0
495, 500	16	2	1	2
505, 510	3	0	3	0
515, 520	2	2	1	0
525, 530	1			0
535, 540				0
545, 550				0
555, 560				0
565, 570				1
Totals	277	20	109	55

\* These frequency distributions are added together when estimating the speed exceeded once in  $H$  flying hours for the  $V$ - $g$  boundaries for home-based aircraft, all duties.

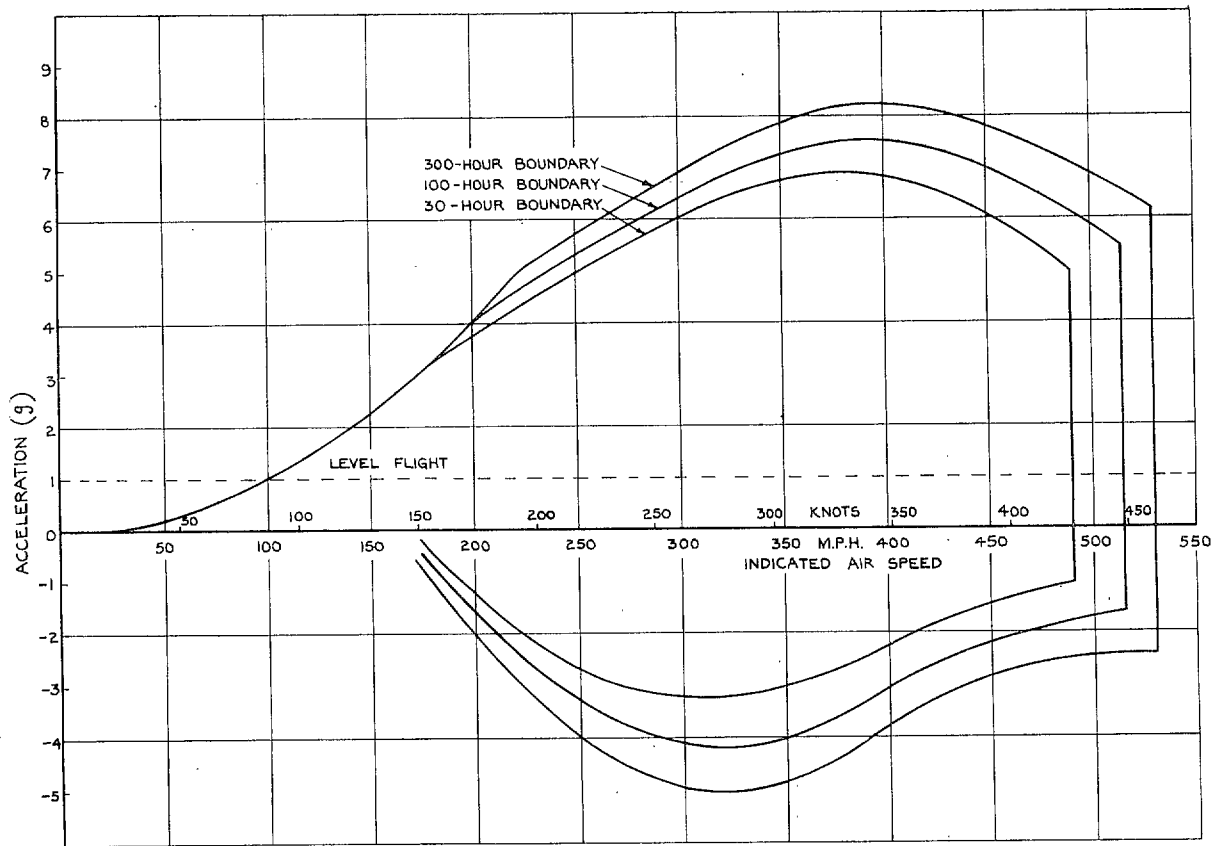


FIG. 1.  $V$ - $g$  boundaries exceeded once in 30, 100 and 300 flying hours. Home-based *Vampires* on all duties.

