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AFFDL-TR-68-127
VOLUME II

PROJECT HICAT
HIGH ALTITUDE CLEAR AIR TURBULENCE MEASUREMENTS AND METEOROLOGICAL CORRELATIONS

WALTER M. CROOKS, FREDERIC M. HOBLIT, FINIS A. MITCHELL, et al

Lockheed-California Company

TECHNICAL REPORT AFFDL-TR-68-127

VOLUME II
APPENDIXES III-VI

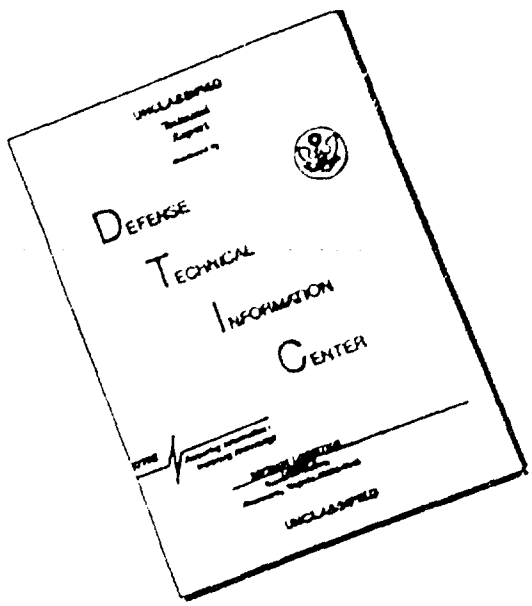
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AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

468

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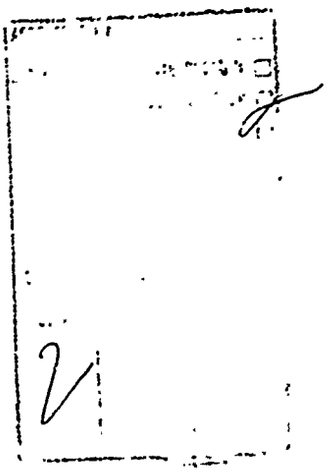


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300 - January 1969 - CO455 - 62-1394

PROJECT HICAT
HIGH ALTITUDE CLEAR AIR TURBULENCE MEASUREMENTS AND METEOROLOGICAL CORRELATIONS

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VOLUME II
APPENDIXES III-VI

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FOREWORD

This report was prepared by the Lockheed-California Company, Burbank, California, for the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio, under Contract F33615-67-C-1461, "High Altitude Critical Atmospheric Turbulence (HICAT)", ADP 682E. the Lockheed-California Company report number is LR 21718, dated July 29, 1968. The manuscript was released by the authors on September 27, 1968 for publication.

Air Force Flight Dynamics Laboratory management responsibility was under the ALLCAT Program Director, Mr. E. Brazier with Mr. J. P. Boone as the Air Force Project Engineer. The Lockheed-California Company Program Manager was Mr. C. B. Fabian with Mr. W. M. Crooks as the Technical Leader.

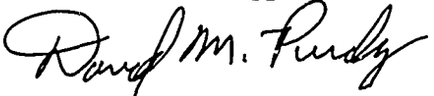
All HICAT aircraft operations and field team logistics support were under the direction of Lt. Col. J. J. King, USAF, Air Force Flight Test Center, Directorate of Systems Test, V/STOL Operations Branch, Edwards Air Force Base, California.

Special Acknowledgments are due to the following personnel who actively participated in developing high altitude meteorological forecasts during field operations: Mr. L. C. Brown, Meteorological Office, Royal Aircraft Establishment, Bedford, England; 1st Lt. J. A. Calcoate, Det. 19, 26th Weather Sq., Barksdale Air Force Base, Louisiana; Lt. R. E. Introne, Jr., Det. 4, 8th Weather Sq., Loring Air Force Base, Maine; Capt. K. W. Craw, Jr., Det. 5, 5th Weather Wing, Howard Air Force Base, Canal Zone; CWO B. H. Nunes, Det. 11, 6th Weather Wing, Patrick Air Force Base, Florida; Capt. D. W. Shong, Det. 21, 6th Weather Wing, Edwards Air Force Base, California. The assistance and advice of Major G. R. Hammond, ALLCAT Staff Meteorologist and Dr. J. A. Dutton of Pennsylvania State University are also gratefully acknowledged.

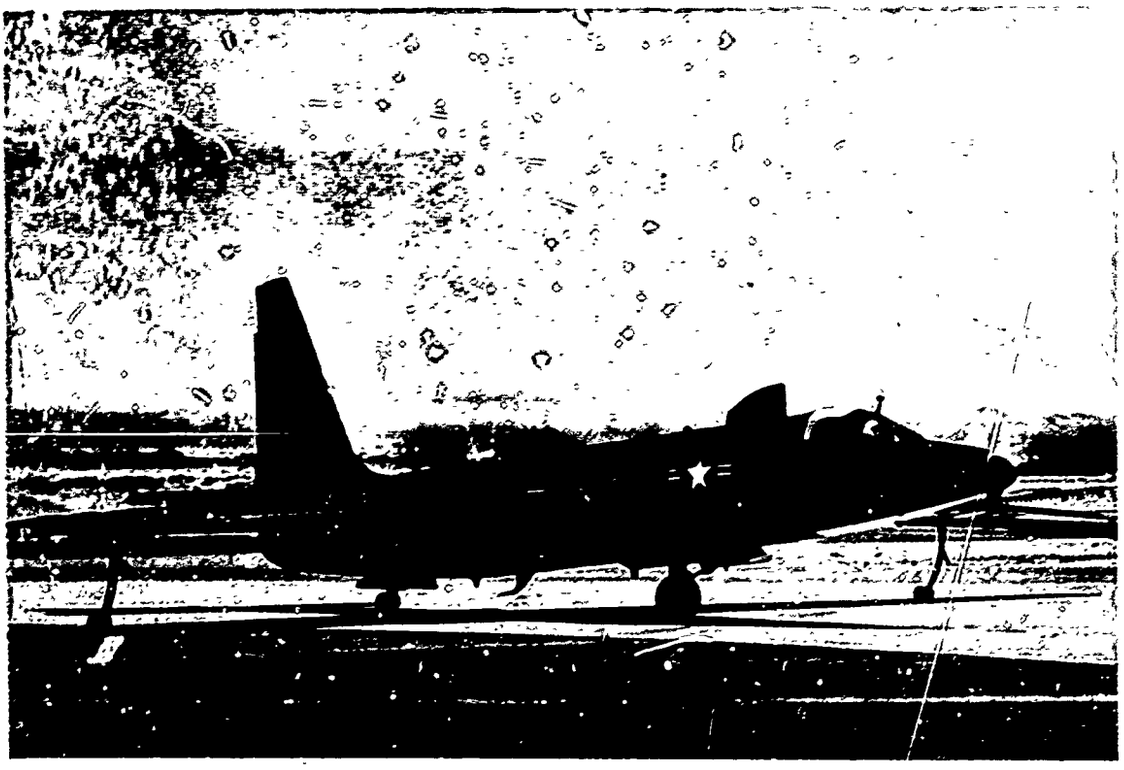
Acknowledgement is made for the valuable assistance of the following Lockheed-California Company personnel: Mr. R. V. Jensen and Miss Joanne McPheeters, data analysis; Mr. D. W. Thompson, field team operation; Messrs R. H. Cook and R. C. Quist, instrumentation; Messrs. R. D. Baker, E. A. Goulette, P. J. Tersigni, and J. M. Rapp, data processing; Messrs. E. V. Ashburn, D. T. Prophet, and D. E. Waco, meteorology; and Mr. R. P. Boal, editor.

This report consists of two volumes. Volume I contains the main body of the report plus Appendix I, Detailed Analysis, and Appendix II, Data Processing. Volume II contains Appendix III, HICAT Flight Test Log, Appendix IV, Time Histories, Appendix V, Gust Velocity Power Spectra, and Appendix VI, Meteorological Summaries of Tests.

This technical report has been reviewed and is approved.



DAVID M. PURDY, 1st Lt., USAF
Chief, Experimental Mechanics Branch
Structures Division



ABSTRACT

This report describes the high altitude clear air turbulence (HICAT) measurements and meteorological correlations derived from Air Force U-2 flights with emphasis upon the results achieved since 13 March 1967, the program extension date. The program effort required the measurement of CAT velocity components at altitudes of 45,000 to 70,000 feet in 6 geographic areas. Instrumentation carried aboard the U-2 consisted of a PCM System, an inertial navigation system, aerodynamic and aircraft response sensors including a fixed vane gust probe, oscillograph recorder, and a digital magnetic tape recorder. Instrumentation capabilities permitted CAT measurements in the wavelength range from about 100 to 50,000 feet. The program objective was to determine the statistical characteristics of high altitude CAT so as to improve structural design criteria. In addition, meteorological forecasts and analyses were to be correlated with the CAT measurements to improve CAT forecast procedures. In the Extended Program, 18.3 hours of high altitude CAT were located and recorded in flights covering over 156,000 miles from bases in England, Louisiana, Maine, Panama, Florida, and California. Actual vertical, lateral, and longitudinal gust velocity time histories and power spectra were determined and analyzed. Peak counts of true vertical gust velocity and derived equivalent gust velocity were obtained. A practical procedure for forecasting high altitude CAT was developed. The pilot's log, gust velocity time histories and power spectra, as well as flight tracks and meteorological descriptions of all the tests appear in Volume II of this report.

Distribution of this Abstract is unlimited.

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GLOSSARY OF RADIOSONDE OBSERVATION STATIONS

UNITED STATES

Station No.	Code	Name
	(UJ-30)*	
402	WAL	Wallops Island, Virginia
403	DIA	Dulles Airport, Virginia
425	HTS	Huntington, West Virginia
503	TEB	Teterboro, New Jersey
506	ACK	Nantucket, Massachusetts
518	ALB	Albany, New York
520	PIT	Pittsburgh, Pennsylvania
528	BUF	Buffalo, New York
606	PWM	Portland, Maine
712	CAR	Caribou, Maine
	(UJ-31)	
201	NQX	Key West, Florida
202	MIA	Miami, Florida
206	JAX	Jacksonville, Florida
208	CHS	Charleston, South Carolina
211	TPA	Tampa, Florida
221	VPS	Valparaiso, Florida
222	PNS	Pensacola, Florida
226	MGM	Montgomery, Mississippi
232	LVE	Boothville, Louisiana
235	JAN	Jackson, Mississippi
304	HAT	Hatteras, North Carolina
311	AHN	Athens, Georgia
317	GSO	Greensboro, North Carolina
327	BNA	Nashville, Tennessee
334	MEM	Memphis, Tennessee
	(UJ-32)	
240	LCH	Lake Charles, Louisiana
248	SHV	Shreveport, Louisiana
250	BRO	Brownsville, Texas
251	CRP	Corpus Christi, Texas
255	VCT	Victoria, Texas
259	GSW	Fort Worth, Texas
261	DRT	Del Rio, Texas
265	MAF	Midland, Texas
266	ABI	Abilene, Texas
340	LIT	Little Rock, Arkansas
344	FSM	Fort Smith, Arkansas
353	OKC	Oklahoma City, Oklahoma
363	AMA	Amarillo, Texas
445	CBI	Columbia, Missouri
451	DDC	Dodge City, Kansas
456	TOP	Topeka, Kansas
465	GLD	Goodland, Kansas
469	DEN	Denver, Colorado
532	PIA	Peoria, Illinois
	(UJ-33)	
429	DAY	Dayton, Ohio
553	OMA	Omaha, Nebraska
562	LBF	North Platte, Nebraska
637	FNT	Flint, Michigan
645	GRB	Green Bay, Wisconsin
654	HON	Huron, South Dakota
655	STC	St. Cloud, Minnesota
747	INL	International Falls, Minnesota
	(UJ-34)	
576	LND	Lander, Wyoming
597	MFR	Medford, Oregon
681	BOI	Boise, Idaho
694	SLE	Salem, Oregon
764	BIS	Bismarck, North Dakota
768	GGW	Glasgow, Montana
775	GTF	Great Falls, Montana
785	GEG	Spokane, Washington
797	UIL	Quillayute, Washington

*Teletype circuit iden. no.

UNITED STATES (Cont)

Station No.	Code	Name
	(UJ-35)	
270	ELP	El Paso, Texas
274	TUS	Tucson, Arizona
280	YUM	Yuma, Arizona
290	MYF	Montgomery Field, San Diego, Calif.
291	NSI	San Nicolas Island, California
295	LAX	Los Angeles, California
365	ABQ	Albuquerque, New Mexico
374	INW	Winslow, Arizona
385	UCC	Yucca Flat, Nevada
386	LAS	Las Vegas, Nevada
393	VBG	Vandenburg Air Force Base, California
476	GJT	Grand Junction, Colorado
486	ELY	Ely, Nevada
493	OAK	Oakland, California
572	SLC	Salt Lake City, Utah
583	WMC	Winnemucca, Nevada
	EDW	Edwards Air Force Base, California

CANADA

Station No.	Code	Name
600	SA	Sable Island, Nova Scotia
722	MW	Maniwaki, Quebec
807	AR	Argentia, Newfoundland
811	ZV	Seven Islands, Quebec
815	JT	Stephenville, Newfoundland
816	YR	Goose Bay, Newfoundland
826	NI	Nitchiquon, Quebec
836	MO	Moosonee, Ontario

CARIBBEAN

Station No.	Code	Name
394	MTY	Monterrey, Mexico
644	MID	Merida, Mexico
692	VER	Veracruz, Mexico
001	MCSP	San Andres Island, Colombia
016	MKKF	Kindly Field, Bermuda
063	MYGM	Great Abaco, Bahamas
076	ZQBL	Harbour Isle, Bahamas
118	ZQJT	Turks Isle, Bahamas
355	MUCM	Camaguey, Cuba
367	MUGM	Guantanamo, Cuba
384	MKCG	Georgetown, Grand Cayman Island
397	MKJP	Kingston, Jamaica
486	MDSD	Santo Domingo, Dominican Republic
501	KSWA	Swan Island, U.S.A.
526	MJSJ	San Juan, Puerto Rico
806	MHHO	Howard AFB, Canal Zone
866	MACM	Juliana Airport, St. Martin
897	MFFR	Raizet Airdrome, Guadelupe
954	MKPB	Seawell Airport, Barbados
988	MACC	Dr. Plesman Airport, Curacao
967	CGU	Chaguaramas Bay, Trinidad
222	MCBO	Bogata, Colombia

EUROPE

Station No.	Name
415	Stavanger, Norway
084	Goteborg, Sweden
005	Lerwick, Shetland Isles
026	Stornoway, Scotland
170	Shanwell, Scotland
322	Aughton, England
496	Hemsby, England
774	Crawley, England
808	Camborne, England
920	Longkesh, England
953	Valentia, Ireland
260	DeBilt, Netherlands
447	Uccle, Belgium
110	Brest/Guipavas, France
145	Trappes, France
180	Nancy, France
513	Köln, Germany
	Ocean Weather Ship "I" (59°N, 19°W)

APPENDIX III

HICAT FLIGHT TEST LOG

This appendix presents the HICAT Flight Test Log. The log documents for each test the following information:

- Test number
- Test date (Greenwich Mean Time)
- Test pilot
- Purpose of the test
- Duration of the test in hours and minutes
- Duration of any CAT encountered above 45,000 feet in hours and minutes
- Remarks describing significant test details, e.g., maximum cg acceleration response in turbulence, aircraft or instrumentation malfunctions, and other unusual events.

The log encompasses all the tests in the extended program beginning with Test 180 and ending with Test 285. The log for the HICAT programs prior to the extension are contained in Reference 4 for the Initial HICAT investigation, and Reference 6 for the Redirected program.

A test appears in the log whenever the HICAT instrumentation package was installed and operated. Flight times were normally established from the quick-look oscillogram by determining the time differential between the start of the takeoff roll and the end of the landing roll. When the oscillograph record was incomplete or unavailable, the time was obtained from the pilot's records. The time in turbulence or HICAT time was determined as described under Editing in Volume I, Section V.

APPENDIX III

HICAT FLIGHT TEST LOG

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min)	Remarks
180	3-13-67	Mason	Ferry flight from Edwards AFB, California to Hanscom Field, Bedford, Massachusetts.	5:40	0:15	Light turbulence en route.
181	3-15-67	Smith	Ferry flight from Hanscom Field, Bedford, Massachusetts to Bedford, England	7:00	0:02	Night flight over Atlantic. Gust sensing vanes damaged during landing in severe crosswind.
182	3-17-67	Mason	HICAT search from Bedford, England	4:46	0:16	Oscillograph inoperative. Light to moderate CAT 48,000 to 55,000 ft. RAE Canberra at 38,000 ft reported no CAT. LN-3 inoperative.
183	3-20-67	Smith	HICAT search from Bedford, England	4:54	0	Light tubulence was forecast.
184	3-21-67	Mason	HICAT search from Bedford, England	5:12	0:06	No turbulence was forecast.
185	3-22-67	Smith	HICAT search from Bedford, England	4:27	0:01	No turbulence was forecast.
186	3-28-67	Mason	HICAT search from Bedford, England	3:54	0	Light CAT was forecast.
187	3-30-67	Smith	Functional check and HICAT search from Bedford, England	2:42	0	New aircraft generator installed and checked out.
188	3-31-67	Mason	HICAT search from Bedford, England	4:29	0	Flew over England and Scotland.
189	4-3-67	Smith	HICAT search from Bedford, England	5:35	0:10	Some light CAT. X-distance not functioning.
190	4-4-67	Mason	HICAT search from Bedford, England	5:41	0:14	Extensive turbulence. Several ±0.4g acceleration peaks. Y-distance not functioning.
191	4-12-67	Smith	HICAT search from Bedford, England	6:17	0	Flew over France and Italy. Y-distance inoperative. No tape.
192	4-13-67	Mason	HICAT search from Bedford, England	5:05	0:01	Negligible CAT. Y-distance inoperative.
193	4-14-67	Smith	HICAT search from Bedford, England	4:55	0:12	Flew over France. Light turbulence.
194	4-17-67	Mason	Ferry flight from Bedford, England to Hanscom Field, Massachusetts	7:33	0	Sparmo radiation counter failed.
195	4-18-67	Smith	Ferry flight, and HICAT search, from Hanscom Field, Massachusetts to Patrick AFB, Florida	4:02	0	No Sparmo spare available. HICAT instrument package removed after flight.
196	5-2-67	King	HICAT search from Barksdale AFB, Louisiana	5:00	0:41	Pilot reported light to moderate CAT. Time code generator failed, no tape.
197	5-3-67	Palmer	HICAT search from Barksdale AFB	5:00	0:25	Light to moderate CAT reported. Time code generator failed near end of flight.
198	5-5-67	King	HICAT search from Barksdale AFB	5:45	0:51	First flight in cooperation with Severe Storm Project at Norman, Oklahoma, ±0.5g reported over storm north of Oklahoma City. Y-distance and calibrator failed.
199	5-8-67	Palmer	HICAT search from Barksdale AFB	5:44	0:35	±0.4g reported over Austin, Texas. Y-distance and calibrator failed.
200	5-9-67	King	HICAT search from Barksdale AFB	4:02	0	Negligible CAT.
201	5-10-67	Palmer	HICAT search from Barksdale AFB	4:25	0:06	Severe Storm flight #2, light CAT en route, moderate CAT reported over storm. Oscillograph calibrator malfunctioned.
202	5-12-67	King	HICAT search from Barksdale AFB	4:38	0:21	Severe Storm flight #3. Severe to extreme CAT reported, ±0.8g cg acceleration peaks. Calibrator failed before flight - removed from circuit. X- and Y- distance inoperative. Run of 270 sec of moderate CAT below 4000 ft.

APPENDIX III

HICAT FLIGHT TEST LOG (Continued)

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min)	Remarks
203	5-15-67	Palmer	HICAT search from Barksdale AFB	2:10	0:01	Engine flameout 31 min after takeoff. Restarted engine and returned to base for engine check. Instruments operational.
204	5-15-67	Palmer	HICAT search from Barksdale AFB	3:27	0:14	Damaged α-vane prior to this flight. X- and Y- distance inoperative.
205	5-16-67	King	HICAT search from Barksdale AFB	5:24	0:43	X- and Y- distance inoperative. Pilot reported considerable ±0.4g cg acceleration peaks.
206	5-17-67	Palmer	HICAT search from Barksdale AFB	3:48	0:02	LN-3 computer replaced prior to flight. X- and Y- distance inoperative.
207	5-19-67	King	HICAT search from Barksdale AFB	3:00	0:09	LN-3 platform replaced prior to flight. Severe Storm flight #4. Tape recorder off during first 1 hr and 15 min of flight, IRIG-C time code jumped ahead. X-distance malfunctioning. Moderate CAT reported over storm. Tape unsalvagable.
208	5-22-67	King	HICAT search from Barksdale AFB	4:13	0:05	Damaged α-vane discovered - damaged prior to Test 204. IRIG-C time jumped ahead 1 hour at engine start. X- and Y- distance inoperative. Pilot reported light turbulence.
209	5-24-67	King	HICAT search from Barksdale AFB	2:17	0	Damaged α-vane replaced before flight. No turbulence reported. X-distance inoperative.
210	5-25-67	King	HICAT search from Barksdale AFB	3:42	0	Pilot reported some light and very light turbulence. X- and Y-distance inoperative.
211	5-26-67	King	Ferry flight from Barksdale AFB, Louisiana to Edwards AFB, California	3:36	0:01	Negligible CAT. X- and Y-distance inoperative.
212	6-18-67	Smith	Ferry flight from Edwards AFB, California to Loring AFB, Maine	6:20	0	Rosemount altitude not installed for this flight.
213	6-20-67	King	HICAT search from Loring AFB	3:57	0:01	Pilot reported some light, ±0.1g, turbulence.
214	6-22-67	Smith	HICAT search from Loring AFB	4:37	0	Pilot reported one very light encounter.
215	6-23-67	King	HICAT search from Loring AFB	3:35	0:05	Vernier altitude failed during flight. Pilot reported encountering light and very light turbulence.
216	6-27-67	King	HICAT search from Loring AFB	4:25	0	Engine flameout at 1649Z, LN-3, oscillograph and tape recorder were turned off at this time. Vernier altitude failed during flight. Pilot reported two very light encounters before the flameout.
217	6-29-67	Smith	HICAT search from Loring AFB	4:51	0	IRIG-C time jumped ahead 40 min during power transient prior to takeoff. Fine altitude inoperative. No turbulence reported by pilot.
218	6-30-67	King	HICAT search from Loring AFB	4:25	0	No turbulence reported by pilot. Calibrator malfunctioned. Y-distance in error.

APPENDIX III

HICAT FLIGHT TEST LOG (Continued)

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min,	Remarks
219	7-5-67	Smith	HICAT search from Loring AFB	4:24	0:05	Pilot reported some very light patches of CAT. Vernier altitude failed. Y-distance in error.
220	7-6-67	King	HICAT search from Loring AFB	3:48	0:13	Pilot reported some light turbulence. Vernier altitude operated satisfactorily.
221	7-7-67	Smith	HICAT search from Loring AFB	3:45	0:01	Flameout occurred and system was shut down. Pilot reported some very light turbulence. Vernier altitude failed.
222	7-14-67	Smith	HICAT search from Loring AFB	6:00	0:04	Light turbulence. Oscillograph recorder doubled its speed in flight and timing lines were erratic. Y-distance in error. Run of 2.25 sec of moderate CAT at 1000 ft.
223	7-16-67	Smith	Ferry flight from Loring AFB, Maine to Edwards AFB, California	6:15	0:03	Very light CAT sample at 53,000 ft.
224	7-18-67	King	Ferry flight from Edwards AFB, California to Patrick AFB, Florida	5:30	0:13	LN-3 malfunctioned, no LN-3 data. Oscillograph record lost.
225	7-20-67	King	Ferry flight from Patrick AFB, Florida to Albrook AFB, Panama Canal Zone, Panama	3:35	0	LN-3 malfunctioning. No turbulence.
226	7-24-67	King	HICAT search from Albrook AFB	5:30	0	No IRIG-C time code on oscillograph. No timing lines. Vernier altitude malfunctioning. CG lateral and longitudinal acceleration noisy. LN-3 malfunctioned.
227	7-25-67	King	HICAT search from Albrook AFB	3:47	0:17	Heading sine and cosine malfunctioning. Light CAT encountered at about 57,000 ft. Y-distance in error.
228	7-27-67	King	HICAT search from Albrook AFB	4:05	0:44	Many long samples of light CAT. Y-distance in error.
229	7-28-67	King	HICAT search from Albrook AFB	3:30	0:02	Very light turbulence. Y-distance in error.
230	7-31-67	Smith	HICAT search from Albrook AFB	4:00	0:04	Heading sine malfunctioned. Very light CAT.
231	8-2-67	Smith	HICAT search from Albrook AFB	5:00	0:27	Extensive light to moderate CAT. LN-3 malfunctioned.
232	8-4-67	Smith	HICAT search from Albrook AFB	4:00	0:16	A long sample of moderate CAT at 50,000 ft. Y-distance in error.
233	8-7-67	Smith	HICAT search from Albrook AFB	4:00	0:33	Moderate and severe CAT encountered above a thunderstorm. Peak cg incremental acceleration of approximately 1.0g.
234	8-8-67	Smith	HICAT search from Albrook AFB	4:40	0:02	Light turbulence at approximately 48,500 ft. Y-distance in error.
235	8-10-67	Smith	HICAT search from Albrook AFB	3:30	0:09	No IRIG time code - time in turbulence is estimated. X- and Y-distance in error.
236	8-11-67	Smith	HICAT search from Albrook AFB	4:30	0:18	Sampling rate inadvertently set at 20 sps. Some long samples of light CAT.
237	8-14-67	Smith	HICAT search from Albrook AFB	5:05	0	No turbulence encountered. (Sampling rate is 20 sps).
238	8-17-67	Smith	Ferry flight from Albrook AFB, Panama Canal Zone, Panama to Edwards AFB, California	6:45	0	No turbulence encountered. (Sampling rate is 20 sps).

