



RESEARCH MEMORANDUM

SUMMARY OF THE FIRST SAMPLE OF VGH DATA OF NORMAL
ACCELERATIONS AND ASSOCIATED OPERATING CONDITIONS ON
TWO FOUR-ENGINE TRANSPORT AIRPLANES IN
COMMERCIAL OPERATIONS

By Robert L. McDougal

Langley Aeronautical Laboratory
Langley Air Force Base, Va.

NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

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The desirability and usefulness of detailed knowledge of the repeated gust loads and the associated operating conditions for transport airplanes is indicated in reference 1. Samples of time-history data (NACA VGH records) of normal acceleration, airspeed, and altitude for a low-altitude twin-engine airplane are reported in reference 1. Since the data from the larger transports flown at the higher altitudes are of particular interest, summaries of the information from two records obtained with NACA VGH recorders from two such airplanes have been prepared and are presented herein. Pertinent characteristics of the two airplanes, designated airplanes A and B, were obtained from the operator and from the Civil Aeronautics Administration and are given in table I. Airplane A was operated on a transcontinental route, whereas airplane B was probably operated on parts of a route from New York to Hawaii via Seattle, Washington.

The records obtained cover only about 36 and 52 hours of flight for airplanes A and B, respectively, and represent operations up to an altitude of 25,000 feet. The evaluation of the time-history records was made in accordance with the procedure outlined in reference 1 and results are presented in tables II and III.

The data are presented purely as an initial sample and, in view of the limited sample size, no definite general conclusions are warranted at this time. It may be noted, however, that the load history as

indicated by the present sample appears substantially lower than that obtained from records from the low-altitude operations reported in reference 1.

Langley Aeronautical Laboratory
National Advisory Committee for Aeronautics
Langley Air Force Base, Va.

REFERENCE

1. Steiner, Roy, and McDougal, Robert L.: Summary of Normal Accelerations, Gust Velocities, and Operating Practices from April to August 1949 of a Twin-Engine Airplane in Commercial Transport Operations. NACA RM L50B02, 1950.

TABLE I
AIRPLANE CHARACTERISTICS

Airplane	A	B
Span, ft	117.5	141.2
Wing area, sq ft	1463	1720
Gross weight, lb	93,200	142,500
Design cruising airspeed (indicated), mph	279	312
Never-exceed airspeed (indicated), mph	344	351

The NACA logo is a stylized wing shape with the letters "NACA" inside.

TABLE II

SUMMARY OF VGH DATA FROM AIRPLANE A DURING 36.32 FLIGHT HOURS IN JANUARY 1950

(a) Gust Loads and Airspeeds¹

Flight condition	Flight distance (miles)		Percentage of flight miles in rough air	Average indicated airspeed (mph)		Maximum Δn (g units)	Number of Δn 's $\geq \pm 0.3g$	Number of Δn 's $\geq \pm 0.3g$ per mile of rough air
	Rough	Smooth		Rough	Smooth			
Climb	129	625	17.1	197.6	191.2	-0.59	20	0.1557
En route	354	5743	5.8	252.9	242.3	-.32	16	.0452
Descent	343	1380	19.9	218.9	245.7	+.79	106	.3032
Total	826	7748					142	
Average	---	---	9.6	228.2	237.8	---	---	.1696

(b) Percentage of Flight Miles by Altitude² and Turbulence Condition

Altitude, ft \ Flight condition	0 to 5,000		5,000 to 10,000		10,000 to 15,000		15,000 to 20,000		20,000 to 25,000	
	Rough	Smooth	Rough	Smooth	Rough	Smooth	Rough	Smooth	Rough	Smooth
Climb	1.19	3.01	0.31	2.60	---	1.45	---	0.22	---	---
En route	2.21	15.73	.20	9.52	1.28	32.85	0.30	7.44	0.15	1.46
Descent	3.45	8.36	.43	5.68	.09	1.86	.04	.19	---	---
Total	6.85	27.10	.94	17.80	1.37	36.14	.34	7.85	.15	1.46

¹Maximum indicated airspeed = 328 mph.

²Altitude is pressure altitude at standard atmospheric conditions.



TABLE III

SUMMARY OF VGE DATA FROM AIRPLANE B DURING 52.45 FLIGHT HOURS IN MARCH 1950

(a) Gust Loads and Airspeeds¹

Flight condition	Flight distance (miles)		Percentage of flight miles in rough air	Average indicated airspeed (mph)		Maximum An (g units)	Number of An's $\geq \pm 0.3g$	Number of An's $\geq \pm 0.3g$ per mile of rough air
	Rough	Smooth		Rough	Smooth			
Climb	72	868	7.7	207.0	195.1	0.48	19	0.2639
En route	86	9,016	1.0	246.6	229.1	.31	3	.0349
Descent	424	1,612	20.8	235.6	260.0	-.54	85	.2005
Total	582	11,492	—	—	—	—	107	—
Average	—	—	4.8	233.1	229.9	—	—	.1838

(b) Percentage of Flight Miles by Altitude² and Turbulence Condition

Flight condition \ Altitude, ft	0 to 5,000		5,000 to 10,000		10,000 to 15,000		15,000 to 20,000		20,000 to 25,000	
	Rough	Smooth	Rough	Smooth	Rough	Smooth	Rough	Smooth	Rough	Smooth
Climb	0.54	1.88	0.03	2.29	0.03	1.78	—	0.83	—	0.41
En route	—	4.77	.31	11.44	.24	22.19	0.17	23.71	—	12.52
Descent	2.57	5.34	.39	4.05	.49	2.51	.07	1.11	—	.32
Total	3.11	11.99	.73	17.78	.76	26.48	.24	25.65	—	13.25

¹Maximum indicated airspeed = 314 mph.²Altitude is pressure altitude at standard atmospheric conditions.

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