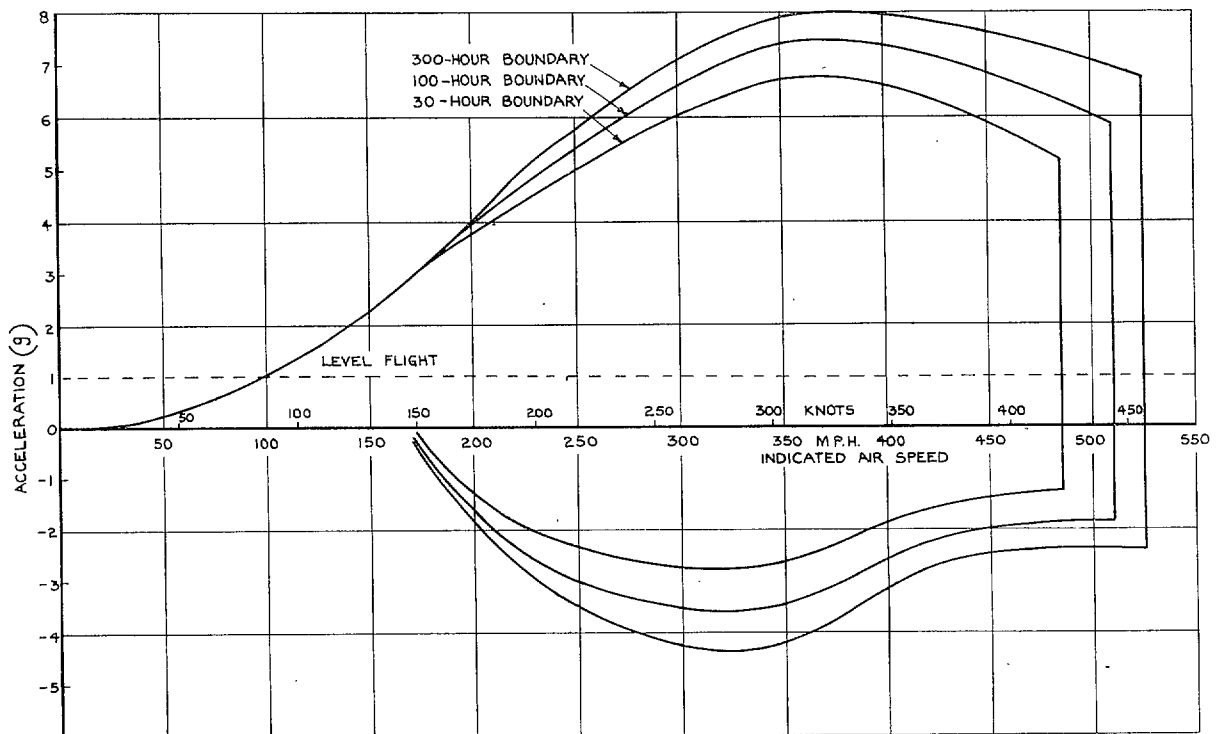


FIG. 2.  $V$ - $g$  boundaries exceeded once in 30, 100 and 300 flying hours. Home-based *Vampires* on duties other than ground-attack.