APPENDIX III

HICAT FLIGHT TEST LOG (Continued)

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min)	Remarks
239	9-5-67	Palmer	HICAT search from Edwards AFB	3:24	0:03	Coarse altitude inoperative on oscillograph. (Sampling rate is 20 sps).
240	9-8-67	Johnson	Ferry flight from Edwards AFB, California to Patrick AFB, Florida	5:22	0	Aileron and rudder position have an extremely high noise level (sampling rate is 20 sps).
241	9-11-67	Johnson	HICAT search from Patrick AFB	5:35	0:11	Very light CAT at 63,000 ft. Tape not salvageable due to intermittent failure of airborne digital record amplifier power supply (sampling rate is 20 sps).
242	9-12-67	King	HICAT search from Patrick AFB	3:54	0:15	CG normal acceleration was inoperative on oscillograph. Turbulence at 62,000 and 67,000 ft. (Sampling rate is 20 sps).
243	9-14-67	Johnson	HICAT search from Patrick AFB	2:54	0	Erroneous sample rate corrected. Vernier altitude - unstable stepping. Oscillograph indicated failure of cg normal acceleration for 24 min and coarse altitude for 29 min.
244	9-15-67	Johnson	HICAT search from Patrick AFB	4:04	0	Excessive noise on elevator, aileron, and rudder position. Vernier altitude unstable when stepping. CG normal acceleration shifts level intermittently.
245	9-18-67	Mason	HICAT search from Patrick AFB	3:05	0	Tape not salvageable. Intermittent failure of digital record amplifier power supply. CG normal acceleration inoperative.
246	9-19-67	Mason	HICAT search from Patrick AFB	4:10	0	Tape not salvageable Intermittent failure of digital record amplifier power supply. Y-distance in error.
247	9-20-67	Mason	HICAT search from Patrick AFB	6:14	0:28	Turbulence from 58,000 to 63,000 ft. Tape has areas of bad parity indication. Turns were made during portions of the turbulence.
248	9-21-67	Johnson	HICAT search from Patrick AFB	3:24	0:07	Tape not salvageable. Intermittent failure of digital record amplifier power supply. Turbulence at 52,000 ft.
249	9-25-67	Basquez	HICAT search from Patrick AFB	4:34	0	Turbulence from 25,000 to 40,000 ft, none higher.
250	9-26-67	Mason	HICAT search from Patrick AFB	3:50	0	Noise on aileron position. Vernier altitude - unstable when stepping.
251	9-27-67	Basquez	HICAT search from Patrick AFB	4:08	0:09	Possible long wave CAT at 59,000 ft.
252	9-28-67	Mason	HICAT search from Patrick AFB	5:21	0:27	Elevator movements during CAT. Possibly some long wave CAT.
253	9-29-67	Basquez	HICAT search from Patrick AFB	4:54	0:08	Coarse altitude inoperative. Some elevator and aileron movement during CAT.
254	10-2-67	Basquez	HICAT search from Patrick AFB	4:02	0:02	Vernier altitude - unstable when stepping. Uneven, patchy CAT.
255	10-3-67	Mason	Ferry flight from Patrick AFB, Florida to Edwards AFB, California	5:10	0	No CAT encountered.
256	11-16-67	Johnson	HICAT search from Edwards AFB	4:33	0:05	Excessive noise on platform vertical acceleration. Coarse altitude was in error throughout flight. Very light turbulence.

APPENDIX III

HICAT FLIGHT TEST LOG (Continued)

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min)	Remarks
257	11-17-67	King	HICAT search from Edwards AFB	3:50	0:23	Noise on rudder position. Extensive communication interference during turbulence runs. Contains a 255 sec run in moderate to severe turbulence below 5000 ft altitude.
258	11-20-67	Mason	HICAT search from Edwards AFB	5:03	0:17	Light to moderate turbulence at about 54,000 ft altitude.
259	11-21-67	Mason	HICAT search from Edwards AFB	3:36	0:15	Mostly light turbulence at 50,000 - 54,000 ft. Three runs of 2 min or more duration.
260	11-22-67	King	HICAT search from Edwards AFB	2:30	0:02	Night flight. Flameout caused termination of data collection after 1 hr and 13 min of flight.
261	11-28-67	King	HICAT search from Edwards AFB	3:53	0:08	Night flight. Elevator position noisy. Very light turbulence.
262	11-29-67	Ludwig	HICAT search from Edwards AFB	4:59	0:58	Moderate turbulence from 80 to 200 sec duration. One incremental cg acceleration peak of ± 0.4g.
263	11-30-67	King	HICAT search from Edwards AFB	3:22	0:01	Night flight. Very little CAT encountered.
264	11-30-67	Mason	HICAT search from Edwards AFB	4:56	0:37	Contains 9 min of moderate to severe CAT including one 6-min sample. Peaks of ± 0.65g incremental cg acceleration were encountered.
265	12-1-67	Johnson	HICAT search from Edwards AFB	4:25	1:09	Night flight. Longest run was 325 sec. Maximun acceleration peaks were ±0.65g. CAT encountered varied from very light to severe. Extensive noise on heading sine and cosine and on aileron position. No timing lines on the oscillograph but the time code was operative.
266	12-1-67	Smith	HICAT search from Edwards AFB	3:48	1:02	Severe turbulence run with + 1.0, - 0.7g incremental peak. Two runs of 7-1/2 min duration were also encountered. Extensive noise on aileron, rudder, and elevator position, and heading sine and cosine.
267	12-2-67	Mason	HICAT search from Edwards AFB	4:35	0:51	Night flight. Longest run was 455 sec. Turbulence was moderate to severe. Maximum cg incremental acceleration was ± 0.6g. Rudder position noisy. Extensive noise on heading sine and cosine.
268	12-2-67	Busquez	HICAT search from Edwards AFB	4:37	0:09	Maximum cg acceleration increments of ± 0.3g. Extensive noise on heading sine and cosine.
269	1-30-68	Smith	HICAT search from Edwards AFB	4:59	0:05	Light turbulence. Oscillograph indicated failure of cg normal acceleration.
270	1-31-68	Johnson	HICAT search from Edwards AFB	3:28	0:05	Control pulses and roller coasters on this flight. Very light turbulence.
271	2-1-68	Palmer	HICAT search from Edwards AFB	4:57	0	No turbulence.
272	2-2-68	Mason	HICAT search from Edwards AFB	3:41	0	Night flight. No turbulence.
273	2-2-68	King	HICAT search from Edwards AFB	5:18	0:02	Very little turbulence encountered.

APPENDIX III

HICAT FLIGHT TEST LOG (Continued)

Test	Date	Pilot	Test Purpose	Flight Time (Hr:Min)	HICAT Time (Hr:Min)	Remarks
274	2-5-68	Mason	HICAT search from Edwards AFB	3:20	0	Negligible turbulence. CG lateral acceleration noisy on oscillograph.
275	2-6-68	King	HICAT search from Edwards AFB	3:40	0	No turbulence.
276	2-8-68	King	HICAT search from Edwards AFB	4:17	0	No turbulence.
277	2-9-68	Mason	HICAT search from Edwards AFB	4:10	0:06	Light turbulence encountered. Some intermittent noise on cg normal acceleration on oscillograph trace.
278	2-12-68	Palmer	HICAT search from Edwards AFB	2:53	0	No turbulence.
279	2-14-68	Smith	HICAT search from Edwards AFB	5:55	0:04	Light turbulence. Extensive communication interference on oscillograph and PCM.
280	2-15-68	Mason	HICAT search from Edwards AFB	6:08	0:43	Moderate to severe turbulence with some peak incremental accelerations of ± 1.0g in mountain wave in Denver area.
281	2-16-68	Johnson	HICAT search from Edwards AFB	6:16	0:06	Some light and moderate CAT in Denver area. Four altitudes sampled, 50,000-59,000 ft. Control pulses and roller coasters performed.
282	2-19-68	King	HICAT search from Edwards AFB	5:45	0:10	Some moderate turbulence with peak incremental accelerations of ±0.55g in Denver area. Three altitudes sampled, 50,000-62,000 ft.
283	2-26-68	King	HICAT search from Edwards AFB	5:42	0:02	Four altitudes sampled, 53,000-62,200 ft in Alamosa, Colorado area. Light CAT only.
284	2-28-68	Palmer	HICAT search from Edwards AFB	3:47	0	No significant turbulence.
285	2-29-68	King	Instrumentation check flight from Edwards AFB	3:29	0	Flew side-by-side with Canadian NAE T-33 from Las Vegas to Grand Junction. This portion of the flight was below 45,000 ft.
105				477:36	18:20	

APPENDIX IV

TIME HISTORIES

In general, gust velocity time histories are presented for all cases in which gust velocities were computed and satisfactory power spectra were obtained and plotted. These time histories appear on the following pages in order by test and run number. For a particular test and run, the first left hand page presents time histories of the first 360 seconds of the vertical, lateral, and longitudinal gust velocity components, derived equivalent gust velocity, corrected pressure altitude, and ambient air temperature. The right hand facing page presents the corresponding 360 seconds of the true airspeed, roll angle, aircraft heading*, elevator position, cg longitudinal acceleration, and cg normal acceleration. For longer runs the sequence described above is repeated in 360-second increments until the end of the run is reached. Each page is labeled with the test number, run number, date, and base of operations. Also included in a separate block are the number of data points plotted per second, the numerical filter pass band, and the start of the run in Greenwich mean time.

The basic time scale on the plots is 10 seconds per major division. The parameter scales can be determined from the individual plots. Normally they are as follows:

Parameter	Scale per Major Division
Vertical, lateral, and longitudinal gust velocities	20 ft/sec
Derived equivalent gust velocity	10 ft/sec.
Corrected pressure altitude	1000 ft
Ambient temperature	5° Celcius
True airspeed	20 ft/sec
Roll angle	5 degrees
Aircraft heading*	5 degrees
Elevator position	2 degrees
CG longitudinal acceleration	0.05g

*Tests 180 through Test 205 show cg lateral acceleration instead of aircraft heading.

Parameter	Scale per Major Division
CG lateral acceleration	0.20g
CG vertical acceleration	0.50g

In those cases where the variation of a parameter was unusually large, the plotting program automatically selects the next larger compatible scale. The change of scale logic considers only the parameter variations occurring in 360 seconds so that in a few cases a scale change will occur in the middle of a run.

In all cases, linear trends were removed from the true gust velocity components as well as the elevator position. Since the linear trend of the latter measurement is negligible, the effect is to maintain the average elevator angle excursions very close to zero.

The letter code following the gust velocity component label identifies the measurements used in the gust velocity determination. If the letter code begins with a "P", then inertial platform measurements were used. If the initial "P" is absent then cg or gust probe (GP) accelerations were integrated to obtain aircraft translational velocities and angular changes were obtained from integration of gyro angular rate measurements. This latter computation is used when the platform measurements are unreliable because of some malfunction. These cases are identified by accelerometer location, i.e., either CG or GP.

In a few cases, instrument malfunctions occurred. Some of these are evident in the time histories. For example, the elevator position potentiometer was occasionally noisy as manifested by the random spikes of Test 205, run 10 (Figure 14) and Test 266, run 12 (Figure 40). Note also that the spikes sometimes cause the plot to be rescaled with a resulting loss in elevator angle resolution. To avoid confusion, known instrument malfunctions appearing in the time histories are so labeled.

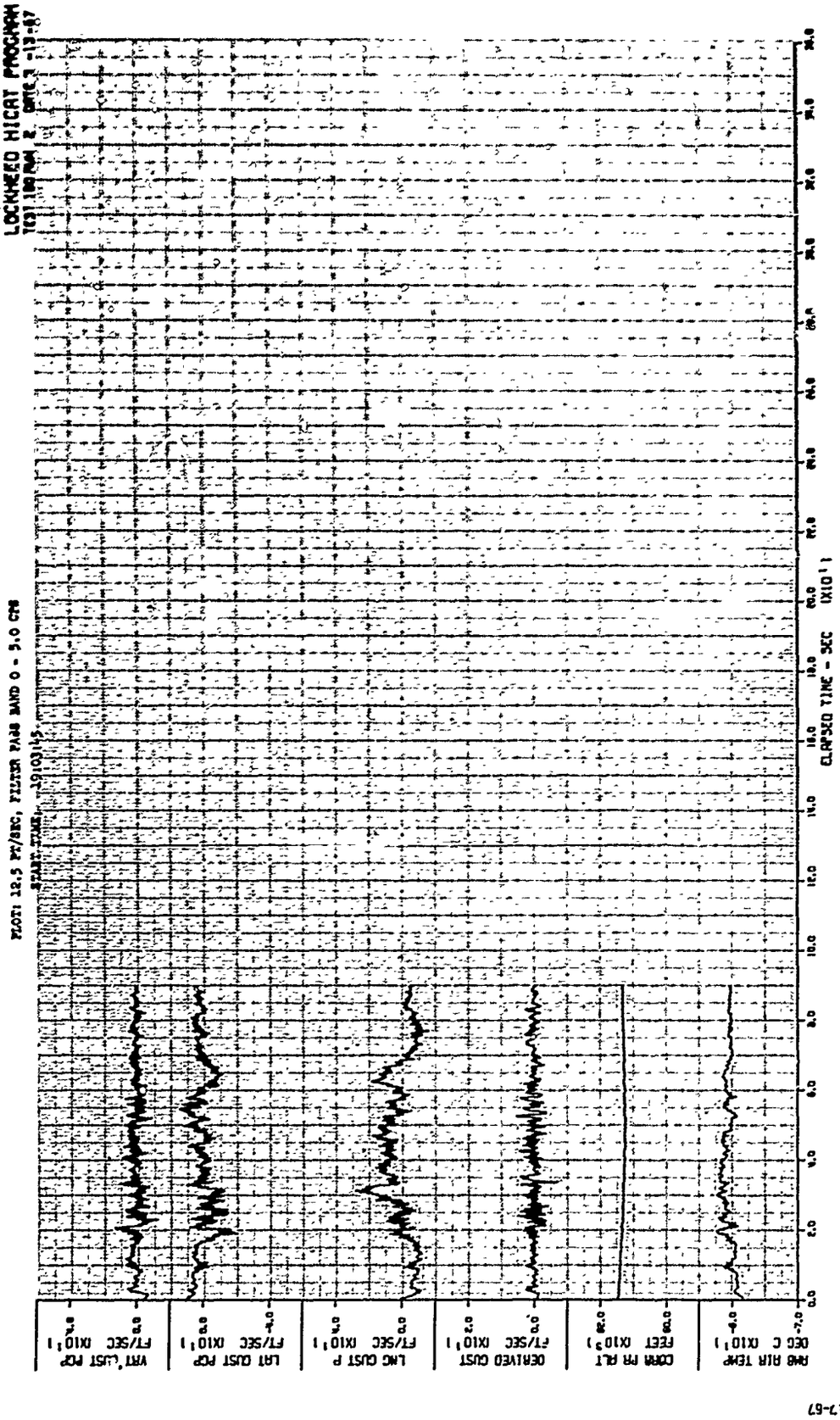


Figure 1A Gust Velocity Time Histories of Test 180, Run 2 - Ferry Flight from Edwards AFB, California, to Hanscom Field, Bedford, Massachusetts, 13 Mar 67

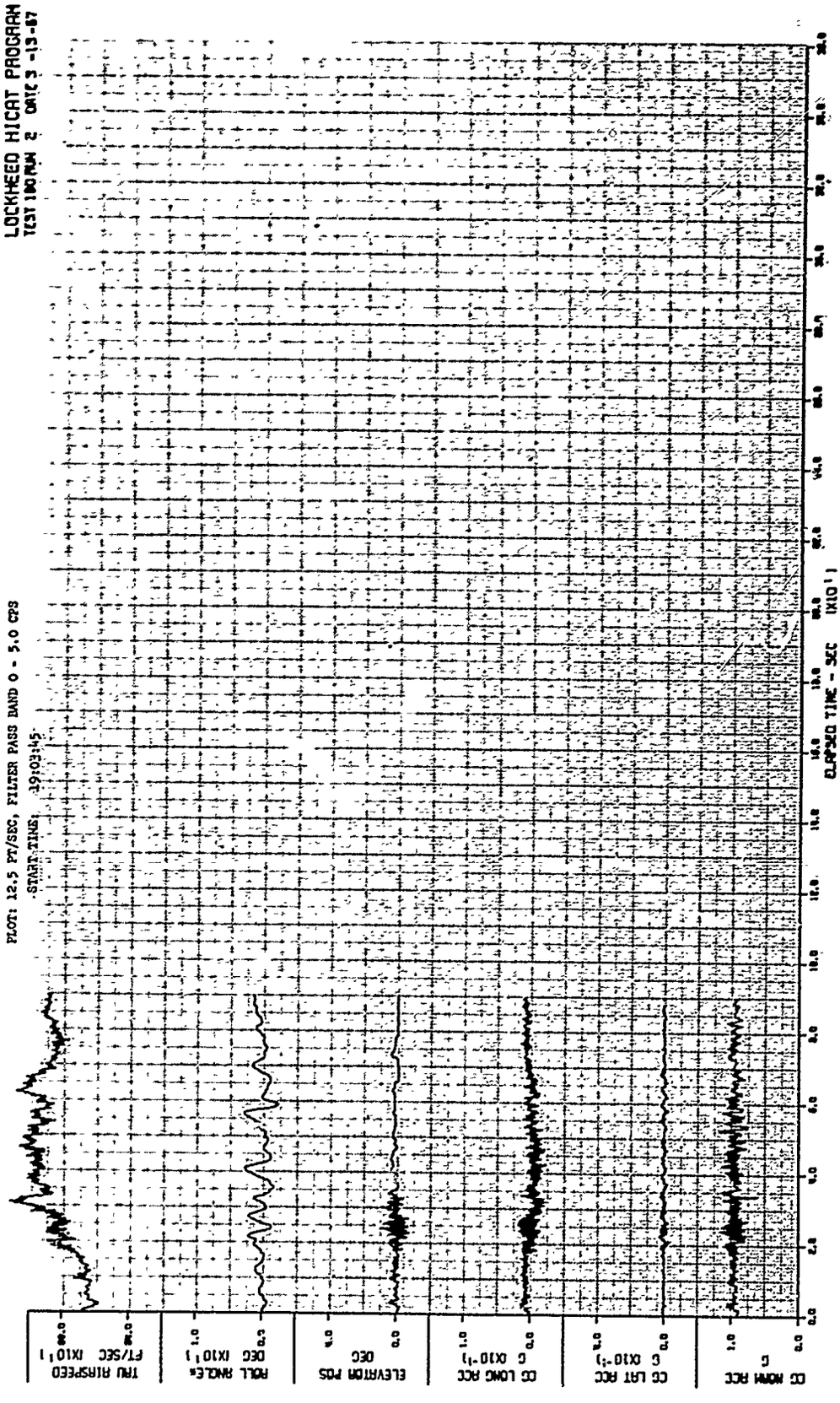


Figure 1B Flight Parameter Time Histories of Test 180, Run 2

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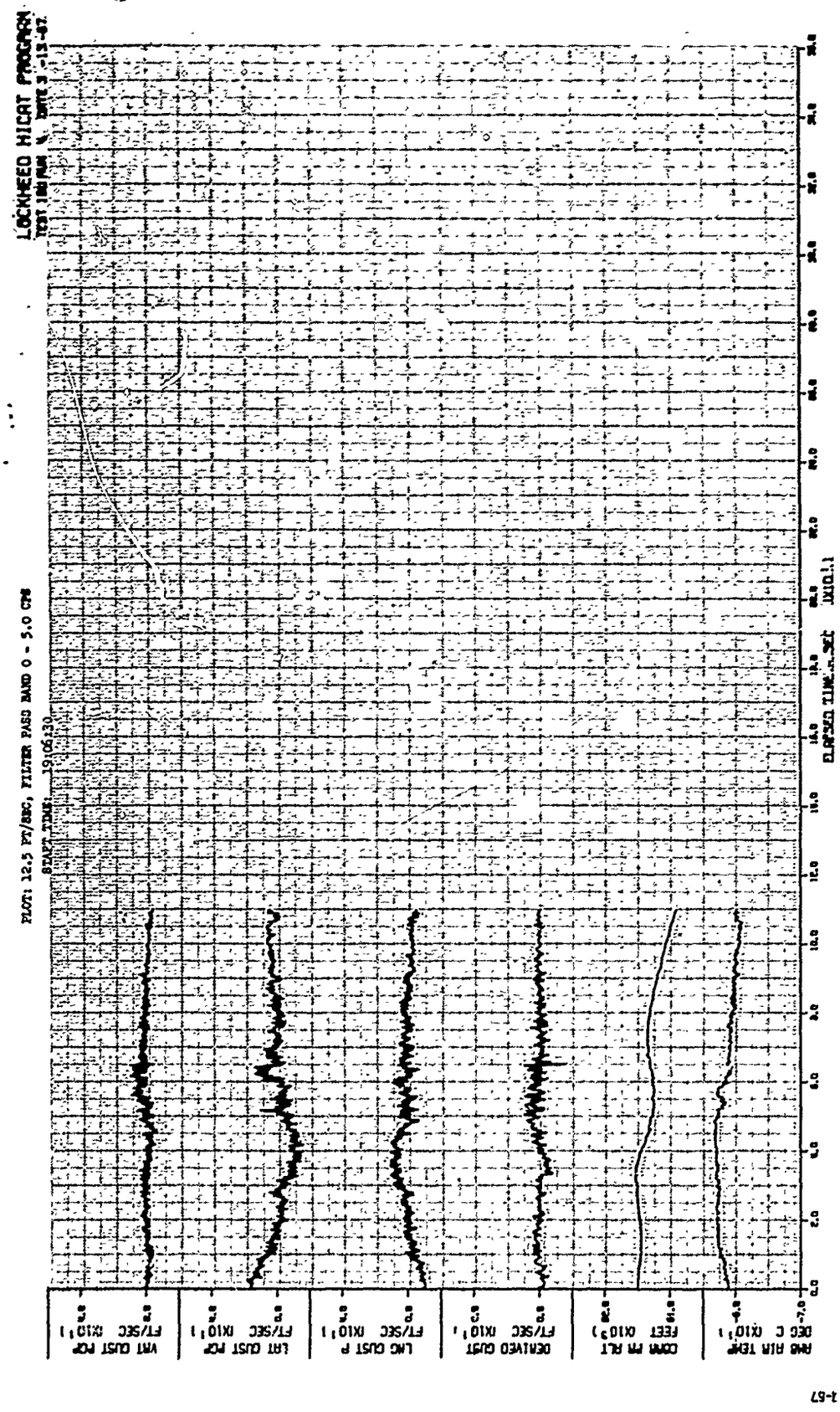


Figure 2A Gust Velocity Time Histories of Test 180, Run 4 - Ferry Flight from Edwards AFB, California, to Hanscom Field, Bedford, Massachusetts, 13 Mar 67