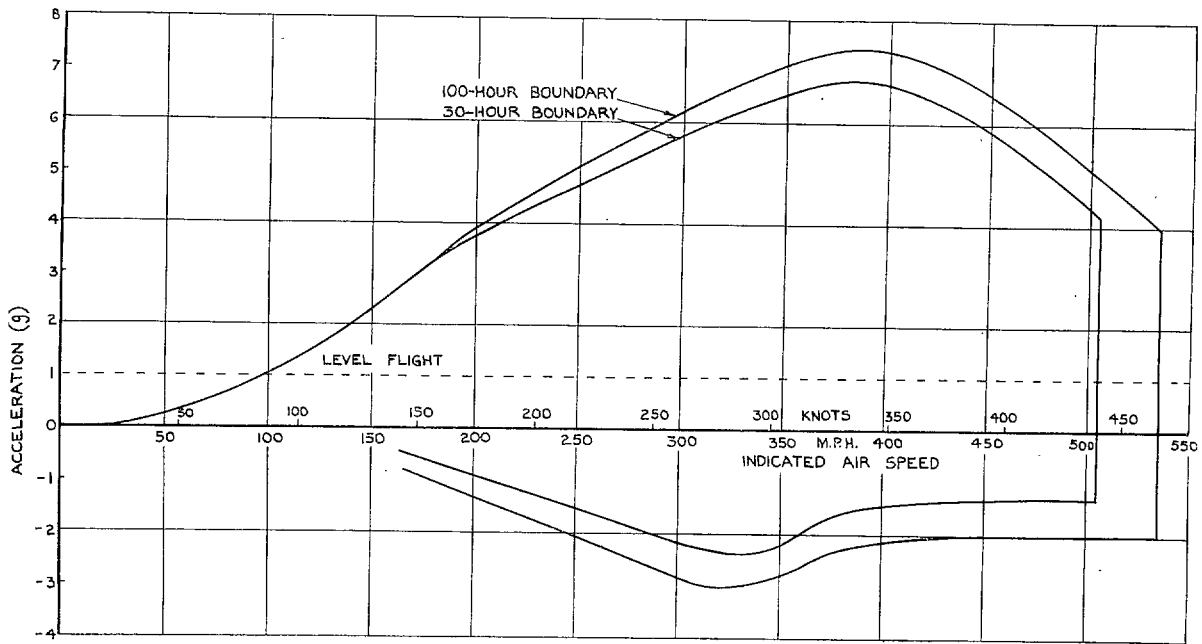


FIG. 3. *V-g* boundaries exceeded once in 30 and 100 flying hours. B.A.O.R. *Vampires* on duties other than ground-attack.