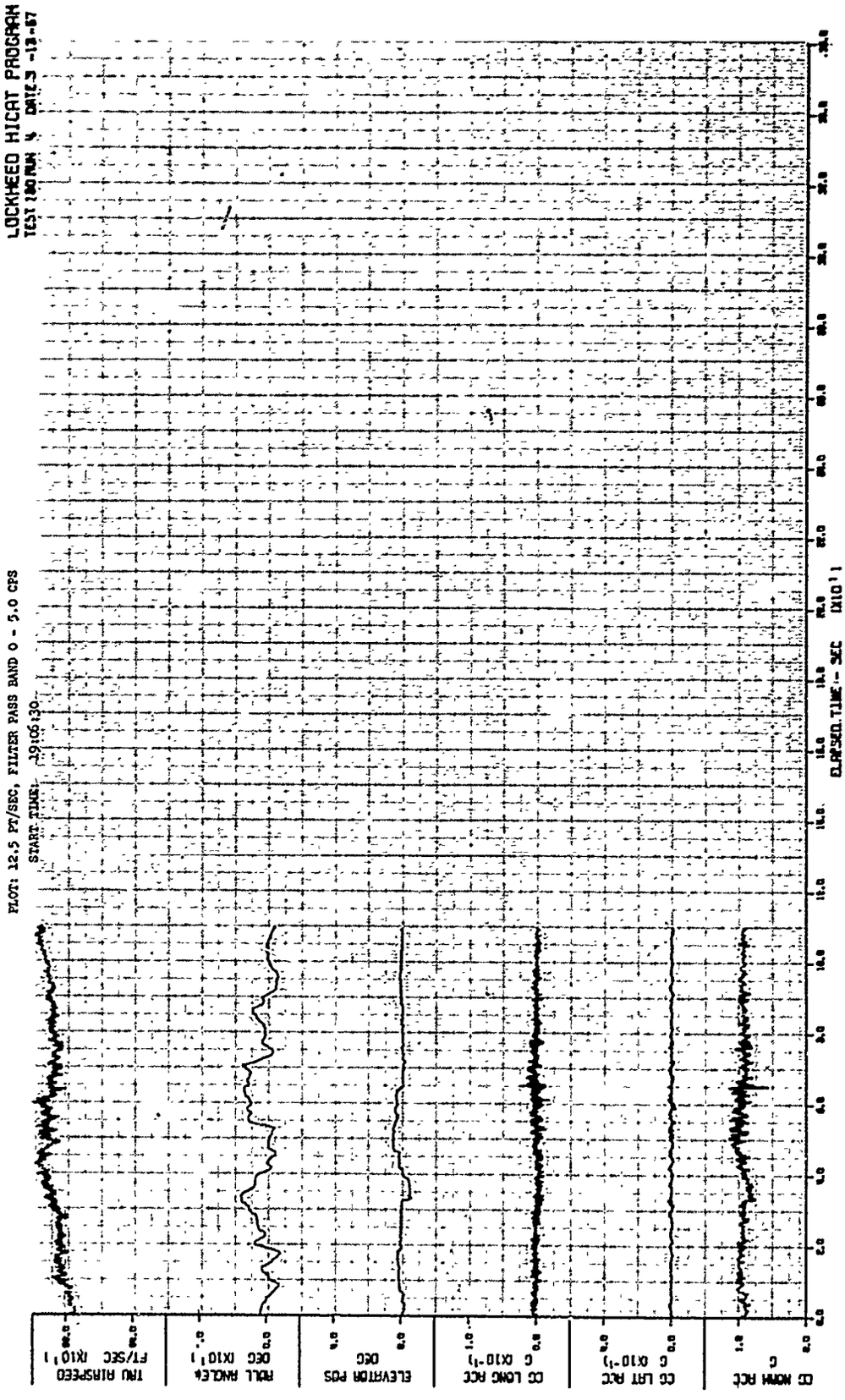


Figure 2B Flight Parameter Time Histories of Test 180, Run 4

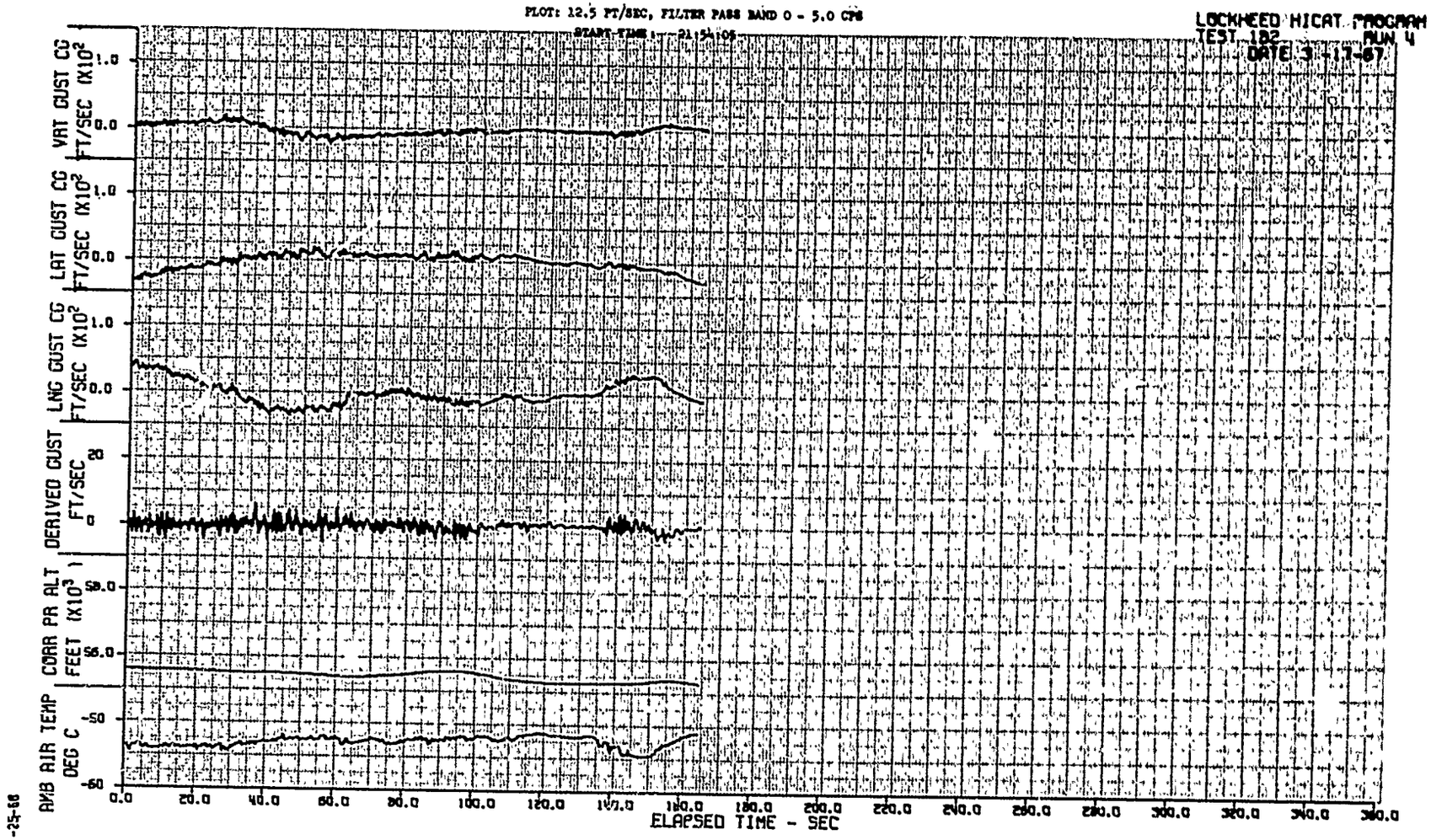


Figure 3A Gust Velocity Time Histories of Test 182, Run 4 - RAE, Bedford, England, 17 Mar 67

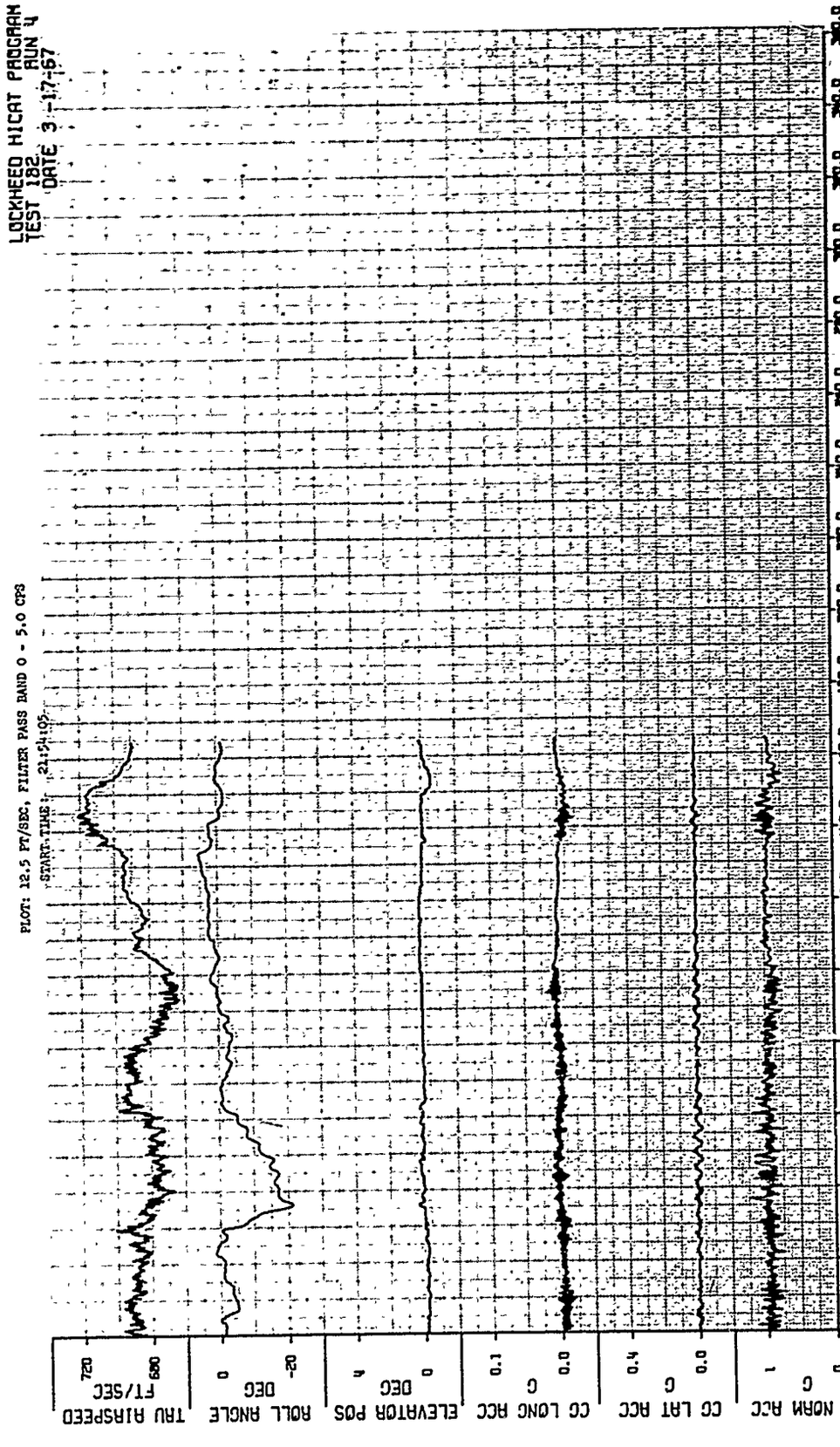


Figure 3B Flight Parameter Time Histories of Test 182, Run 4

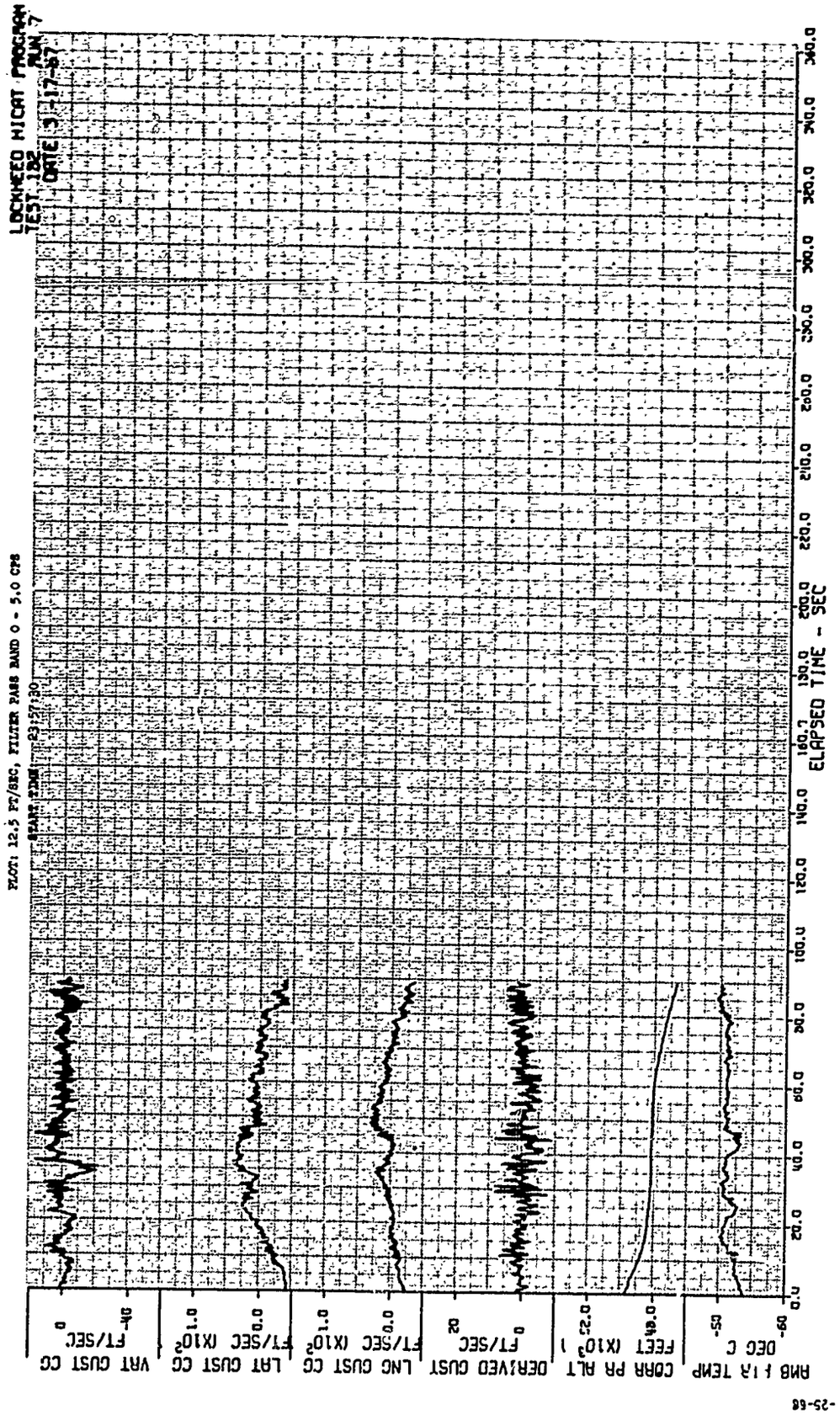


Figure 4A Gust Velocity Time Histories of Test 182, Run 7, RAE, Bedford, England, 17 Mar 67

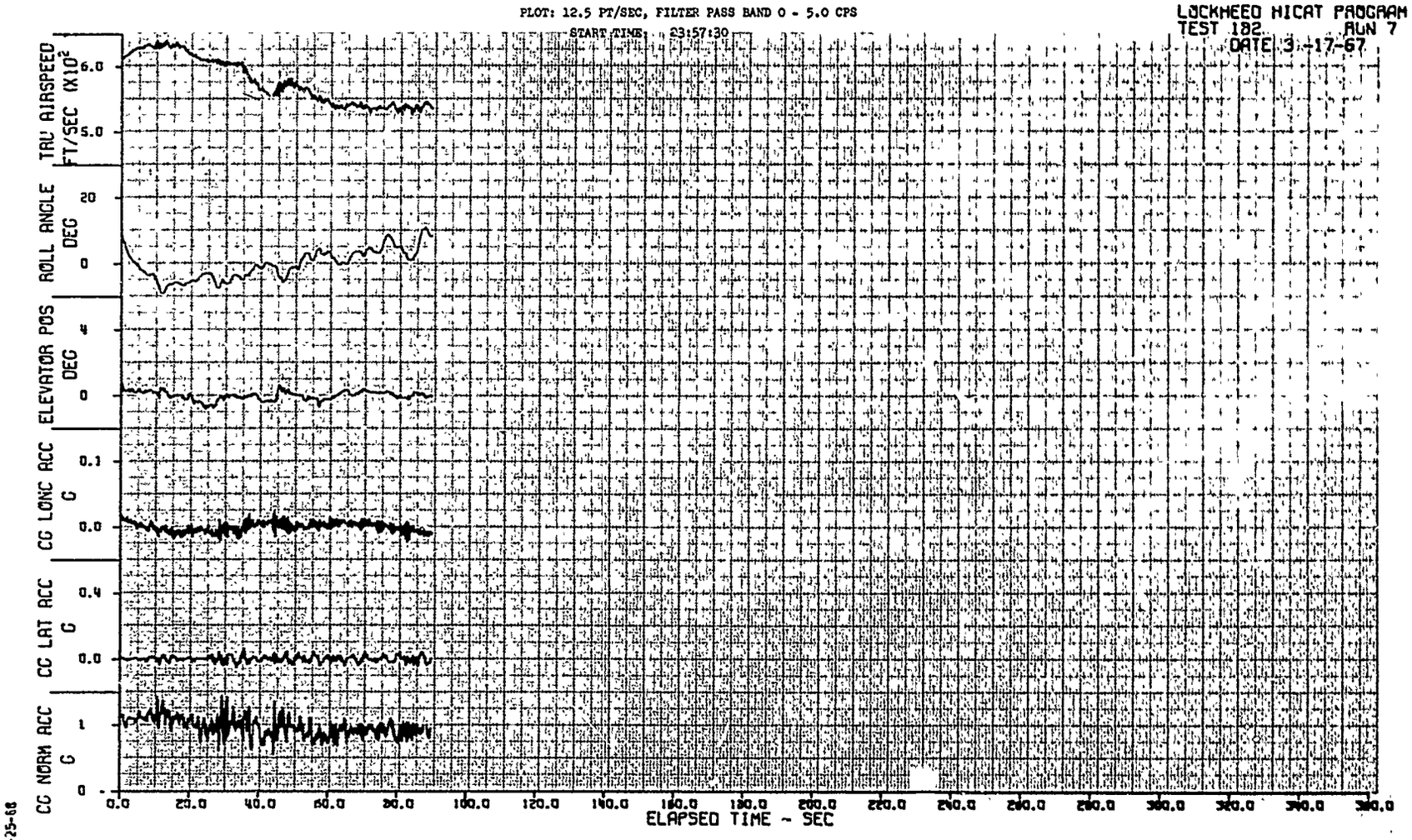


Figure 4B Flight Parameter Time Histories of Test 182, Run 7

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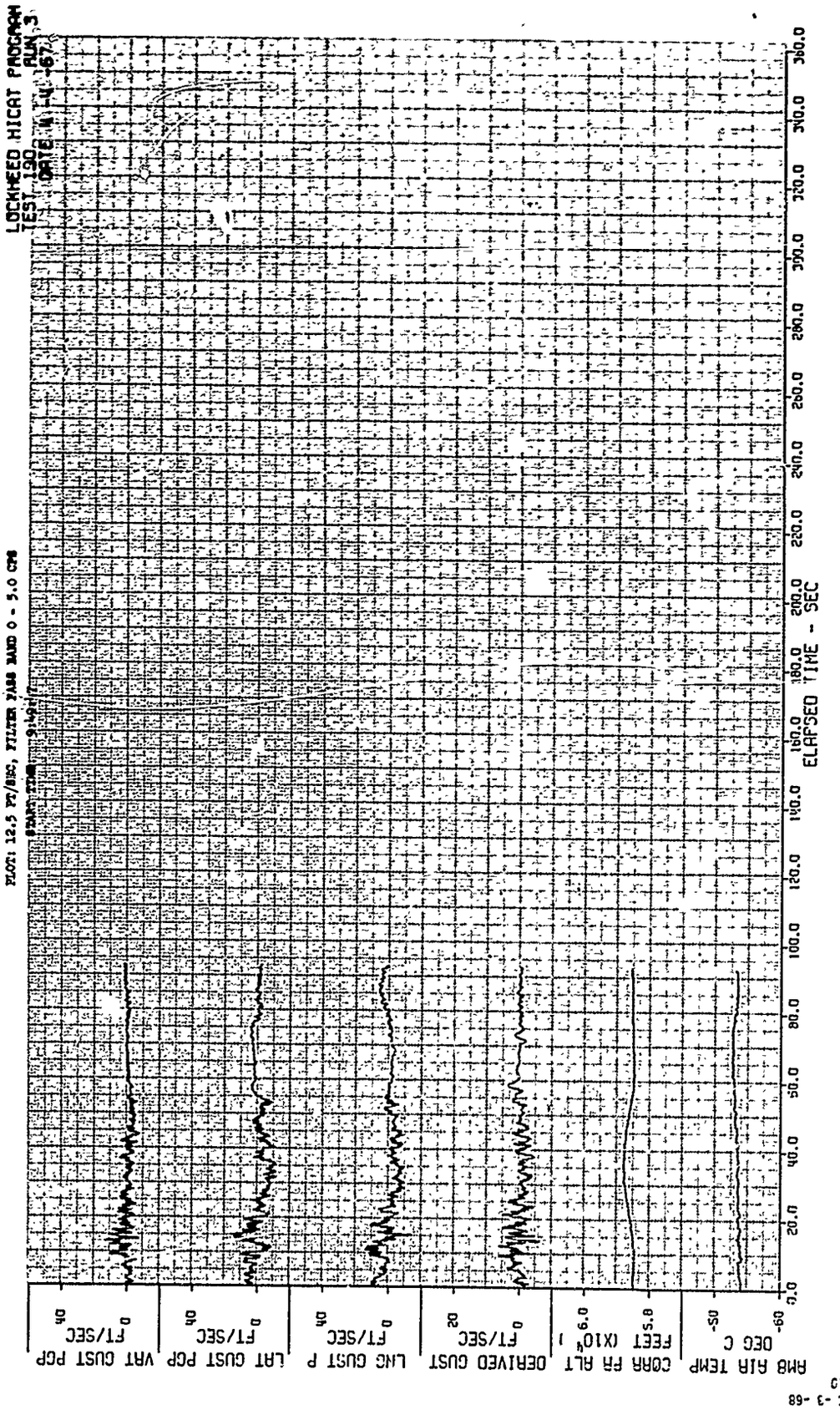


Figure 5A Gust Velocity Time Histories of Test 190, Run 3 - RAE, Bedford, England, 4 Apr 67

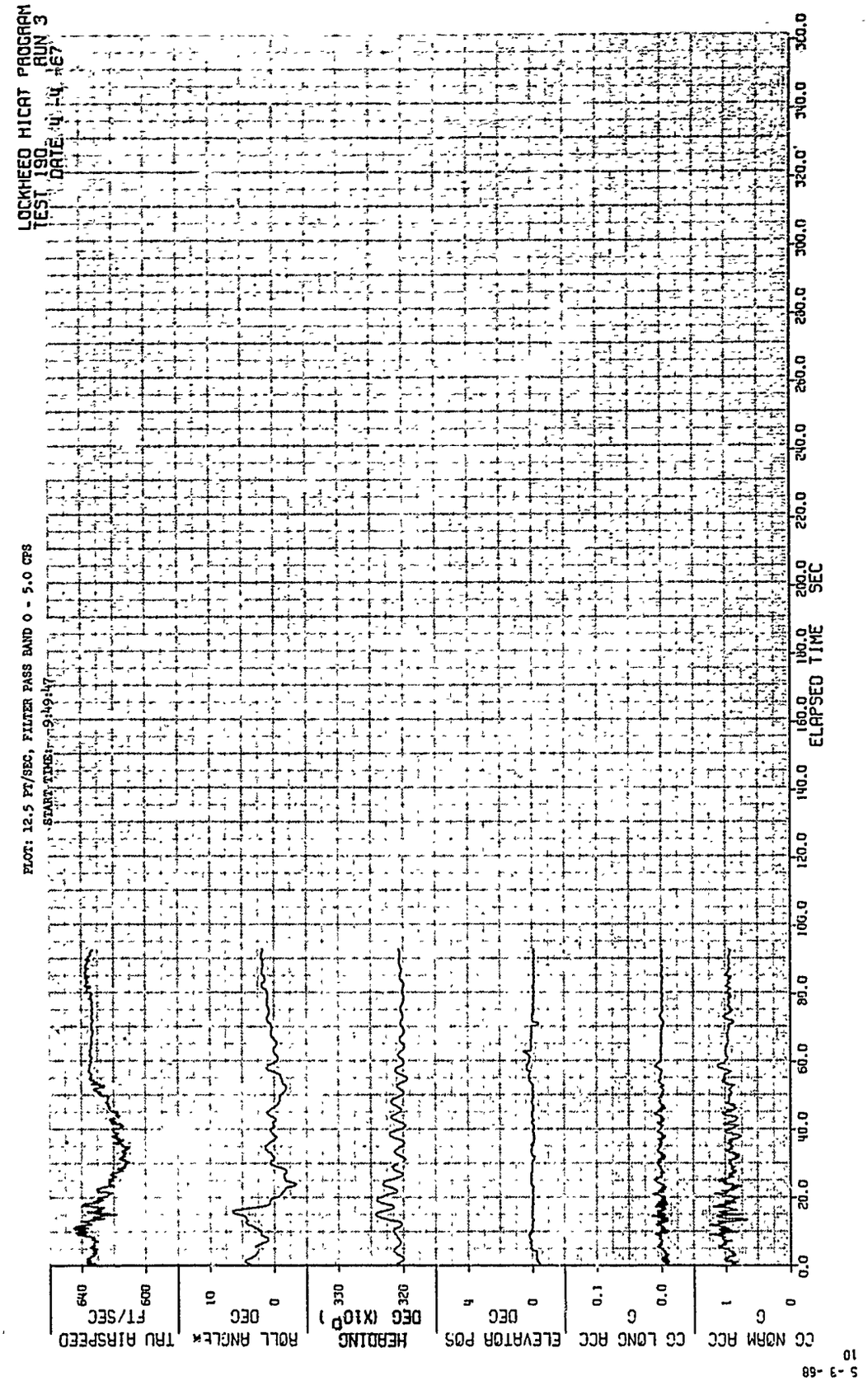
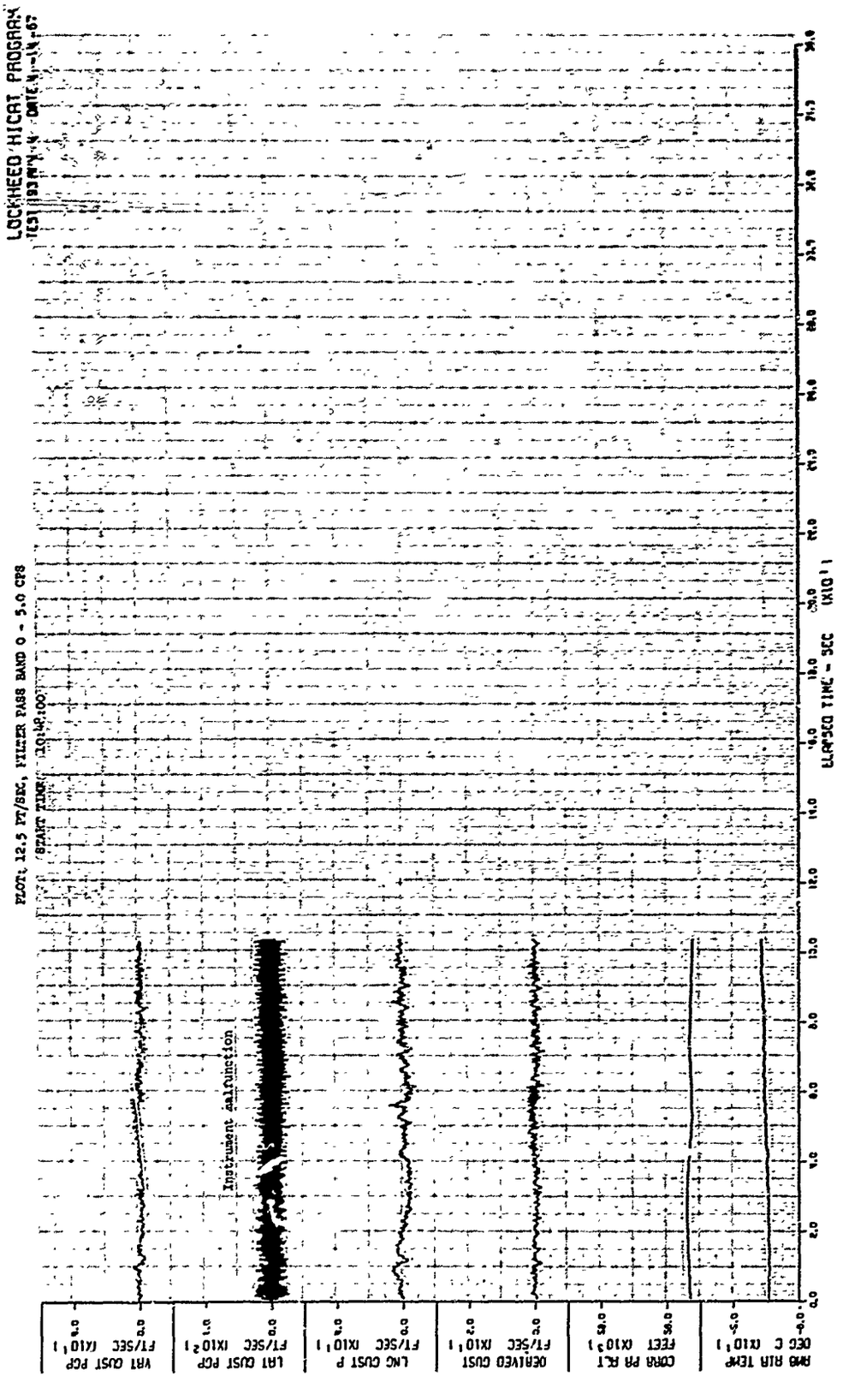


Figure 5B Flight Parameter Time Histories of Test 190, Run 3

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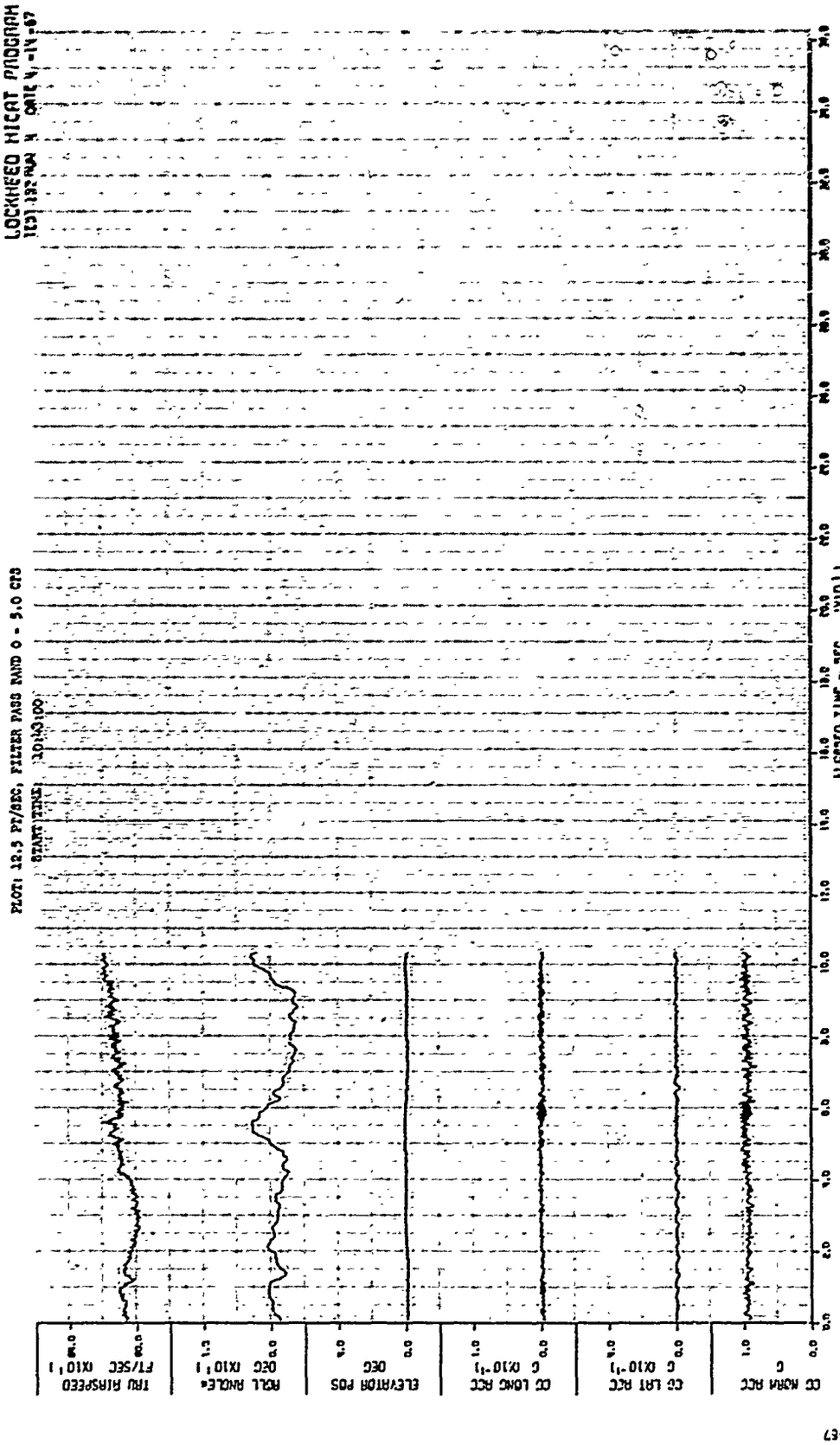


Figure 6B Flight Parameter Time Histories of Test 193, Run 4

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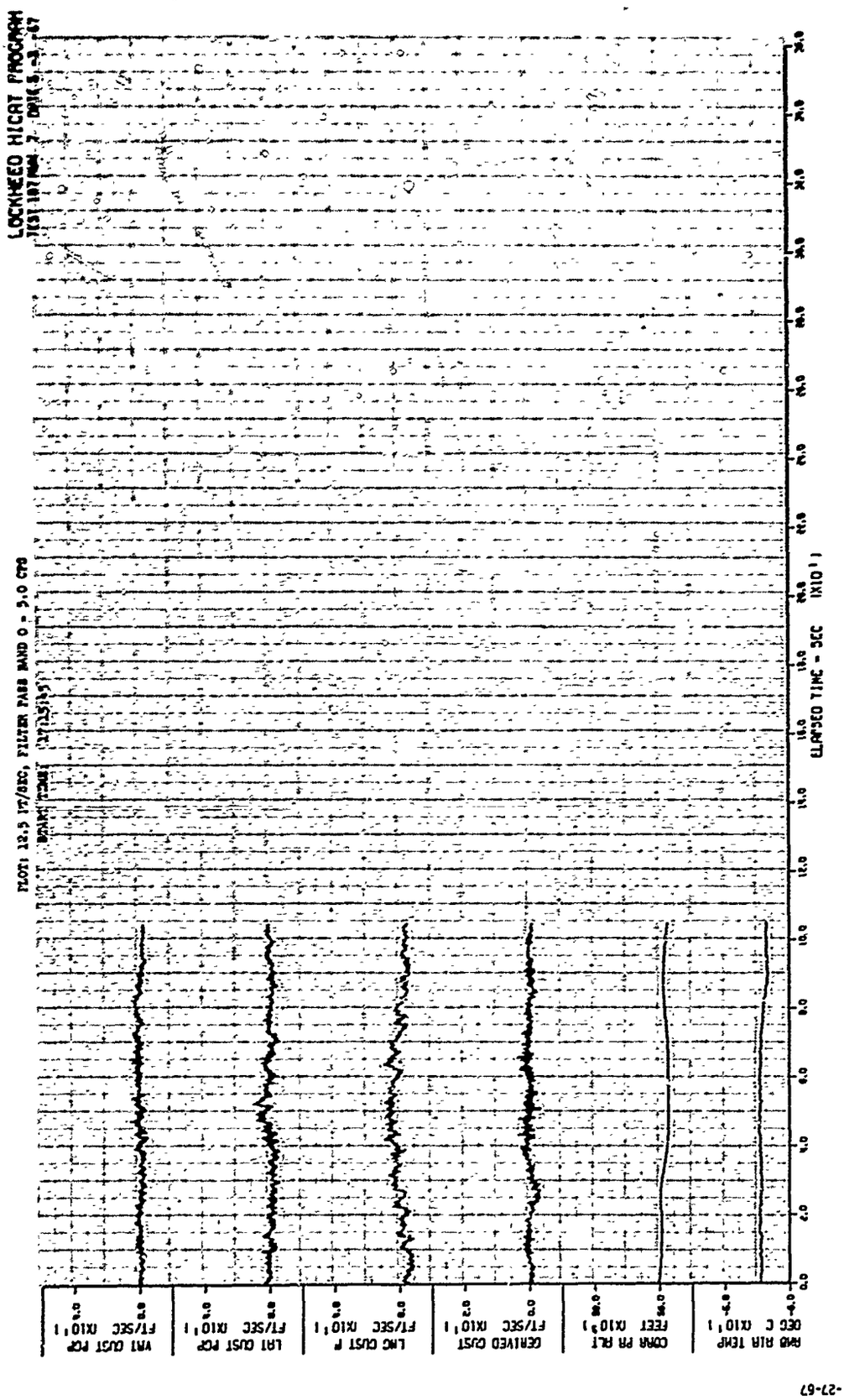


Figure 7A Gust Velocity Time Histories of Test 197, Run 7 - Barksdale AFB, Louisiana, 3 May 67

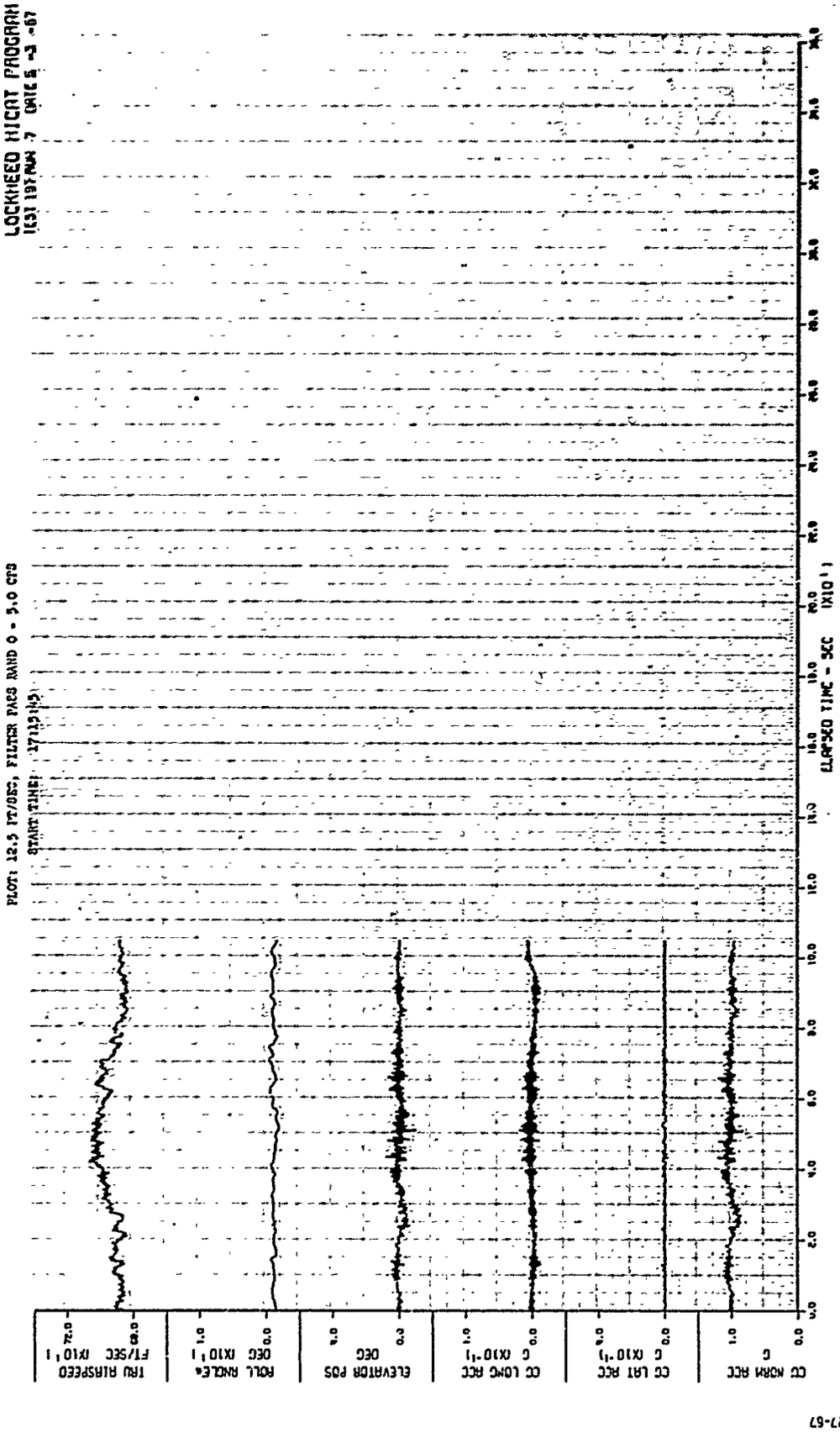


Figure 7B Flight Parameter Time Histories of Test 197, Run 7

7 -27-67

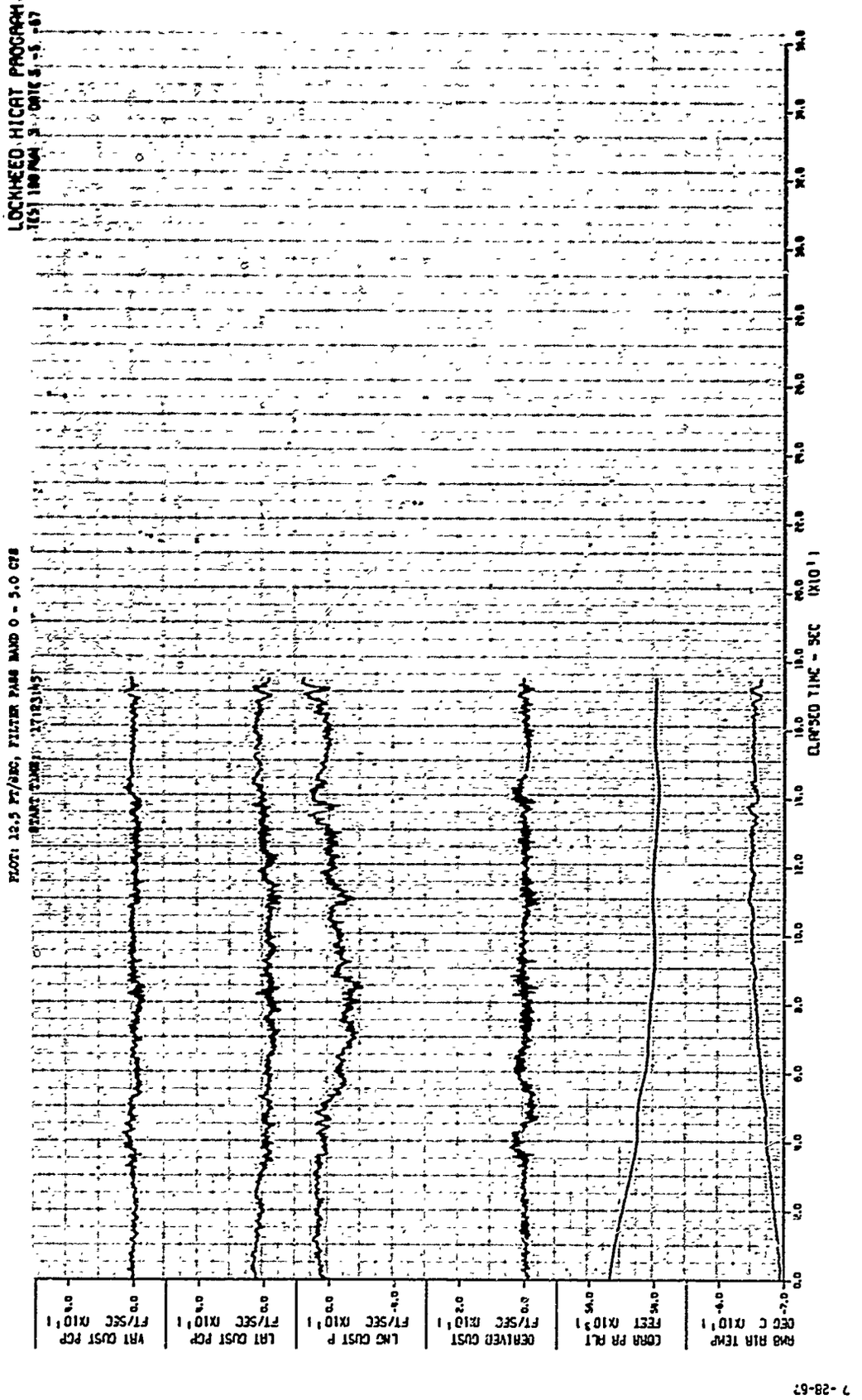


Figure 8A Gust Velocity Time Histories of Test 198, Run 3 - Barksdale AFB, Louisiana, 5 May 67

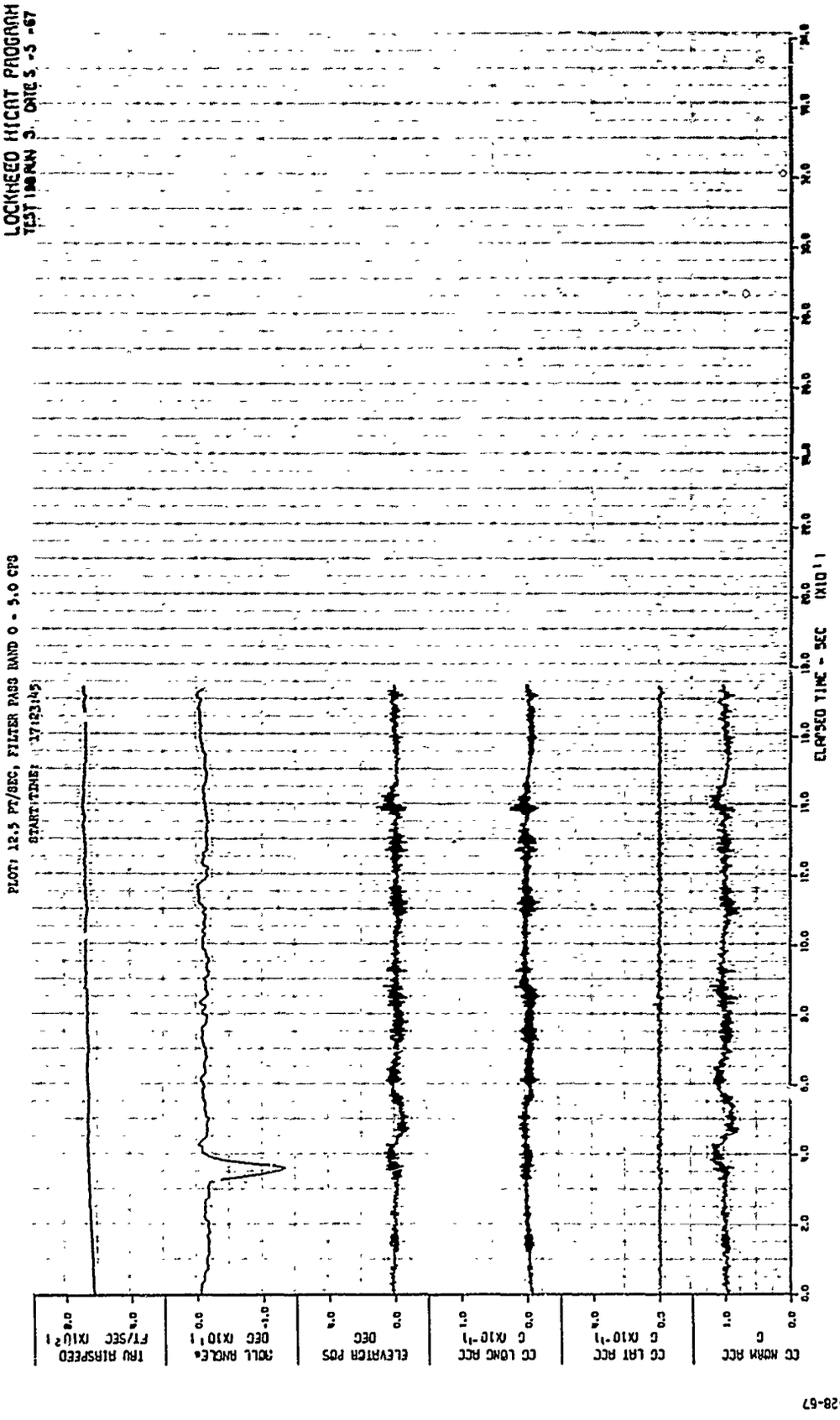


Figure 8B Flight Parameter Time Histories of Test 198, Run 3

7-28-67

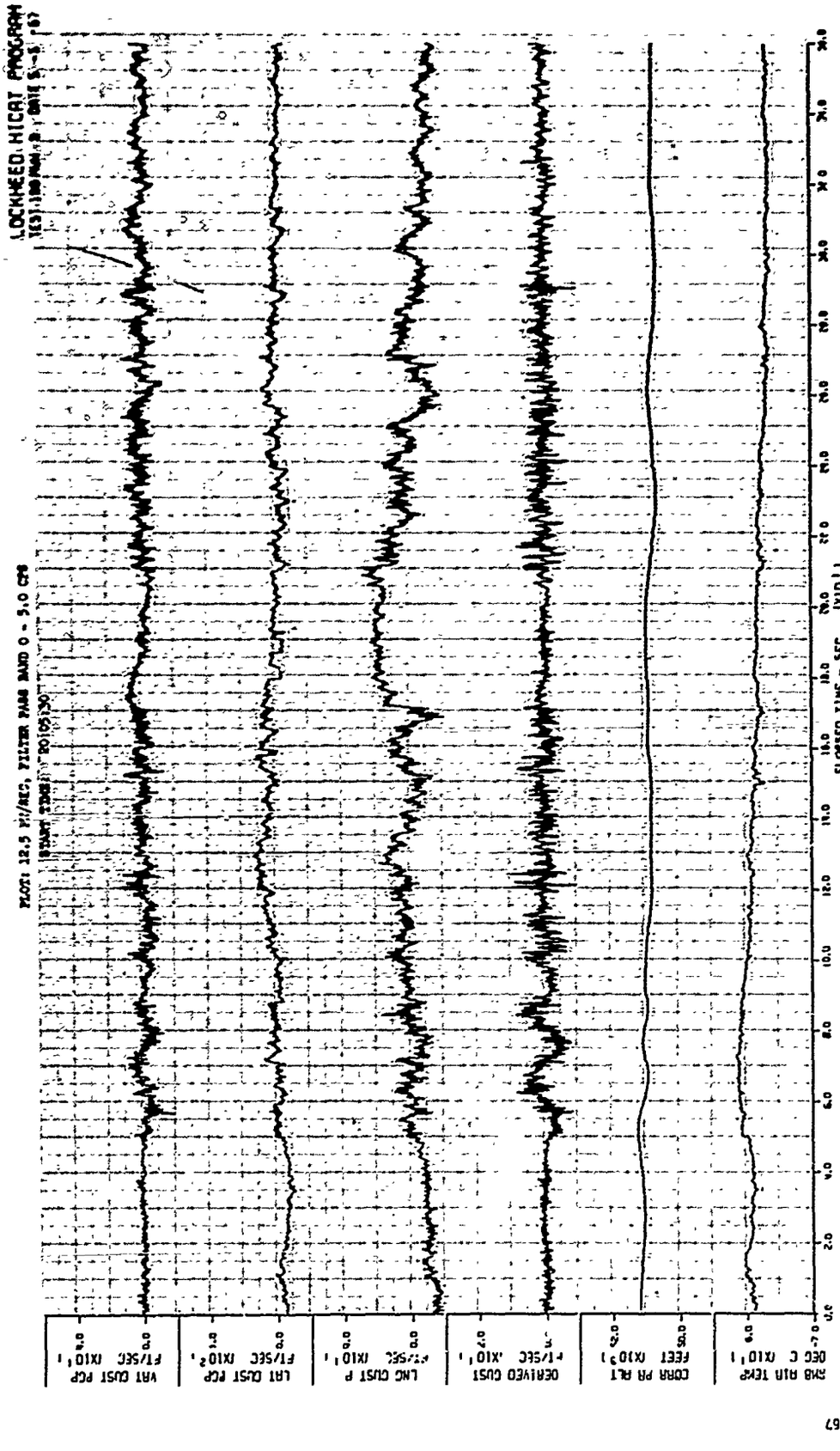


Figure 9A Gust Velocity Time Histories of Test 198, Run 9 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 1 of 2)