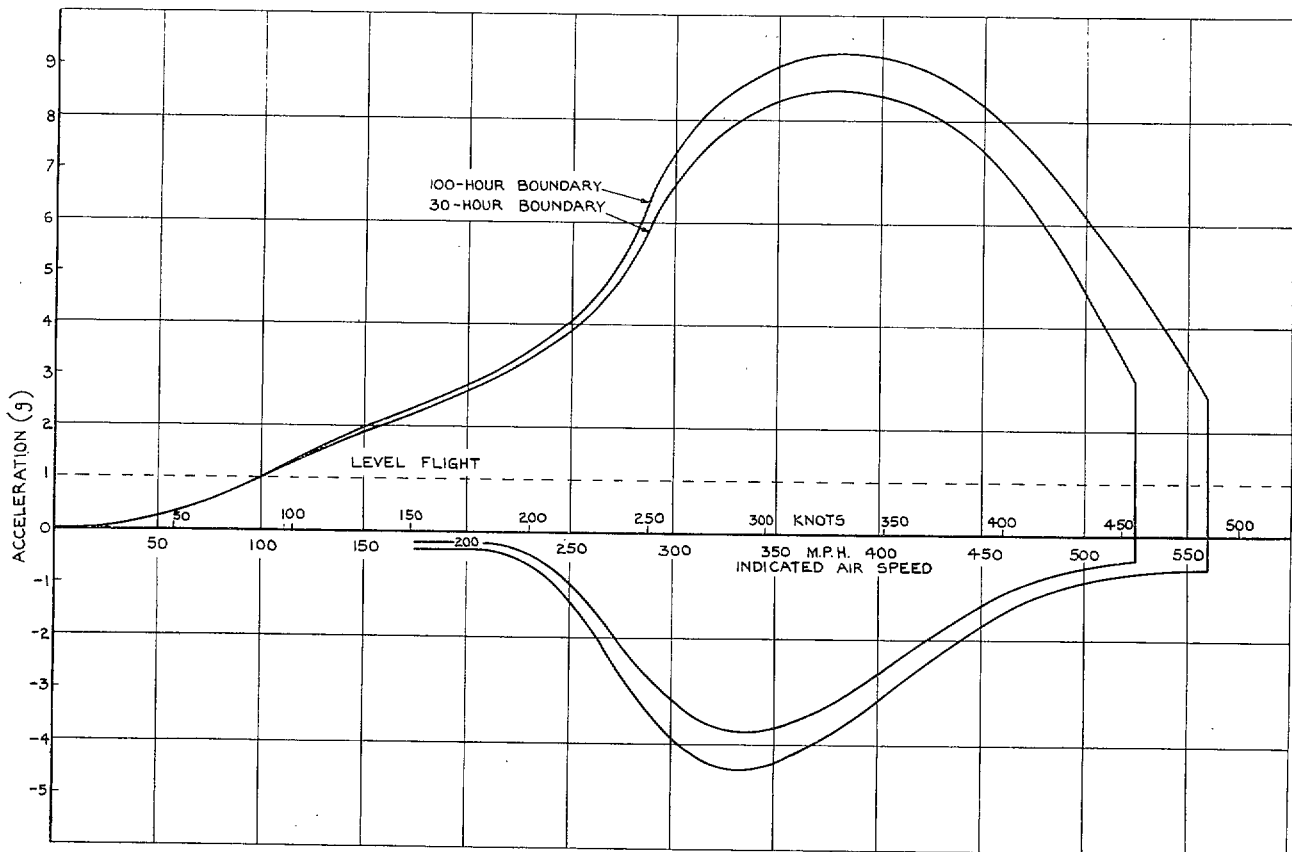


FIG. 4. *V-g* boundaries exceeded once in 30 and 100 flying hours. B.A.O.R. *Vampires* on ground-attack duties.