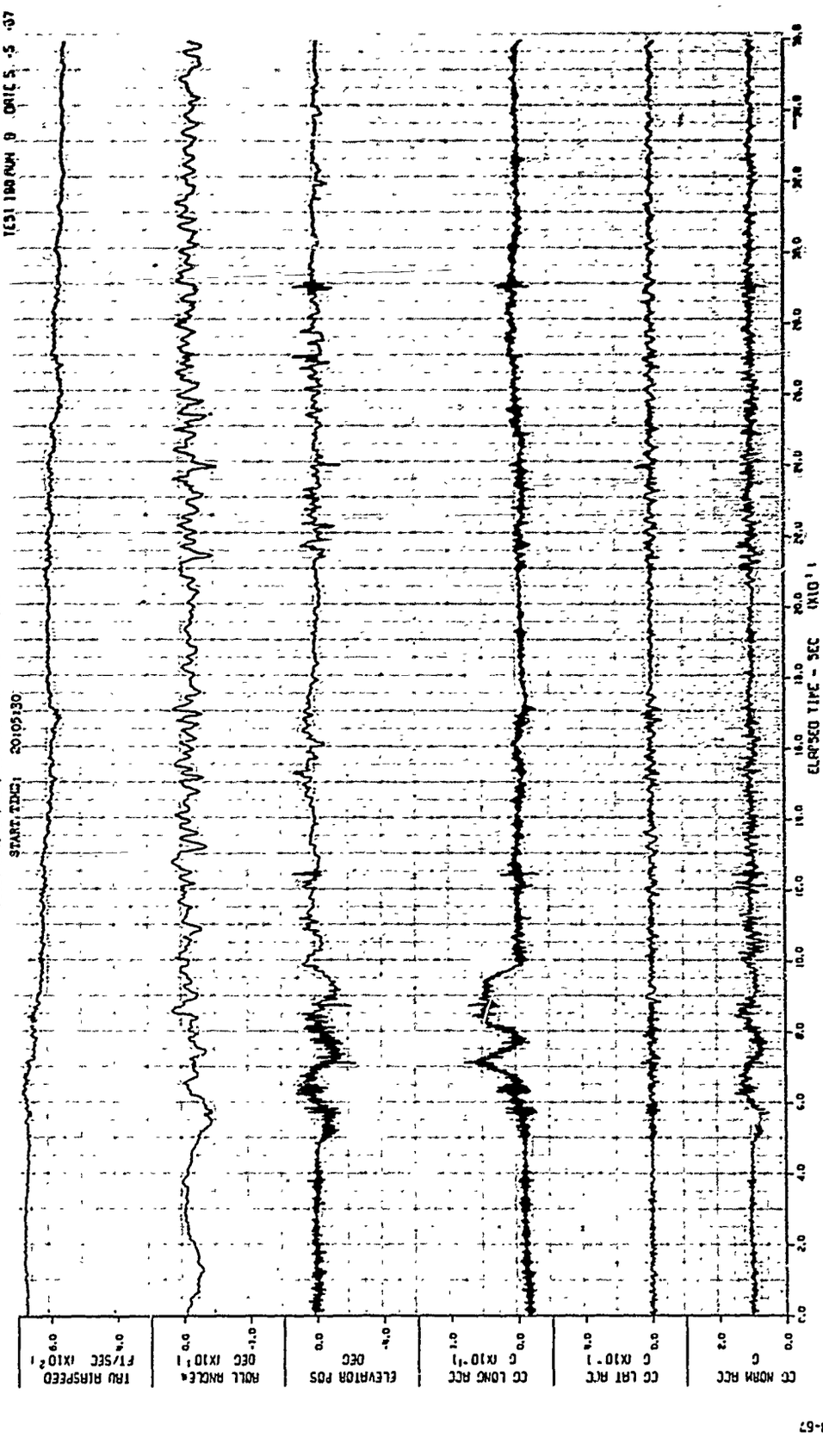


Figure 9B Flight Parameter Time Histories of Test 190, Run 9 (Sheet 1 of 2)

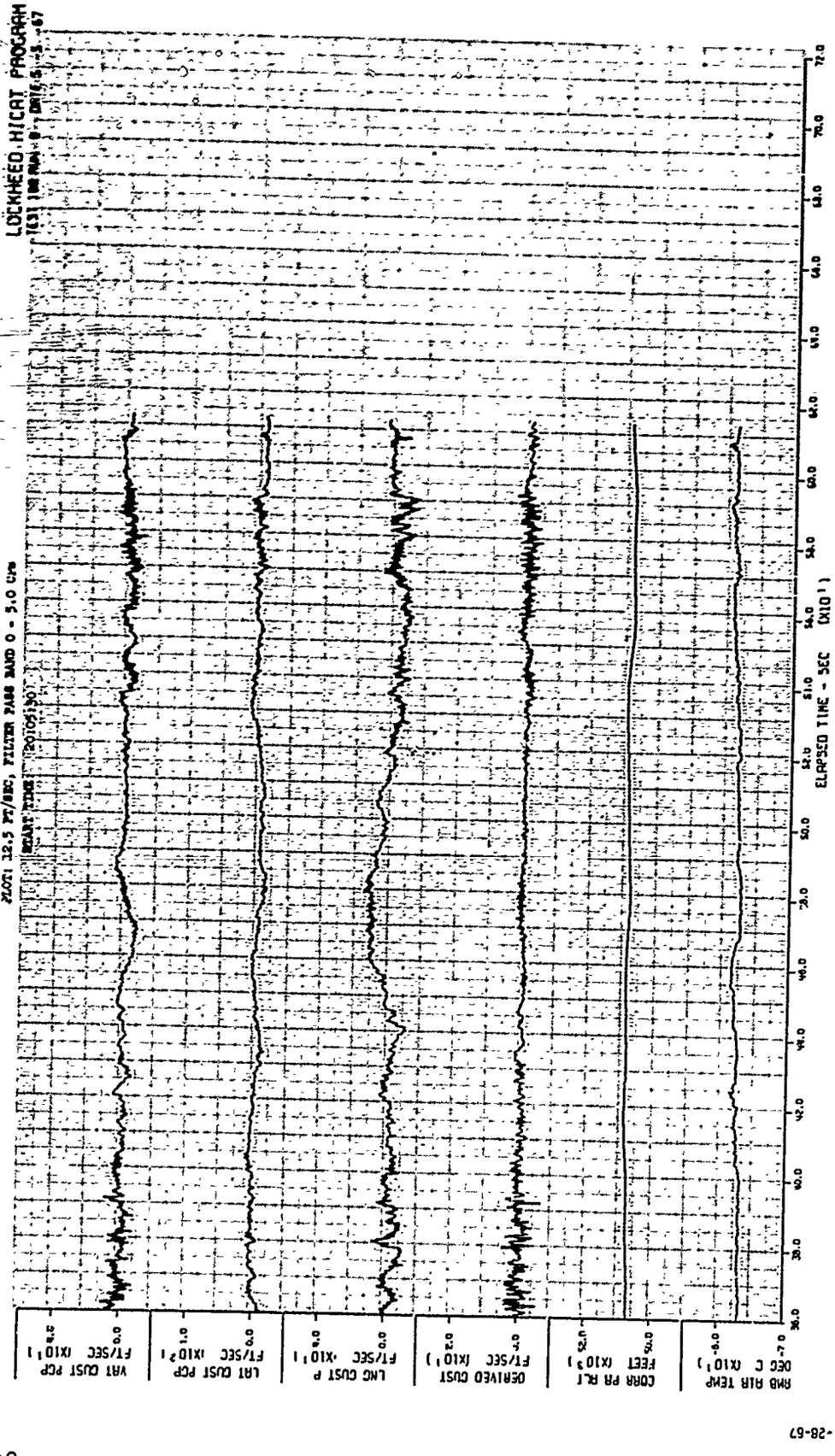


Figure 9A Gust Velocity Time Histories of Test 198, Run 9 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 2 of 2)

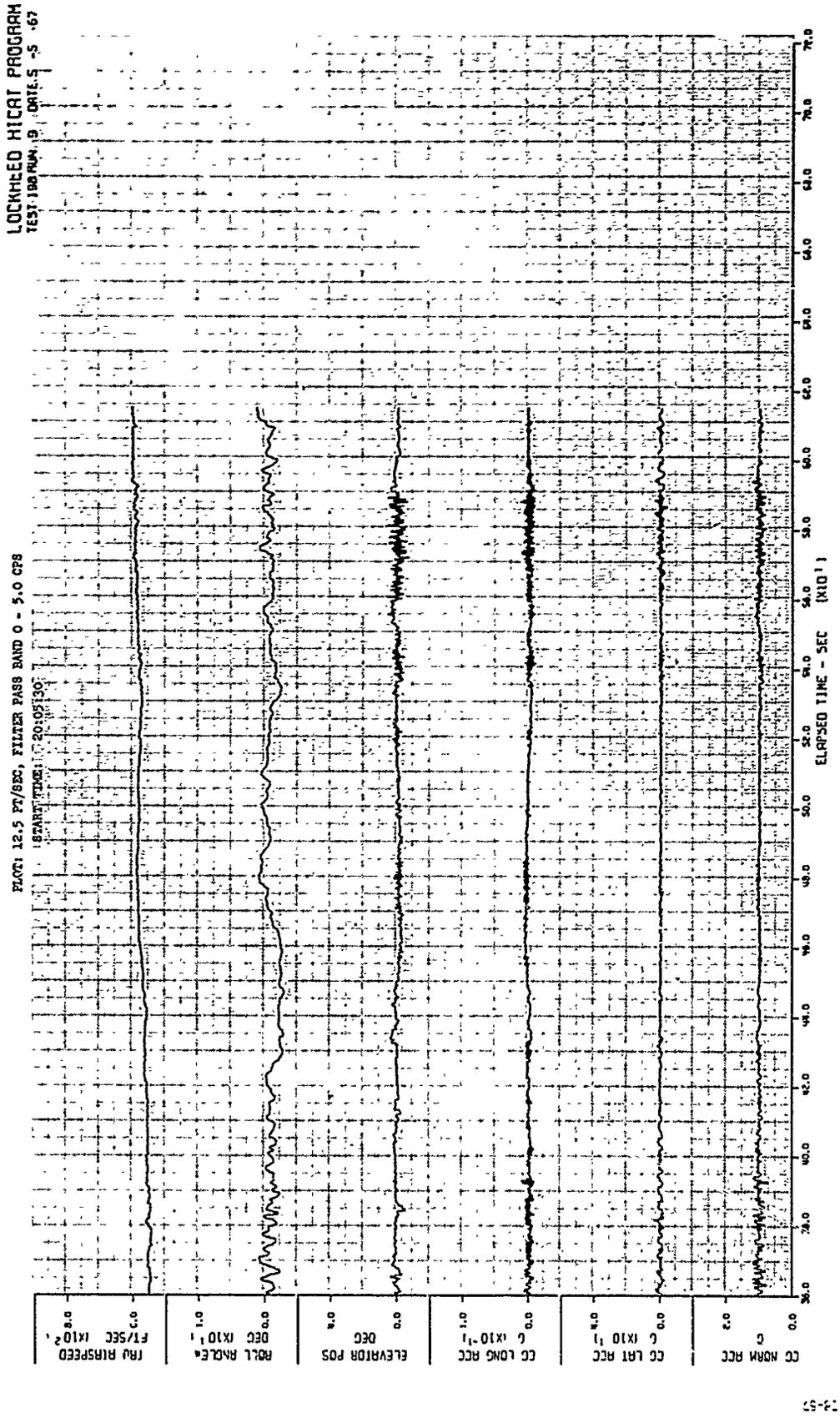


Figure 9B Flight Parameter Time Histories of Test 198, Run 9 (Sheet 2 of 2)

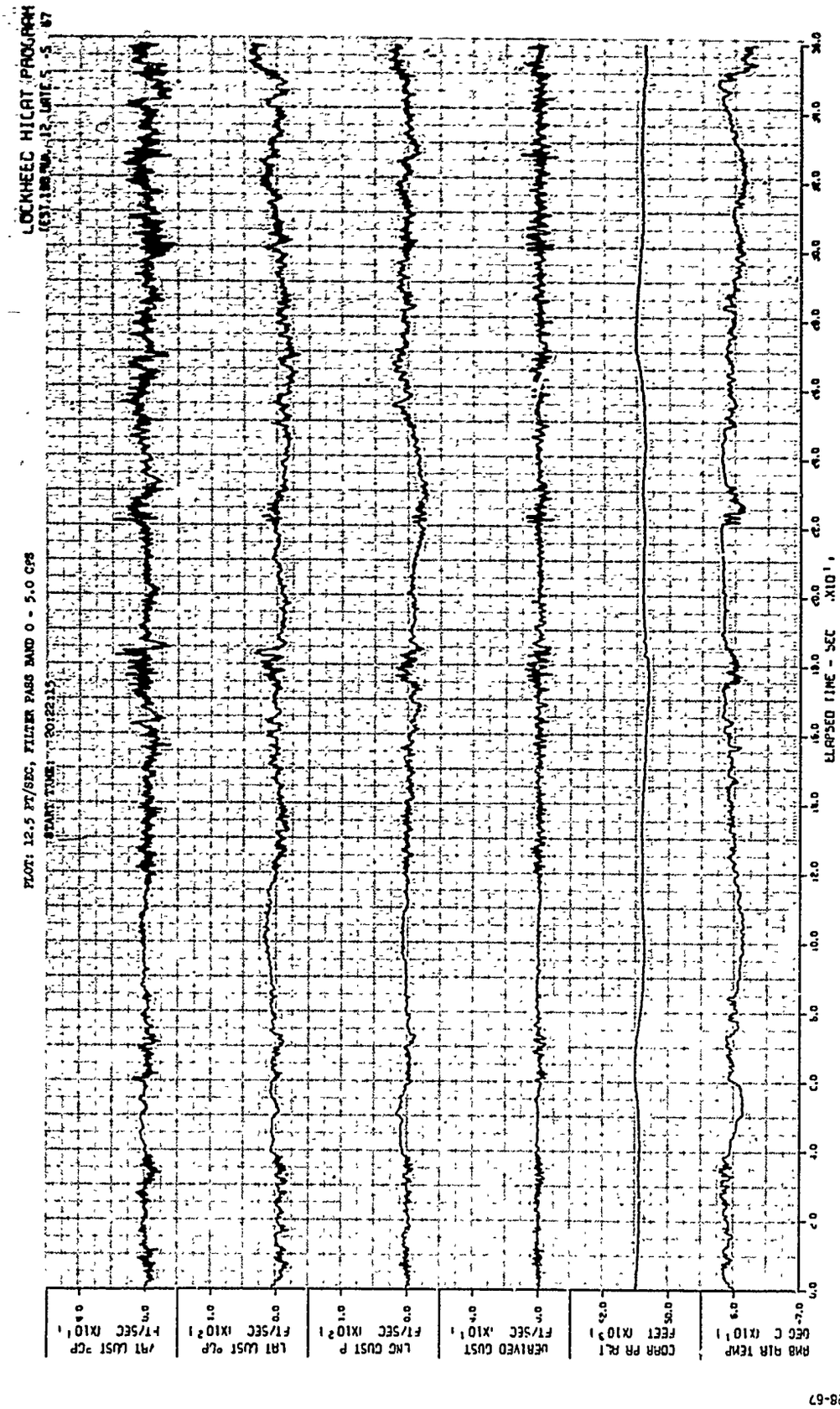


Figure 10A Gust Velocity Time Histories of Test 198, Run 12 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 1 of 2)

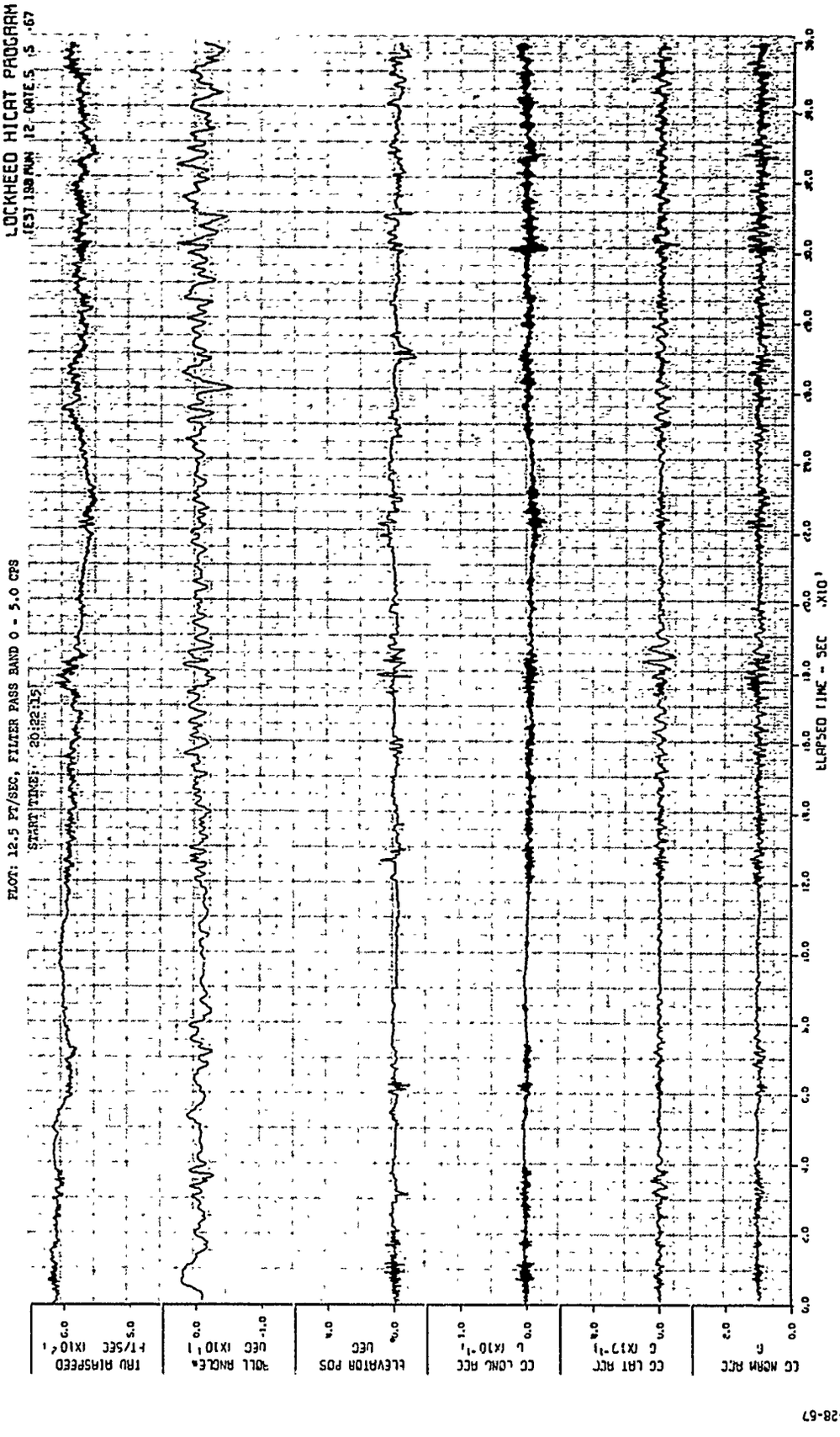


Figure 10B Flight Parameter Time Histories of Test 198, Run 12 (Sheet 1 of 2)

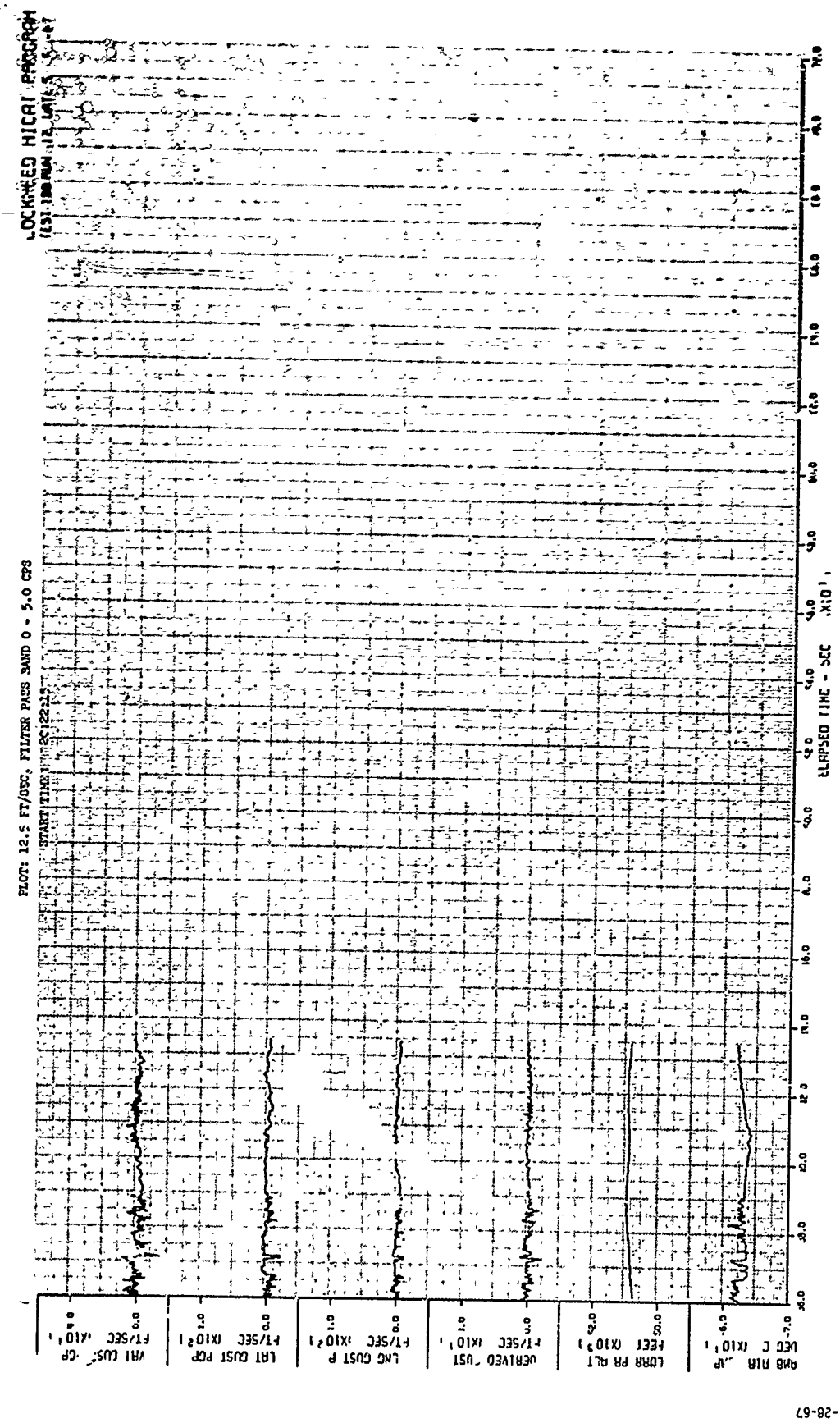


Figure 10A Gust Velocity Time Histories of Test 198, Run 12 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 2 of 2)

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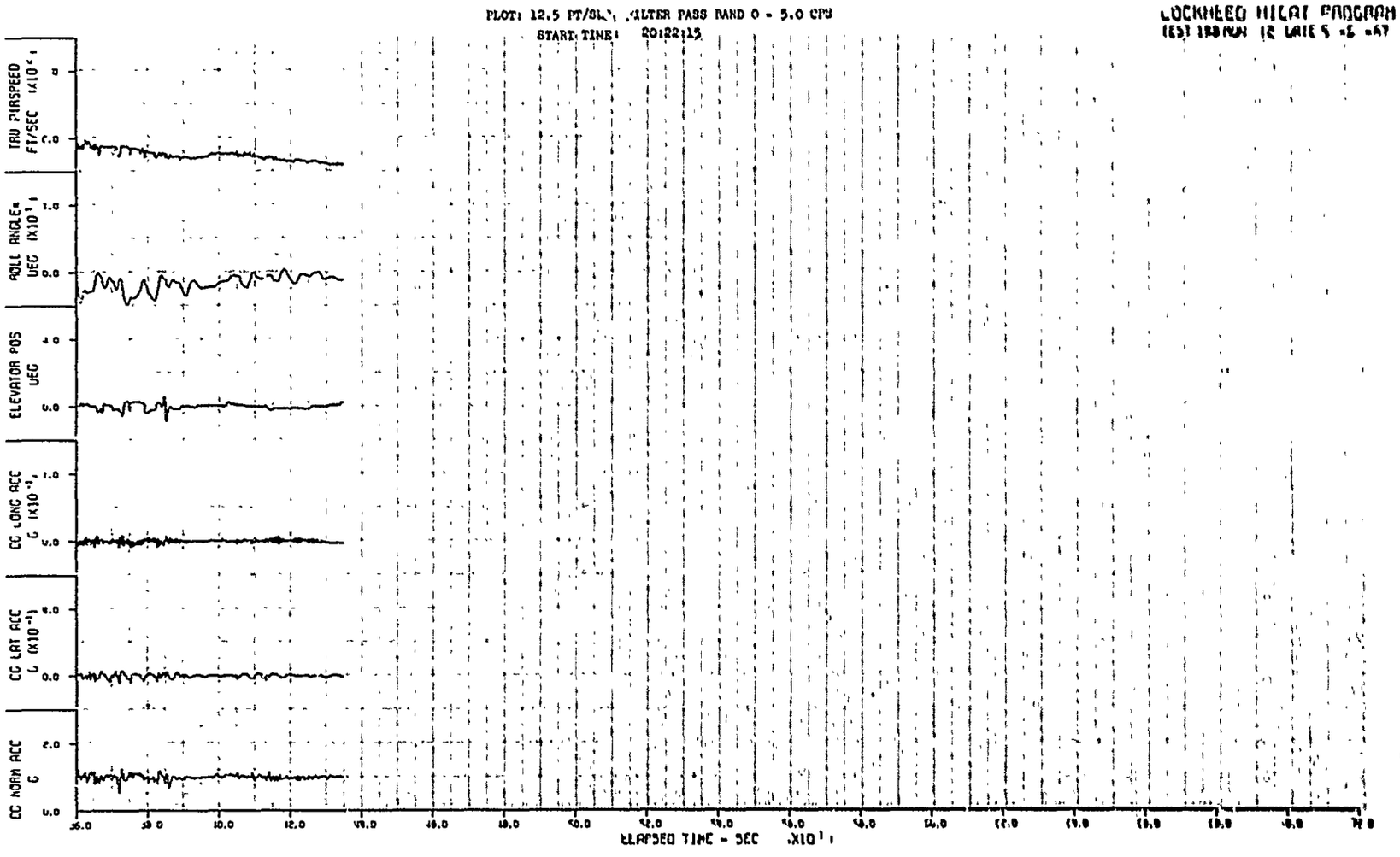