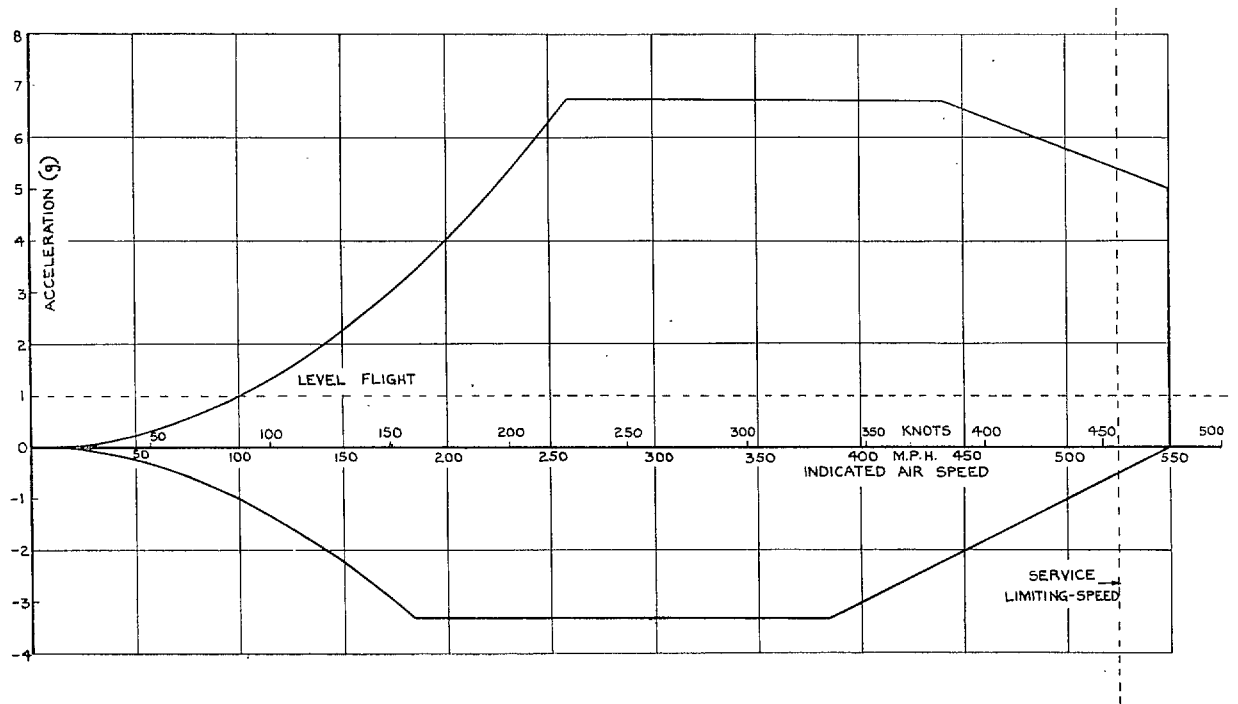


FIG. 5. *Vampire* design envelope.

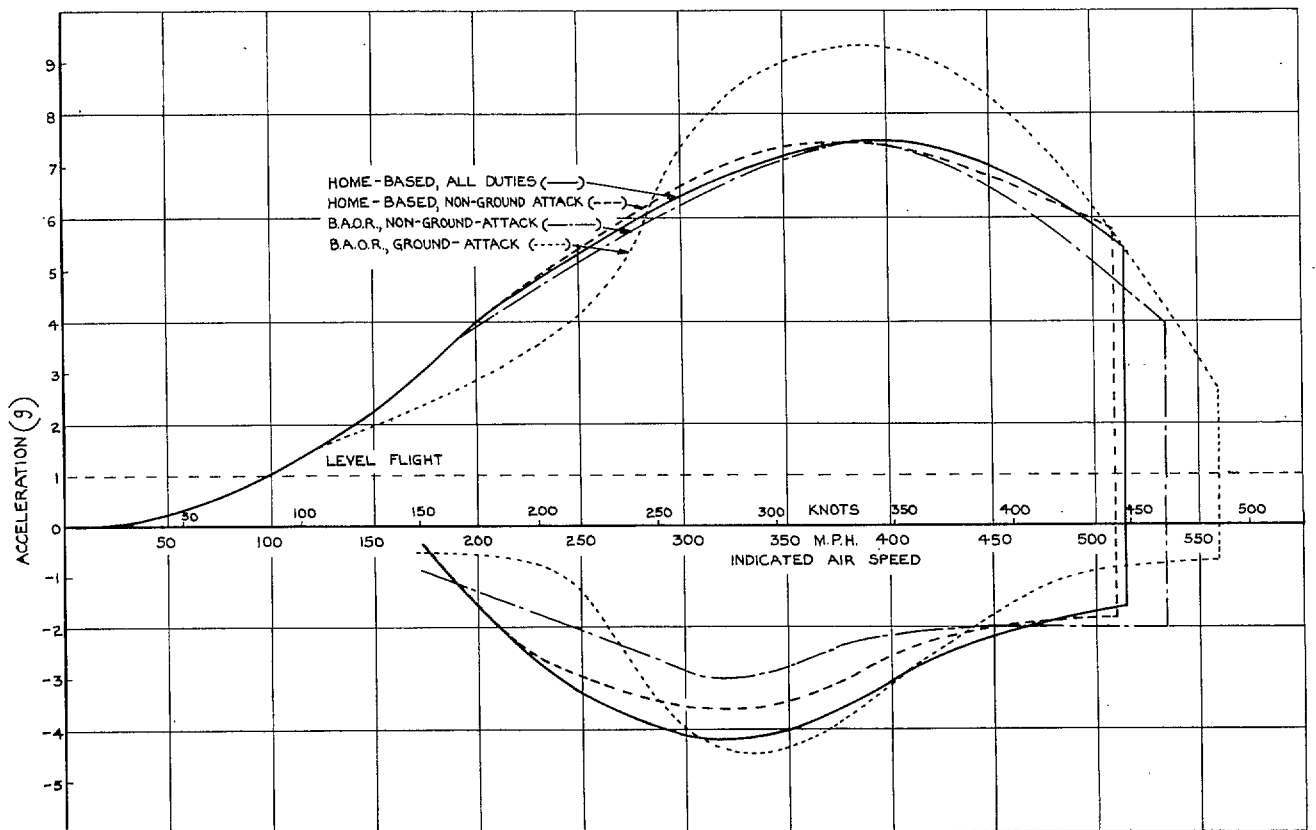


FIG. 6.  $V$ - $g$  boundaries exceeded once in 100 flying hours for all groups of records.

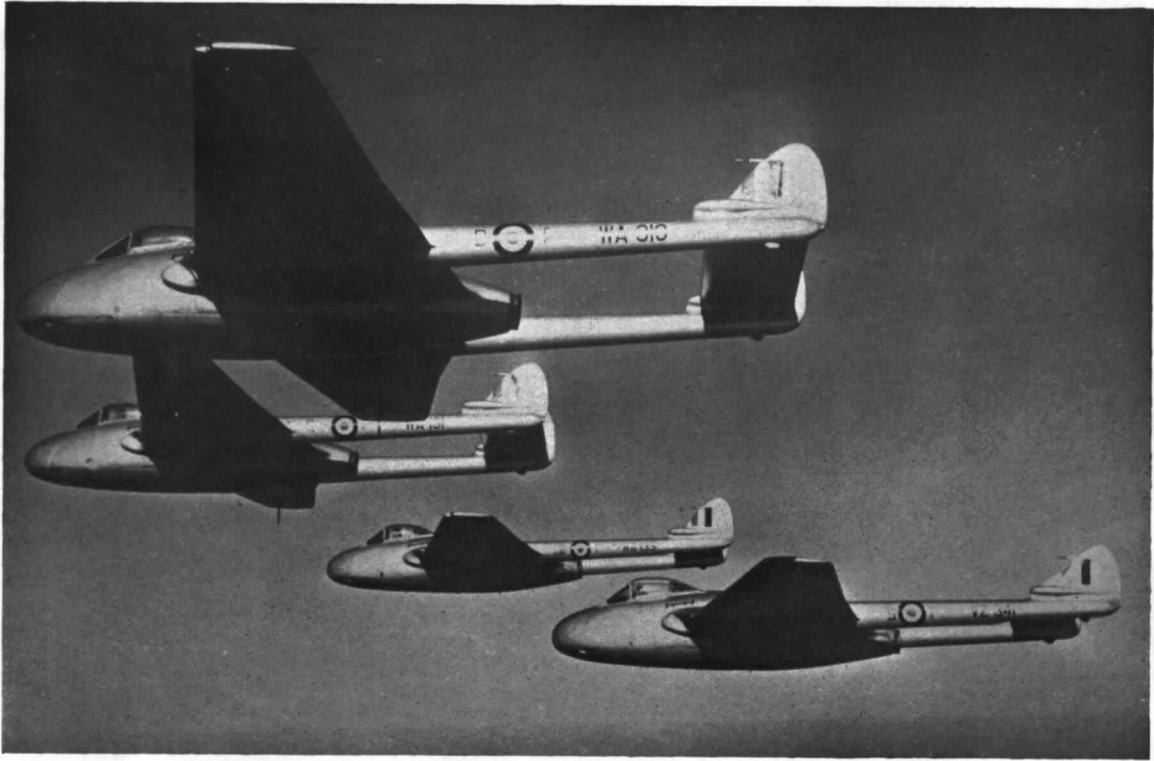


FIG. 7. *Vampire* aircraft in formation.



FIG. 8. *Vampire* releasing rockets during ground-attack.

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