Figure 10B Flight Parameter Time Histories of Test 198, Run 12 (Sheet 2 of 2)

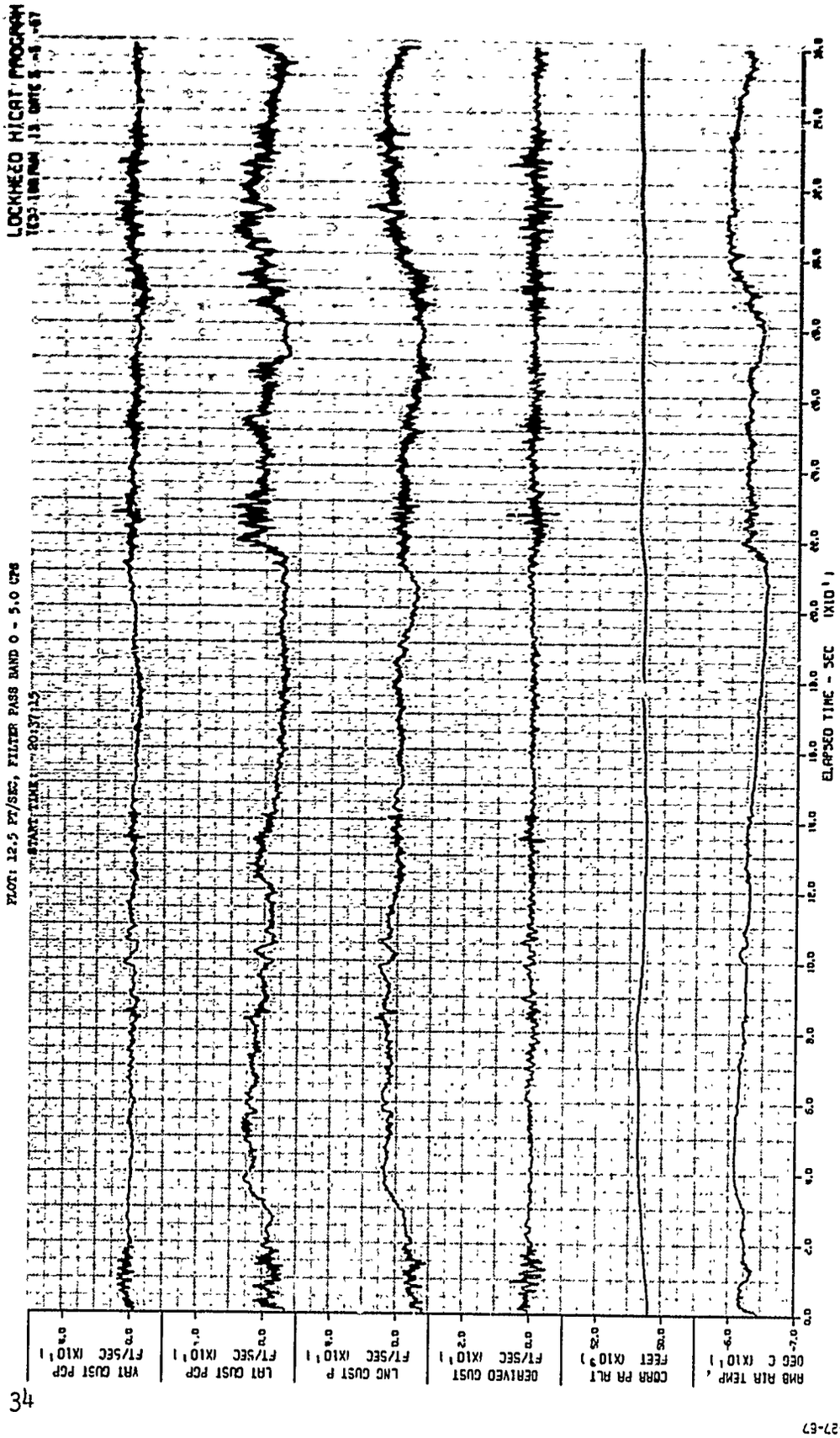


Figure 11A Gust Velocity Time Histories of Test 198, Run 13 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 1 of 2)

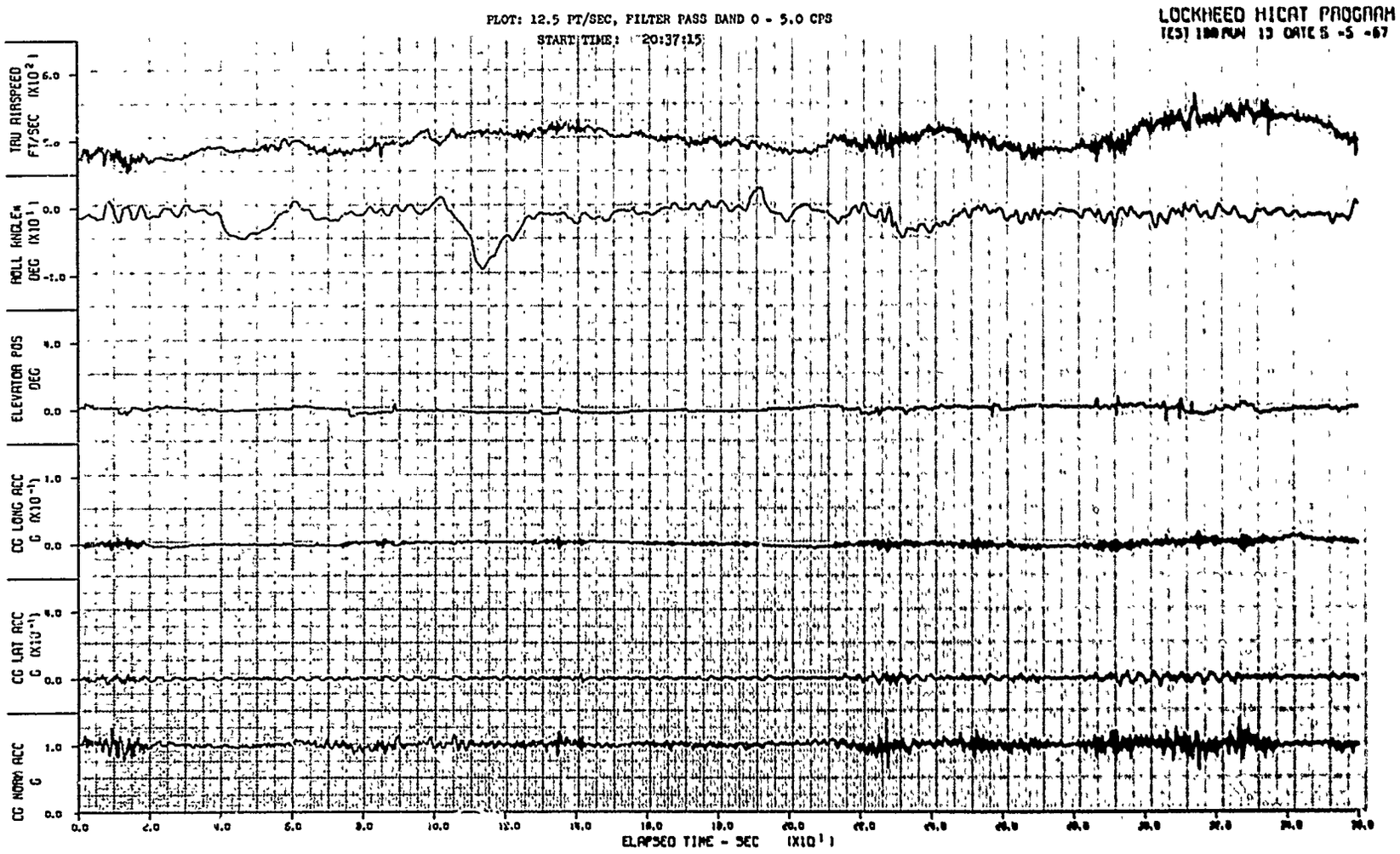


Figure 11B Flight Parameter Time Histories of Test 198, Run 13 (Sheet 1 of 2)

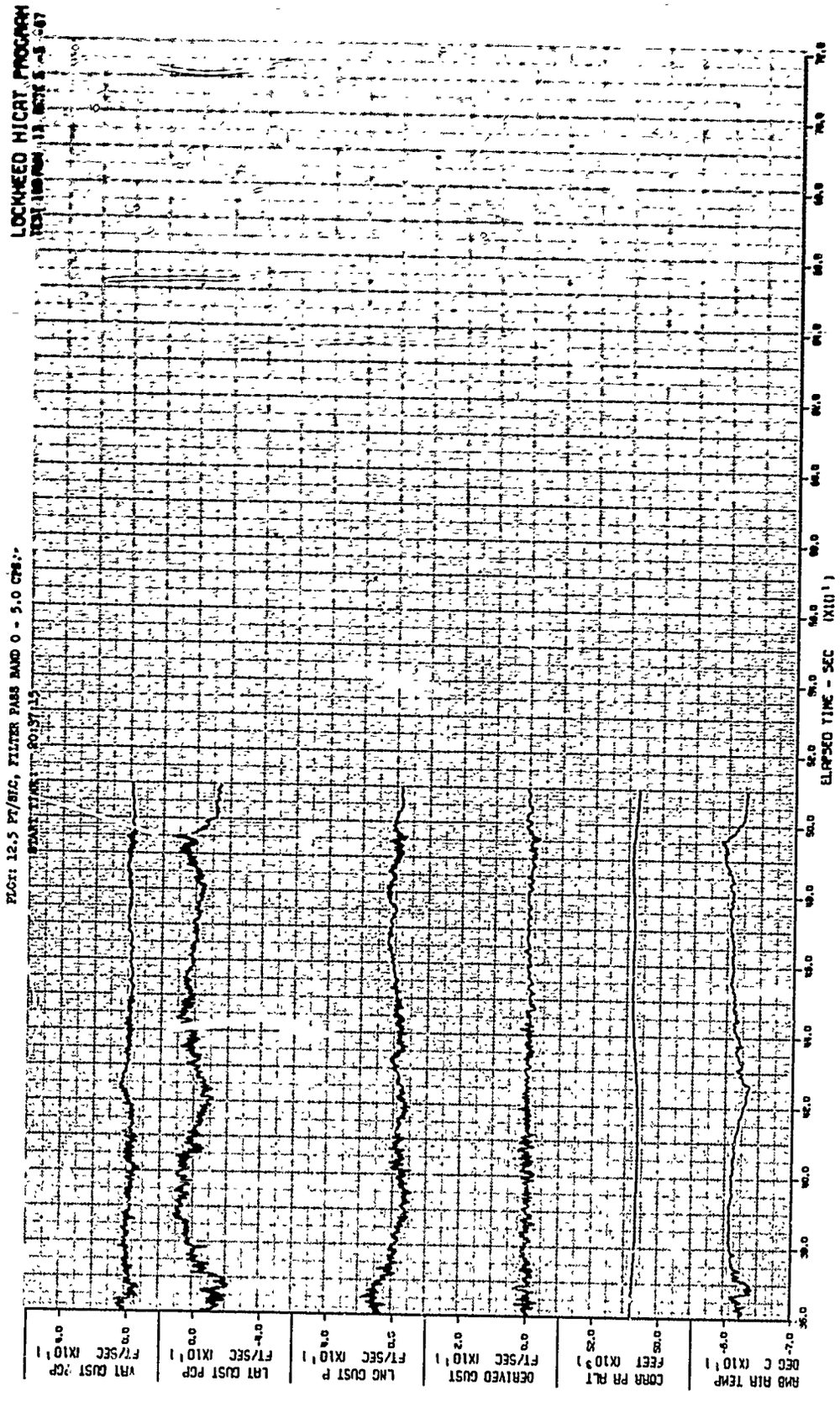


Figure 11A Gust Velocity Time Histories of Test 198, Run 13 - Barksdale AFB, Louisiana, 5 May 67 (Sheet 2 of 2)

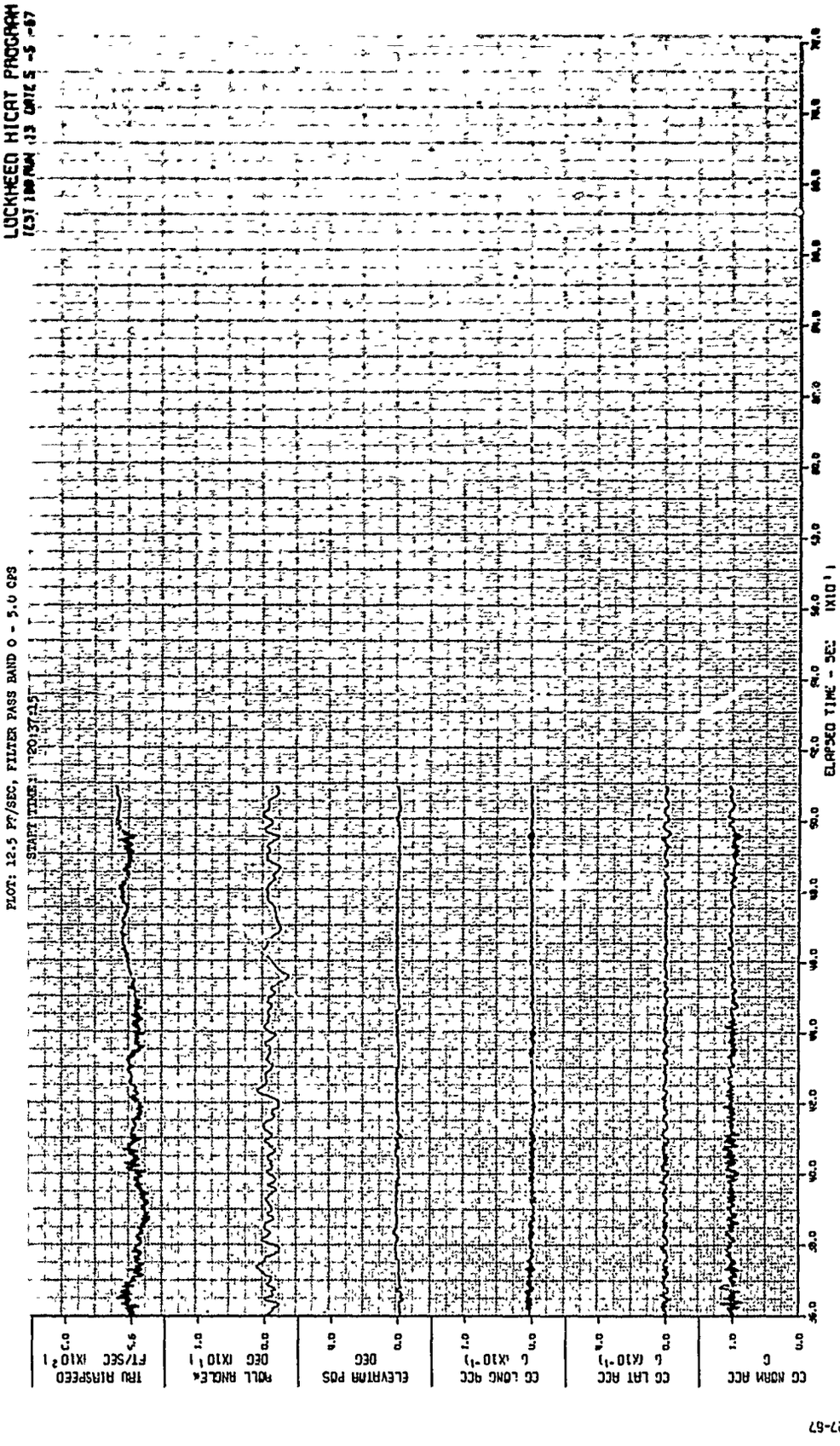


Figure 11B Flight Parameter Time Histories of Test 198, Run 13 (Sheet 2 of 2)

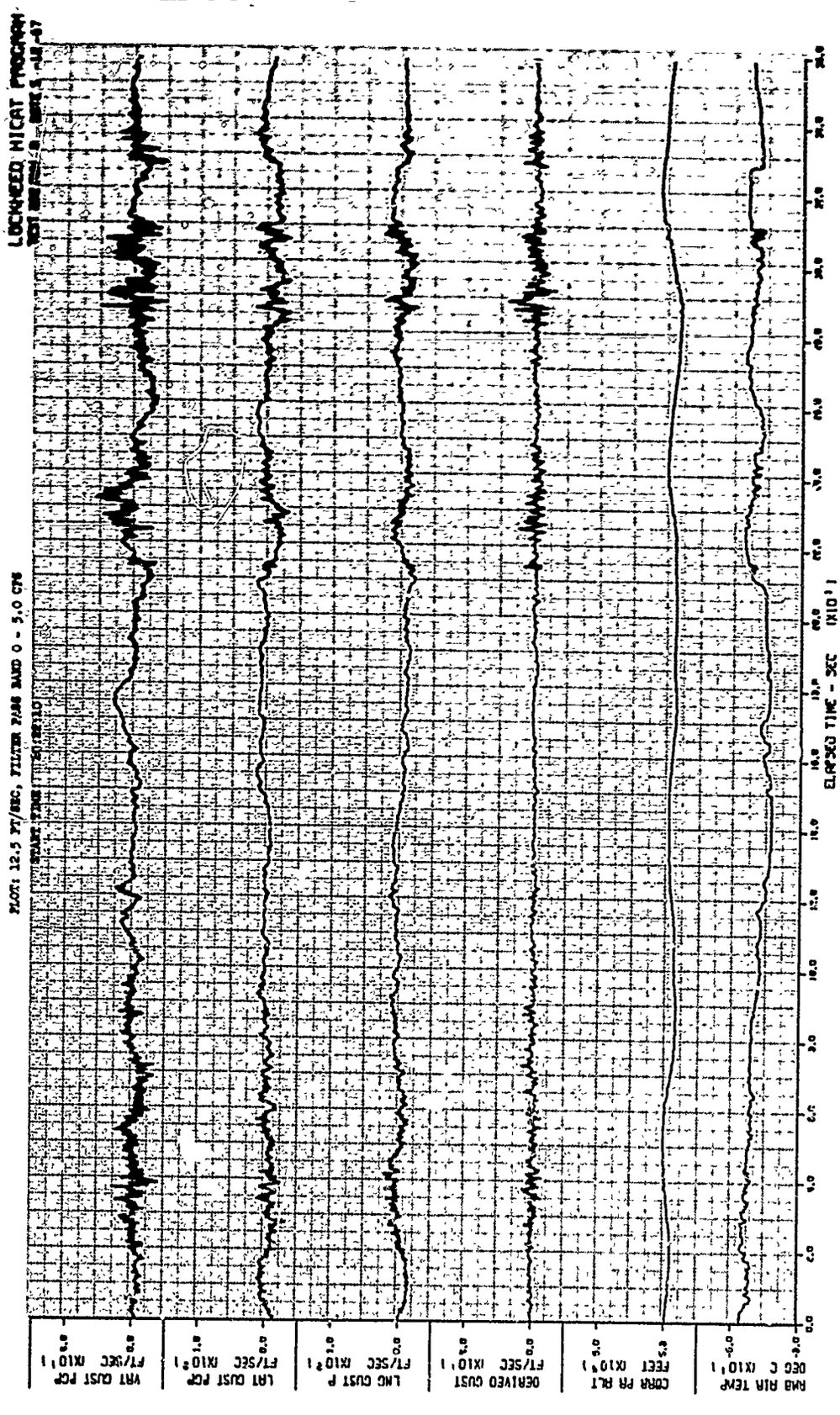


Figure 12A Gust Velocity Time Histories of Test 202, Run 8 - Barksdale AFB, Louisiana, 12 May 67

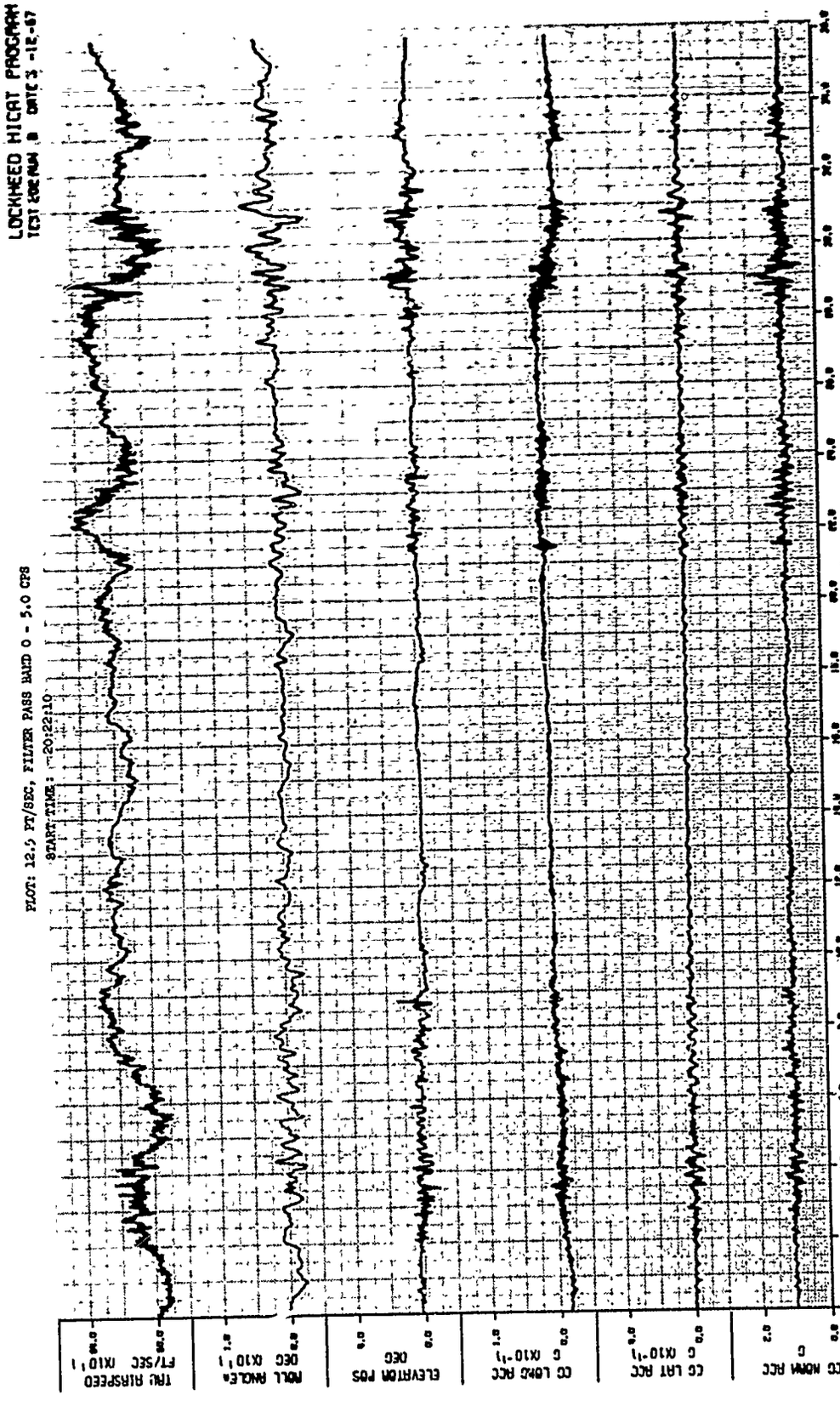


Figure 12B Flight Parameter Time Histories of Test 202, Run 8

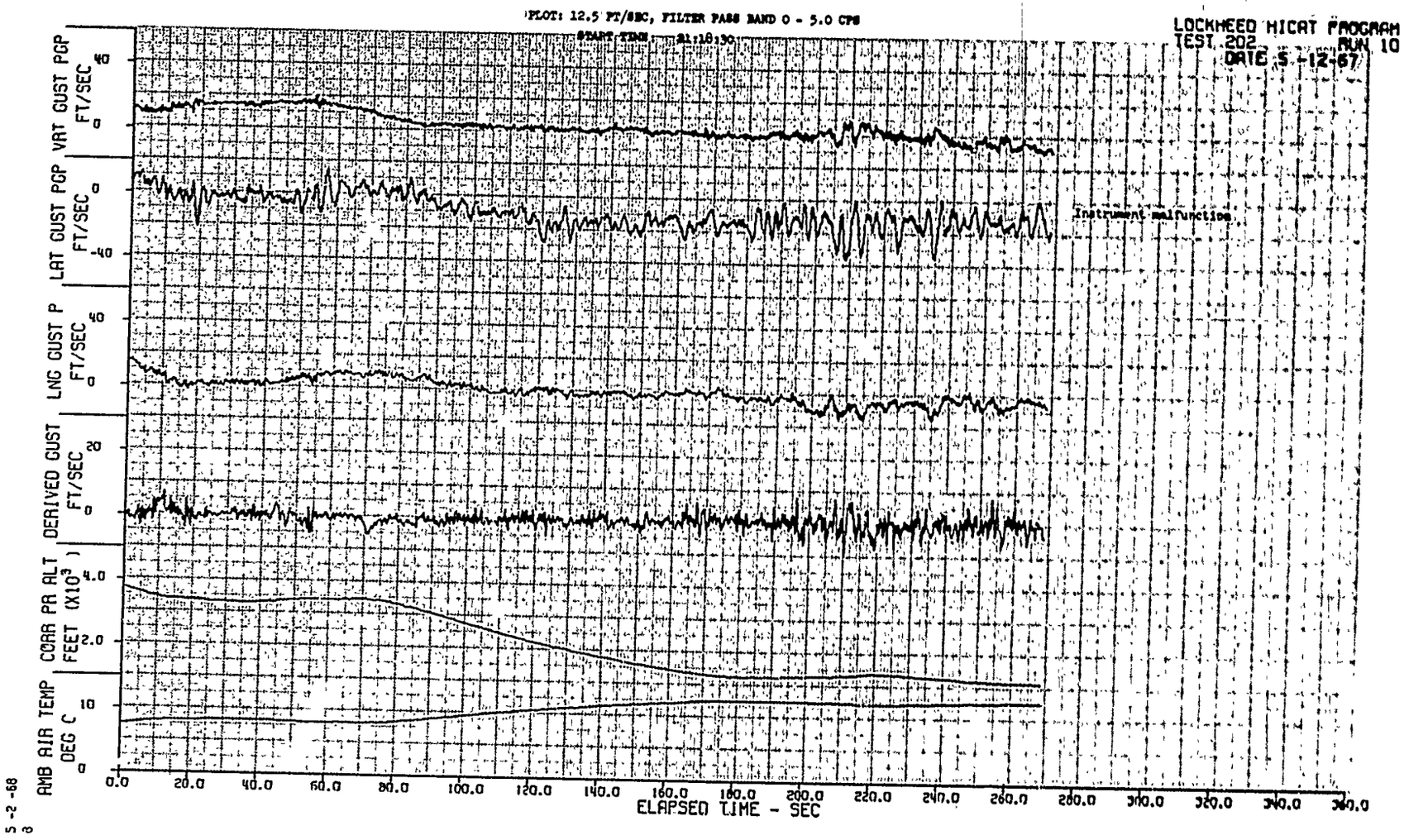


Figure 13A Gust Velocity Time Histories of Test 202, Run 10 (Landing Approach) - Barksdale AFB, Louisiana, 12 May 67

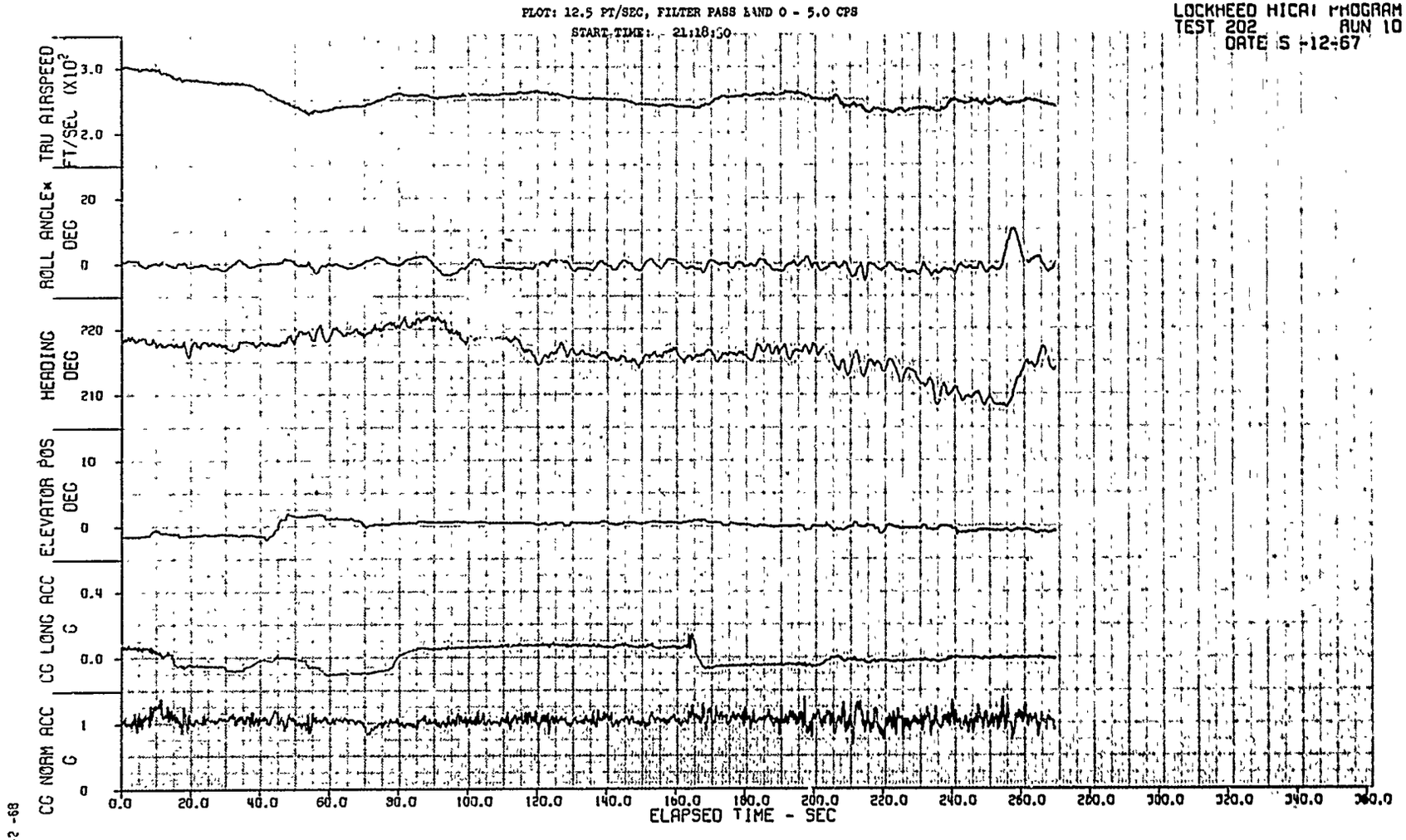


Figure 13B Flight Parameter Time Histories of Test 202, Run 10 (Landing Approach)

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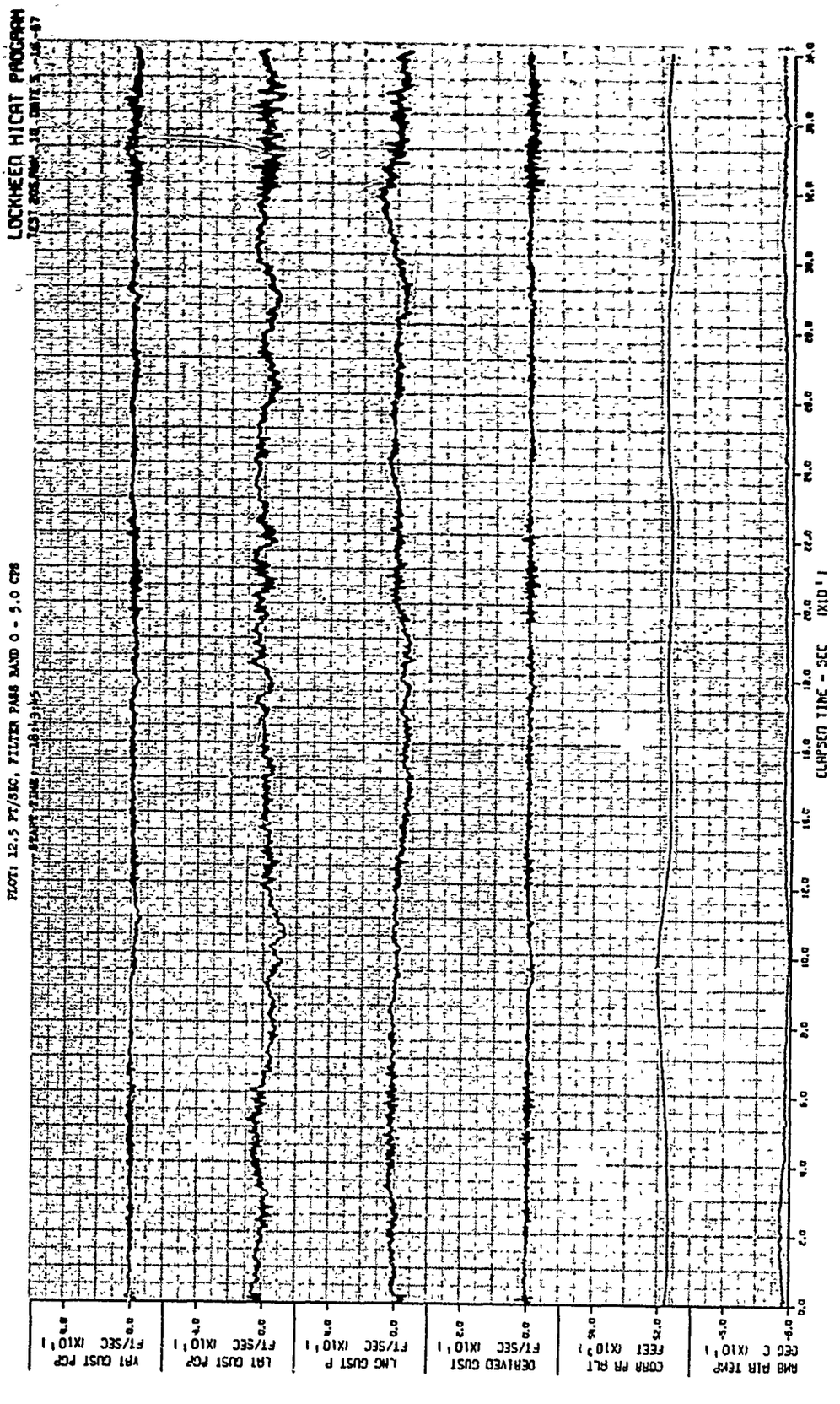


Figure 14A Gust Velocity Time Histories of Test 205, Run 10 - Barksdale AFB, Louisiana, 16 May 67 (Sheet 1 of 2)

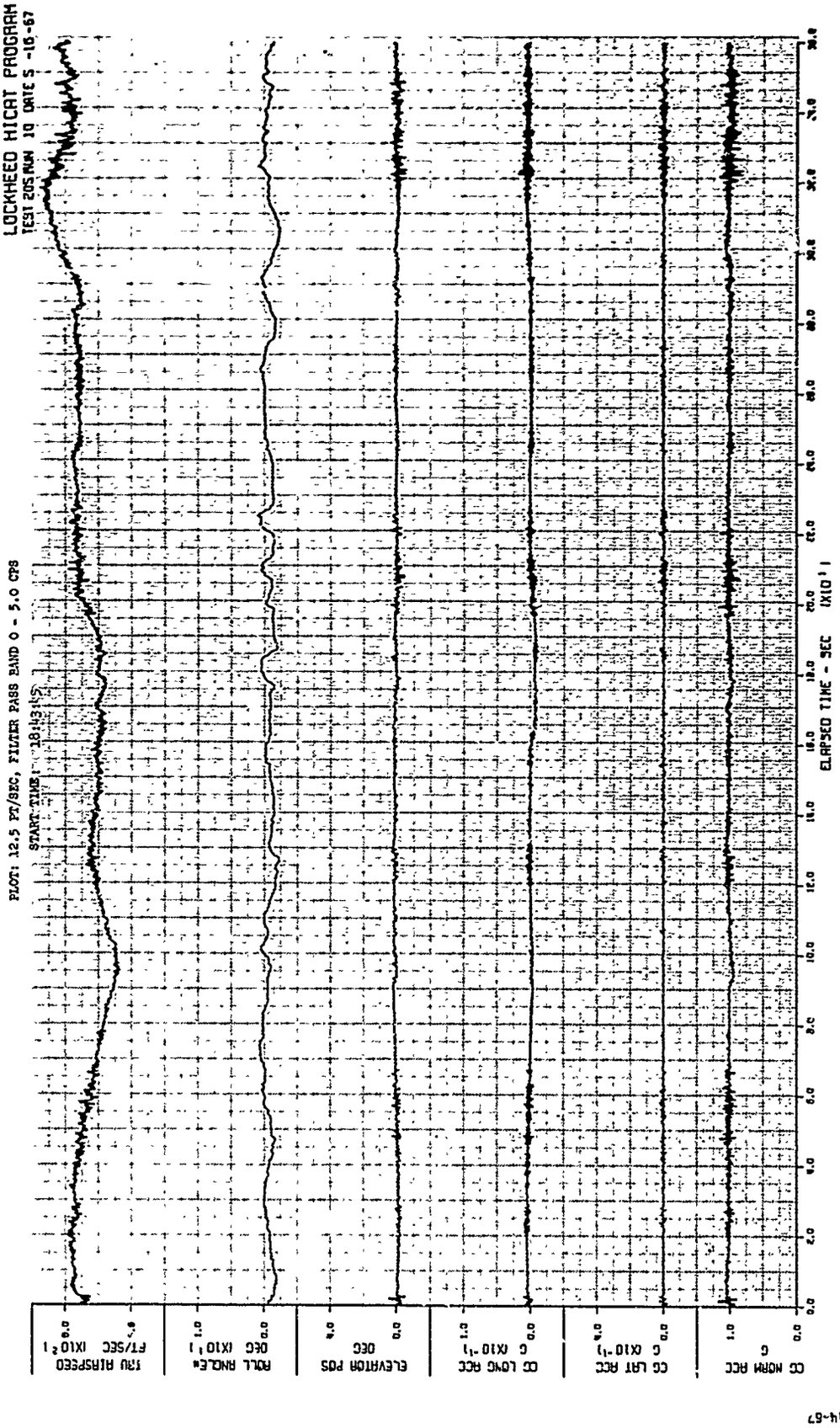


Figure 14B Flight Parameter Time Histories of Test 205, Run 10 (Sheet 1 of 2)

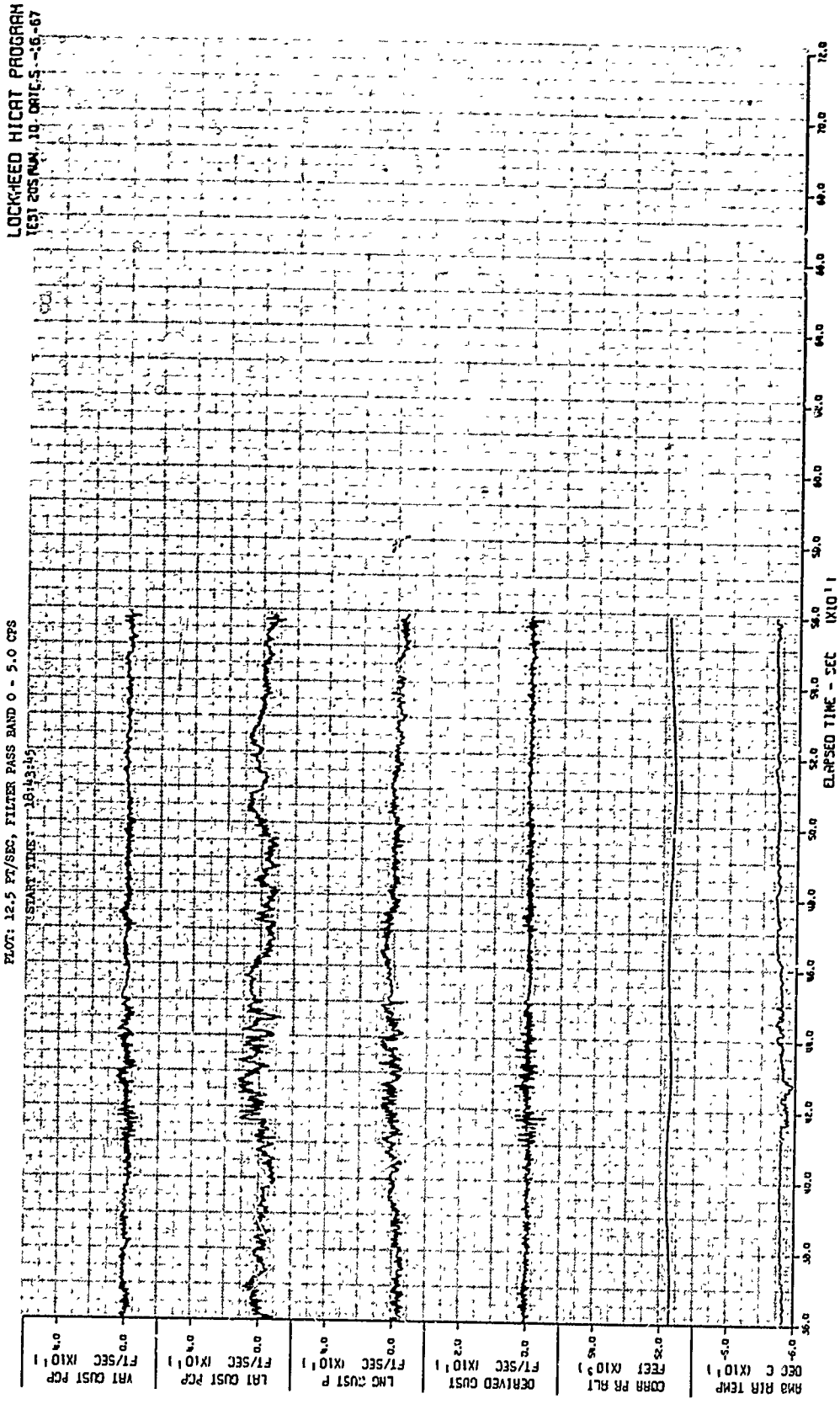


Figure 14A Gust Velocity Time Histories of Test 205, Run 10 - Barksdale AFB, Louisiana, 16 May 67 (Sheet 2 of 2)

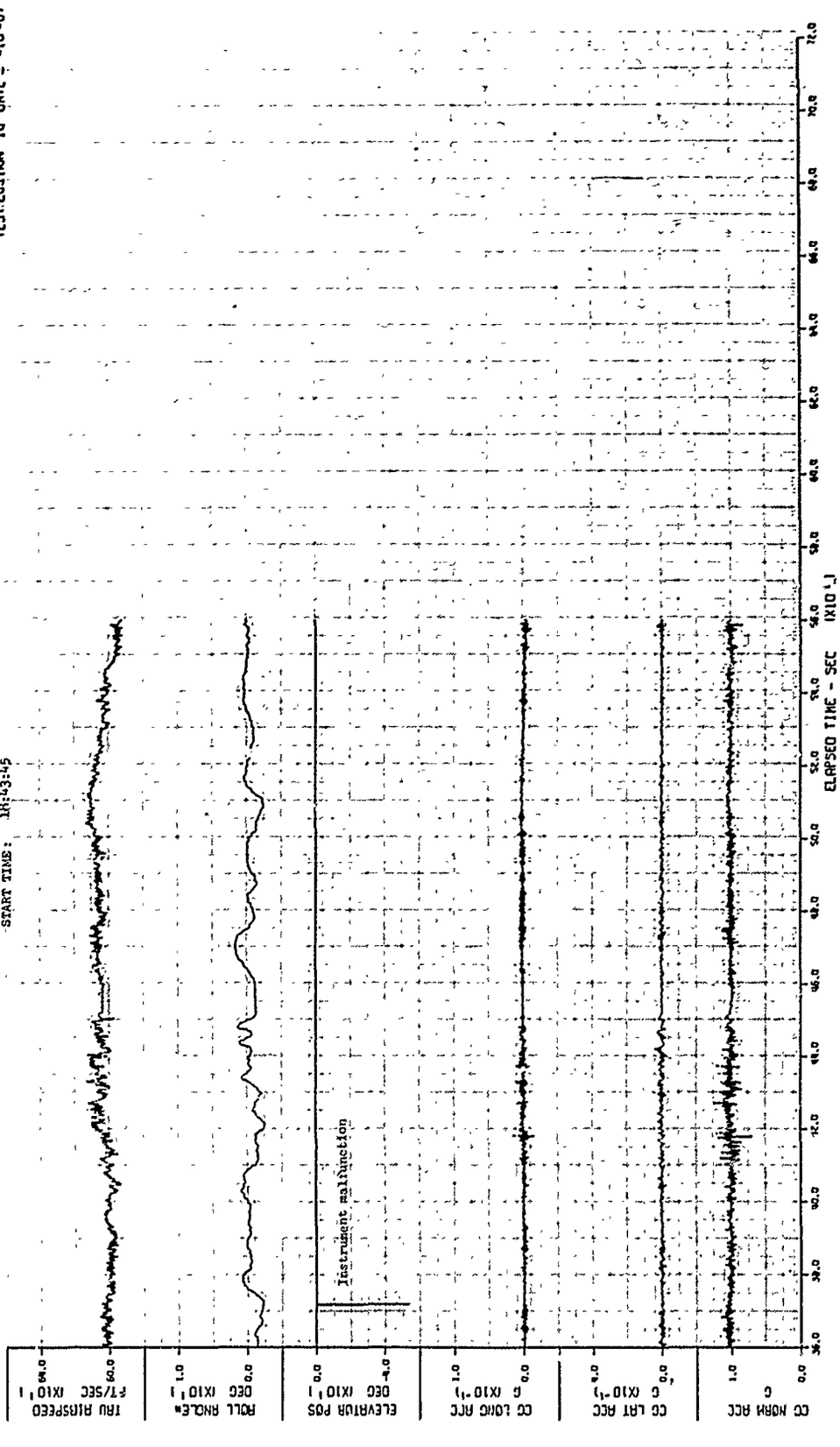


Figure 14B Flight Parameter Time Histories of Test 205, Run 10 (Sheet 2 of 2)

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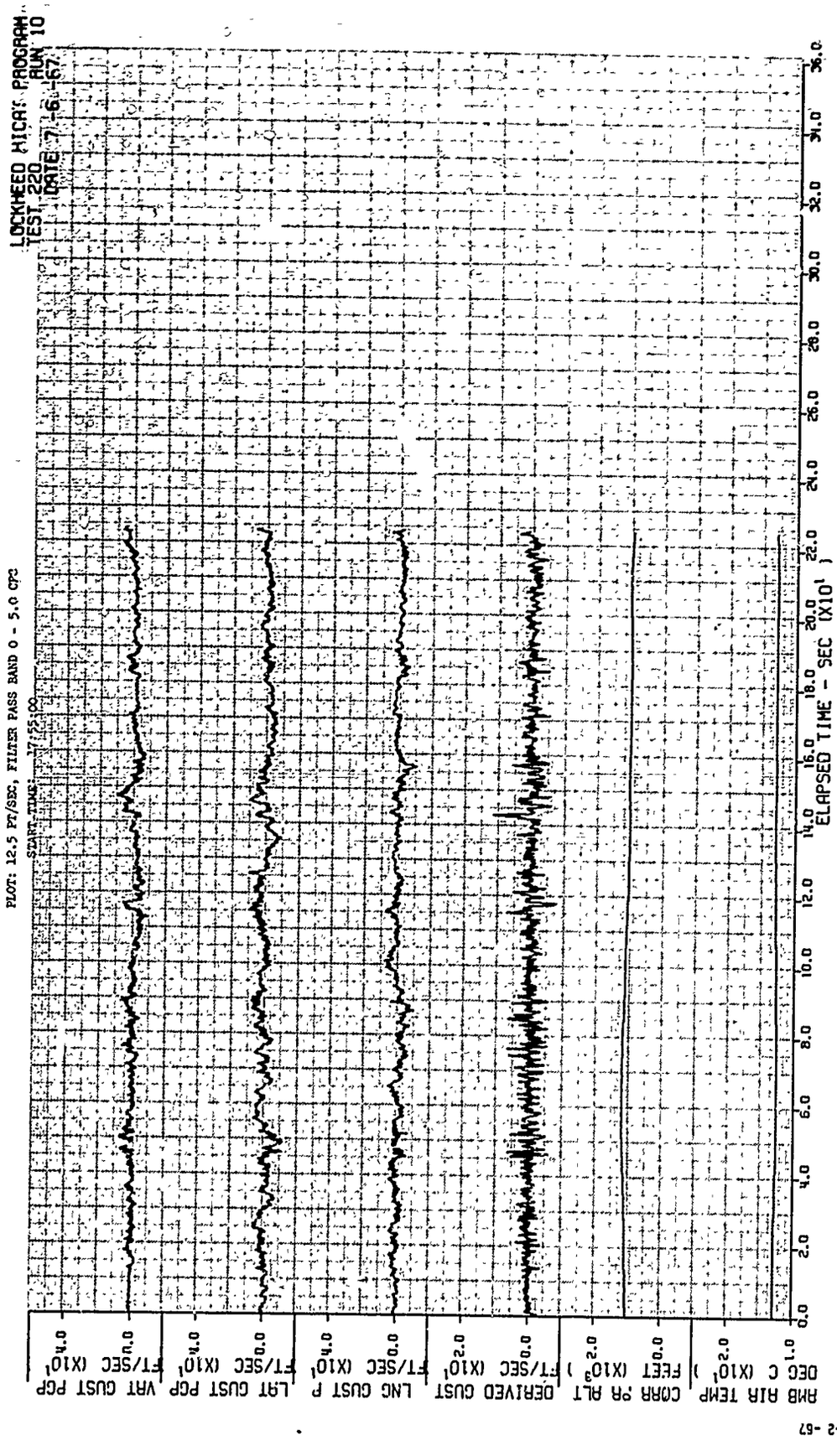


Figure 15A Gust Velocity Time Histories of Test 220, Run 10 (Landing Approach) - Loring AFB, Maine, 6 Jul 67

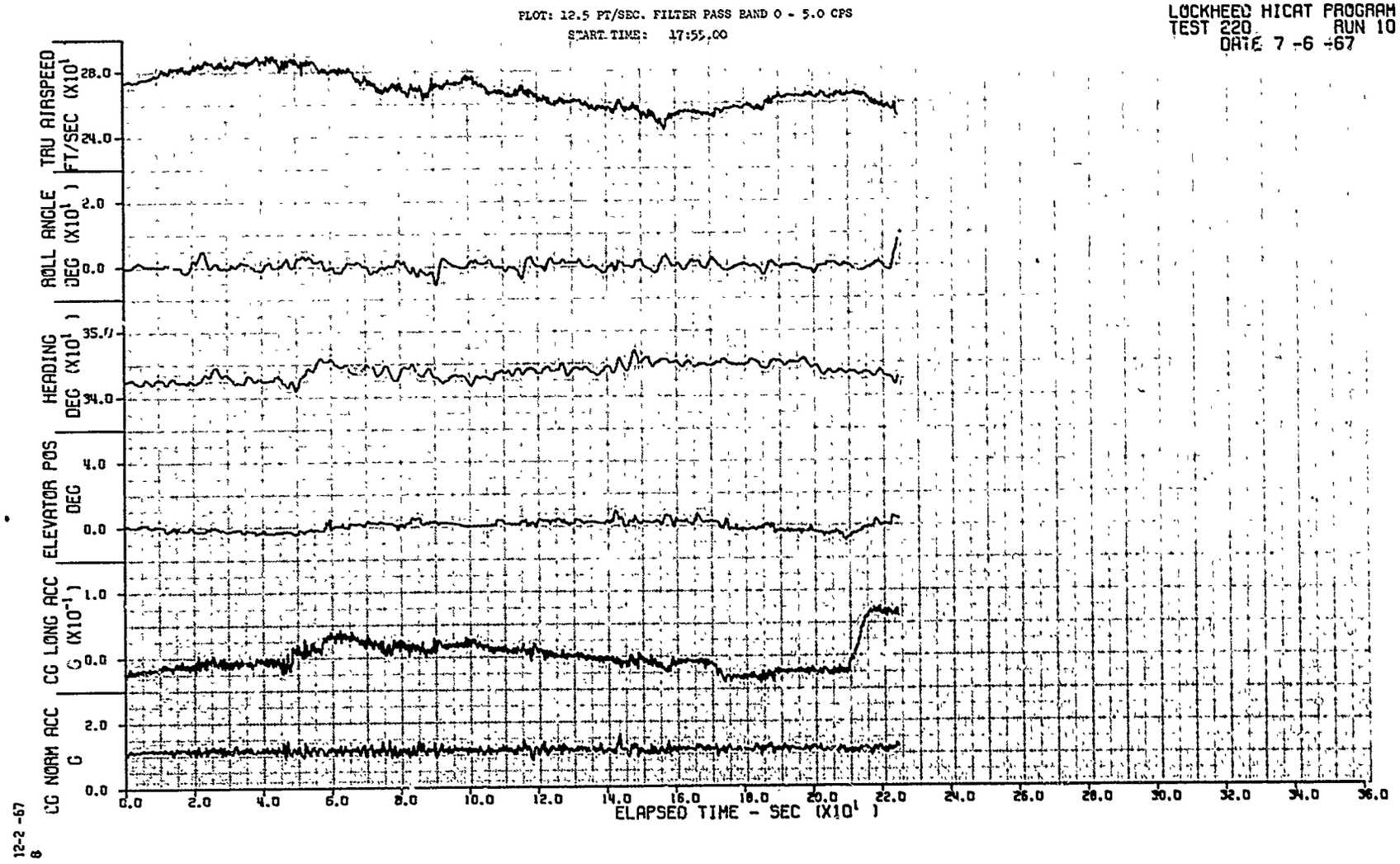


Figure 15B Flight Parameter Time Histories of Test 220, Run 10 (Landing Approach)

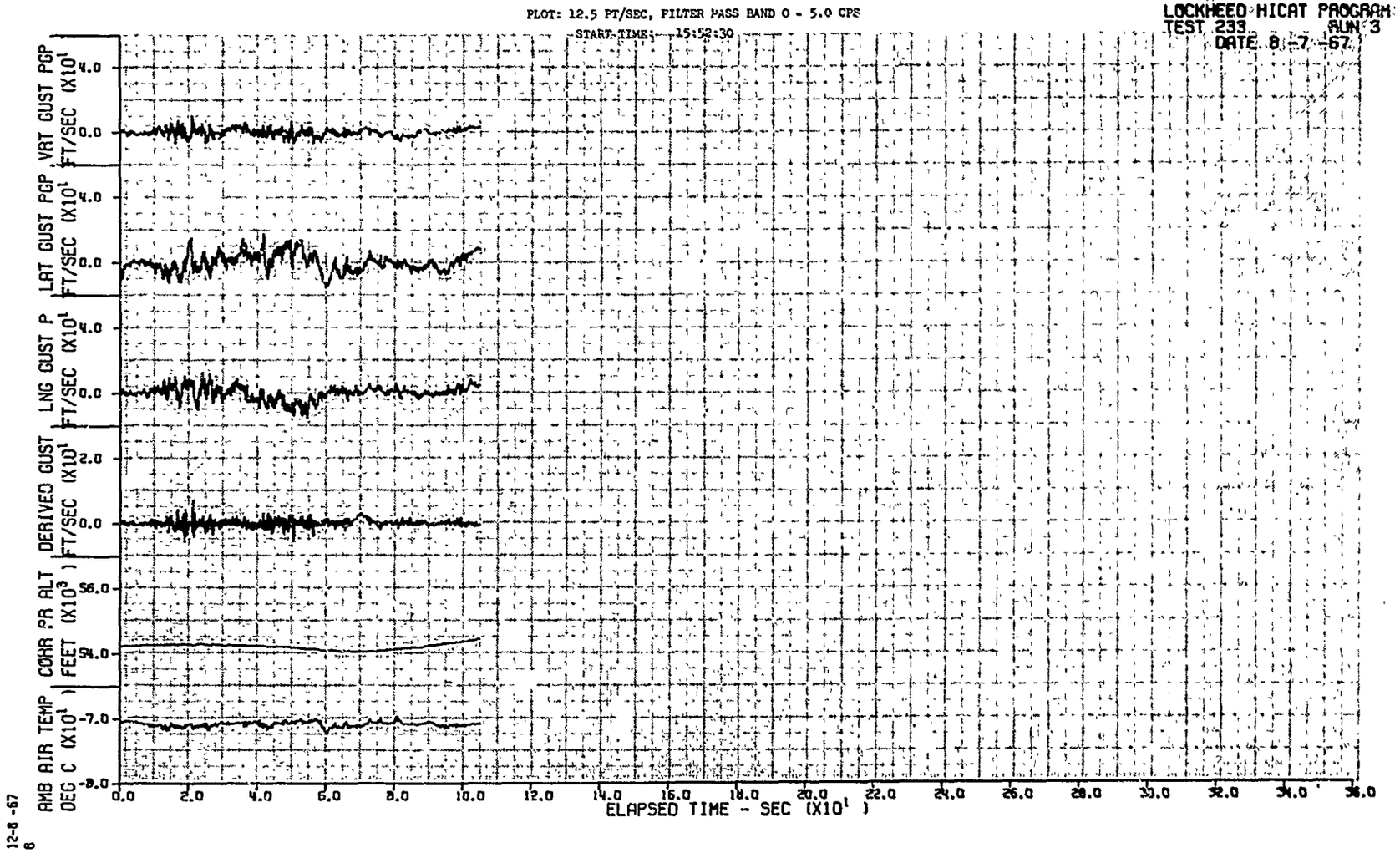


Figure 16A Gust Velocity Time Histories of Test 233, Run 3 - Albrook AFB, Panama Canal Zone, 7 Aug 67

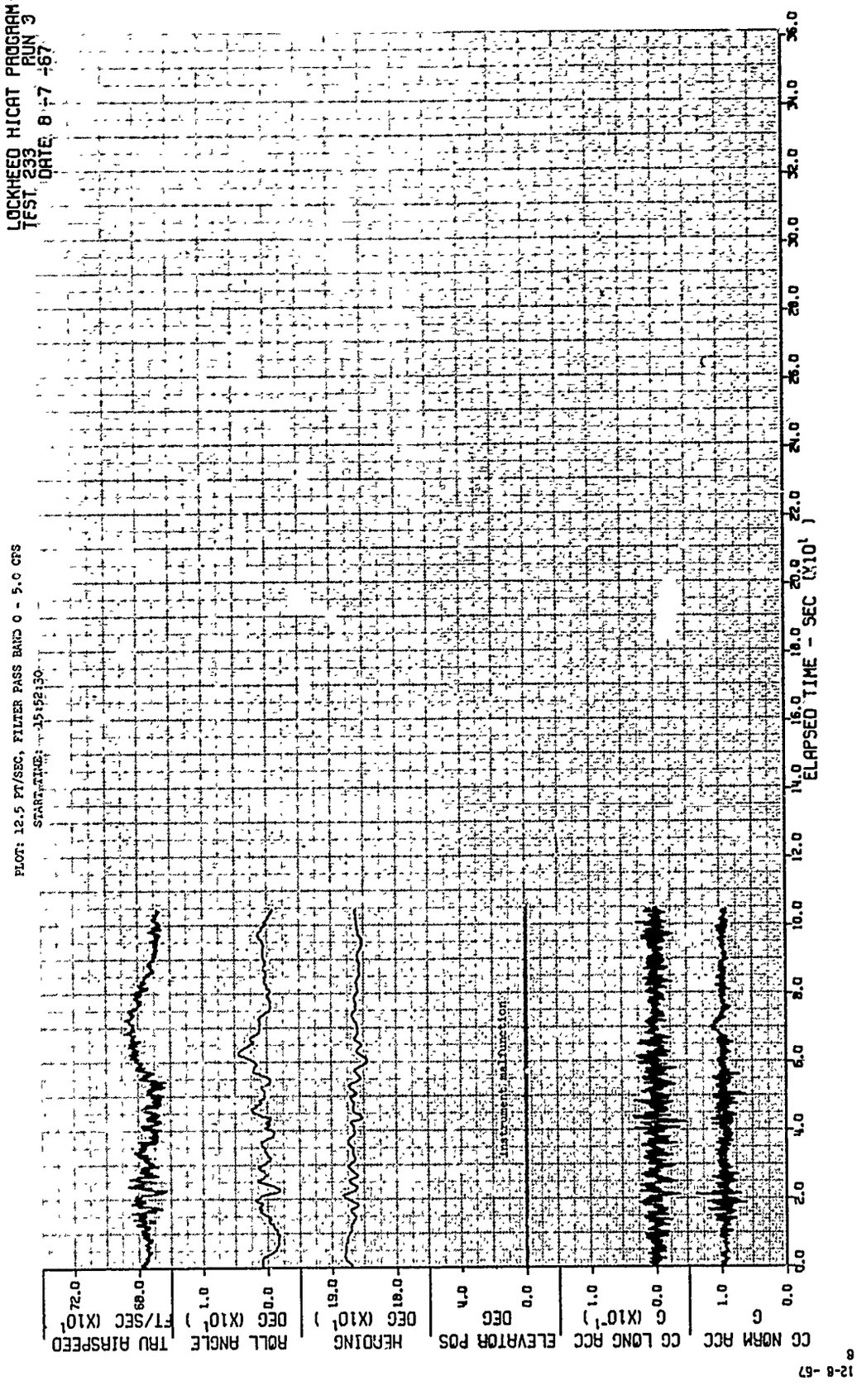


Figure 16B Flight Parameter Time Histories of Test 233, Run 3

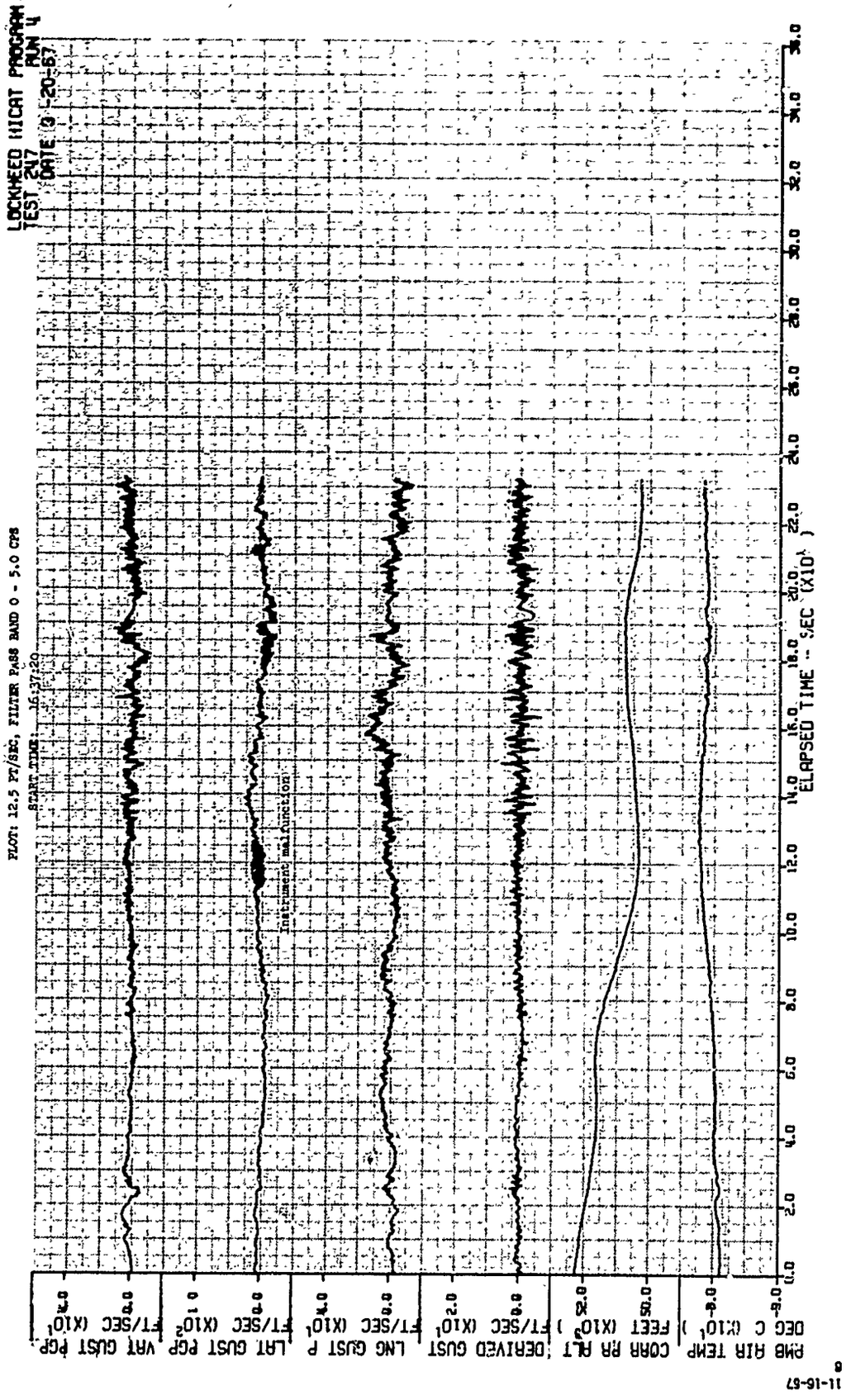


Figure 17A Gust Velocity Time Histories of Test 247, Run 4 - Patrick AFB, Florida, 20 Sep 67

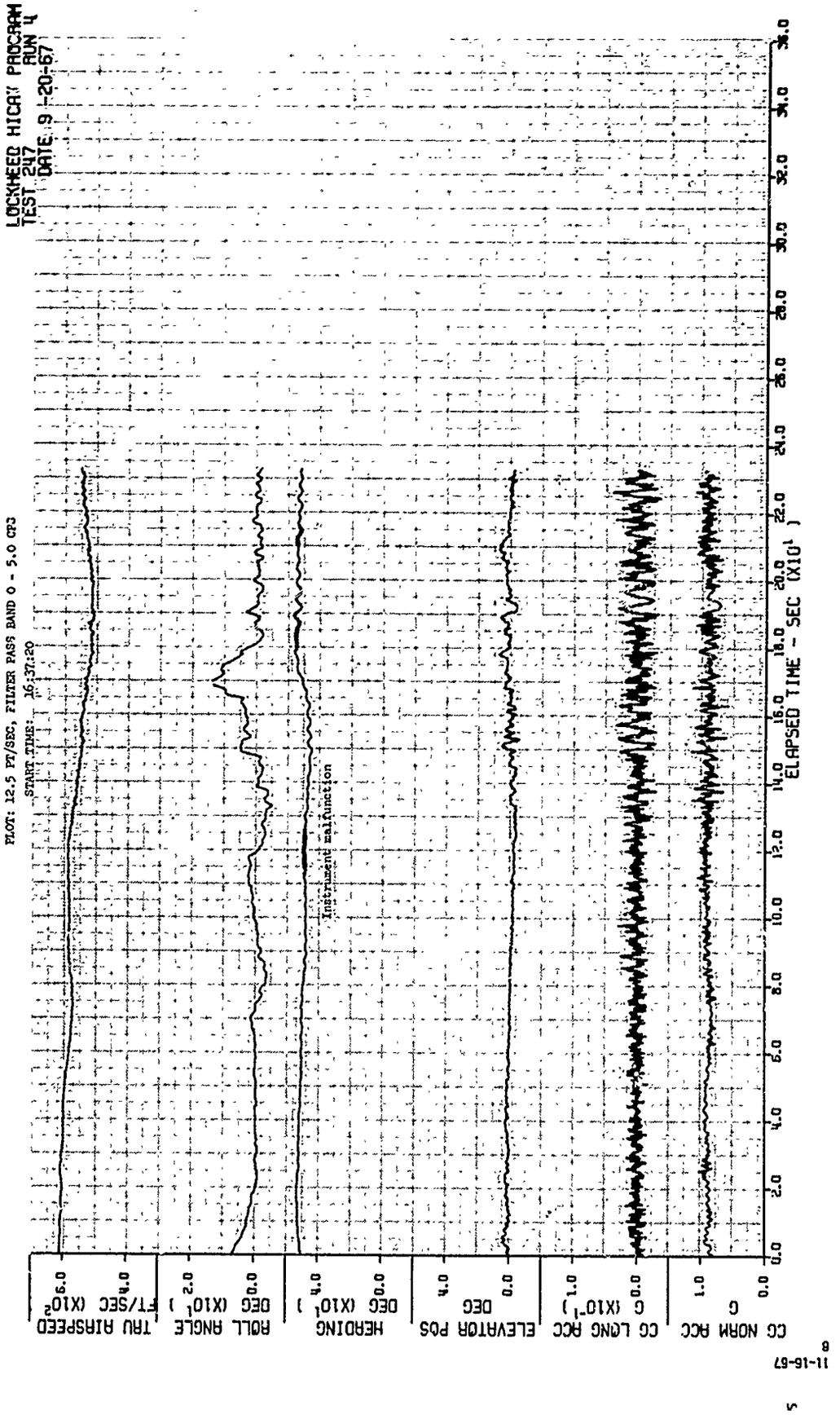


Figure 17B Flight Parameter Time Histories of Test 247, Run 4

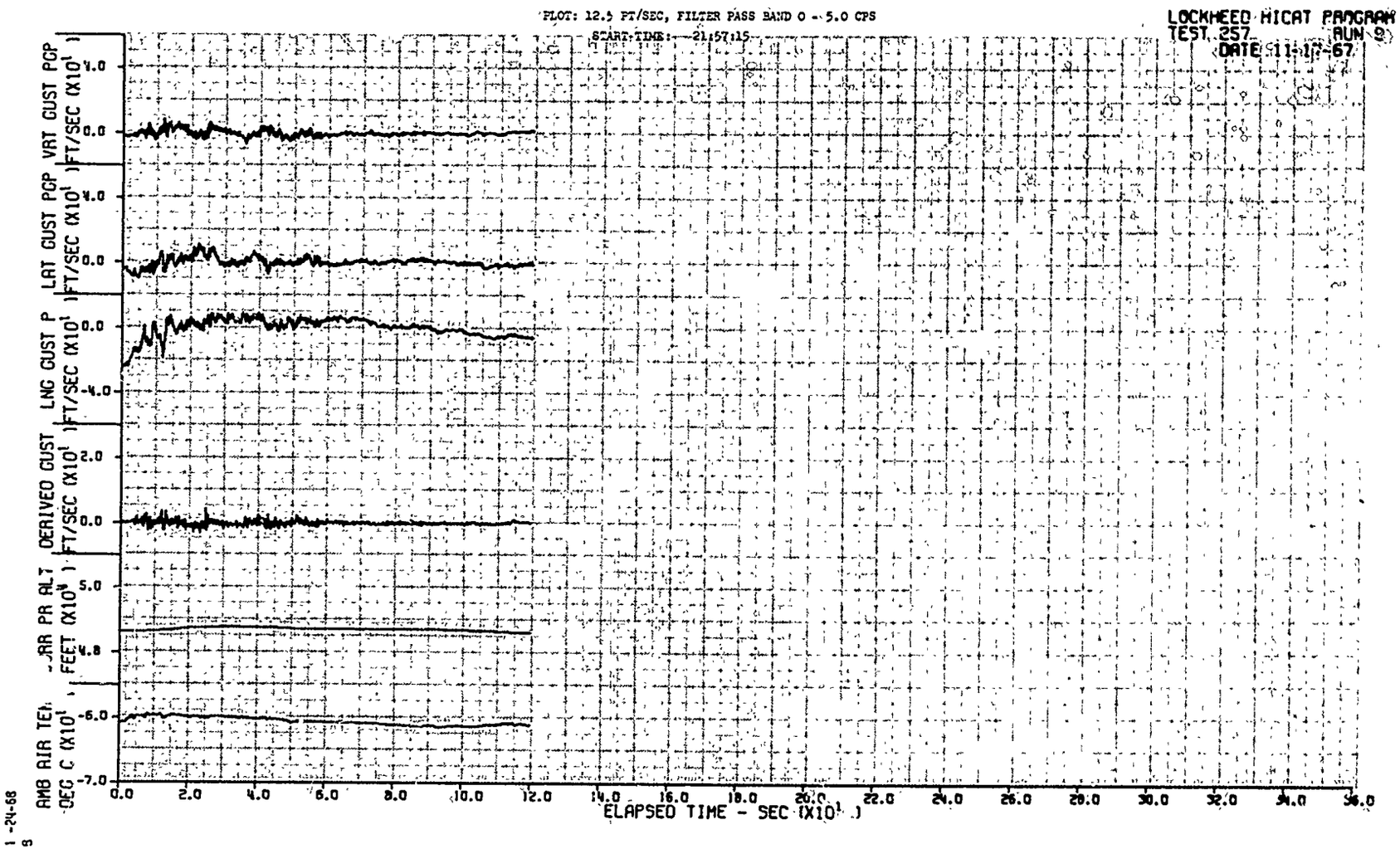


Figure 18A Gust Velocity Time Histories of Test 257, Run 9 - Edwards AFB, California, 17 Nov 67

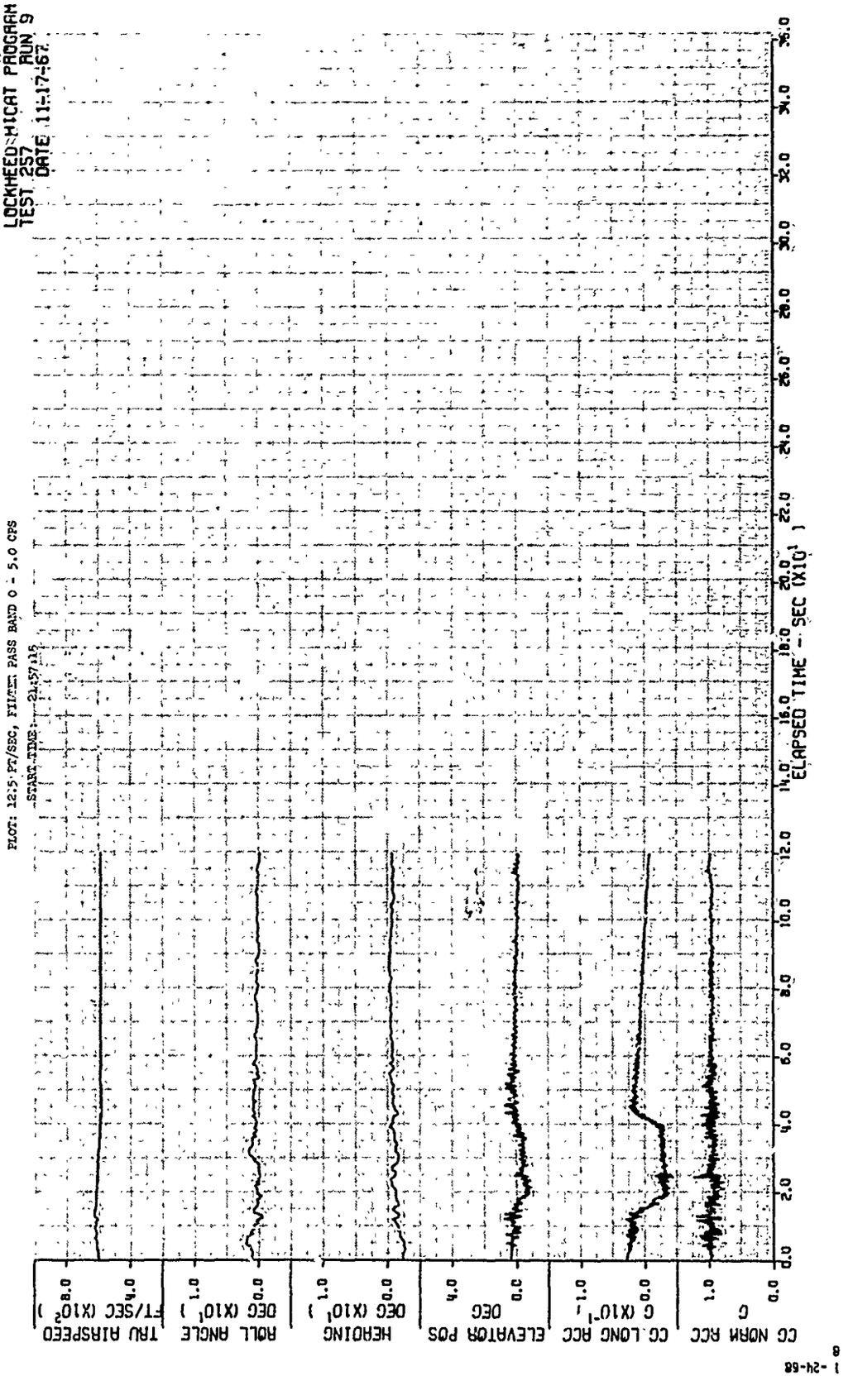


Figure 18B Flight Parameter Time Histories of Test 257, Run 9

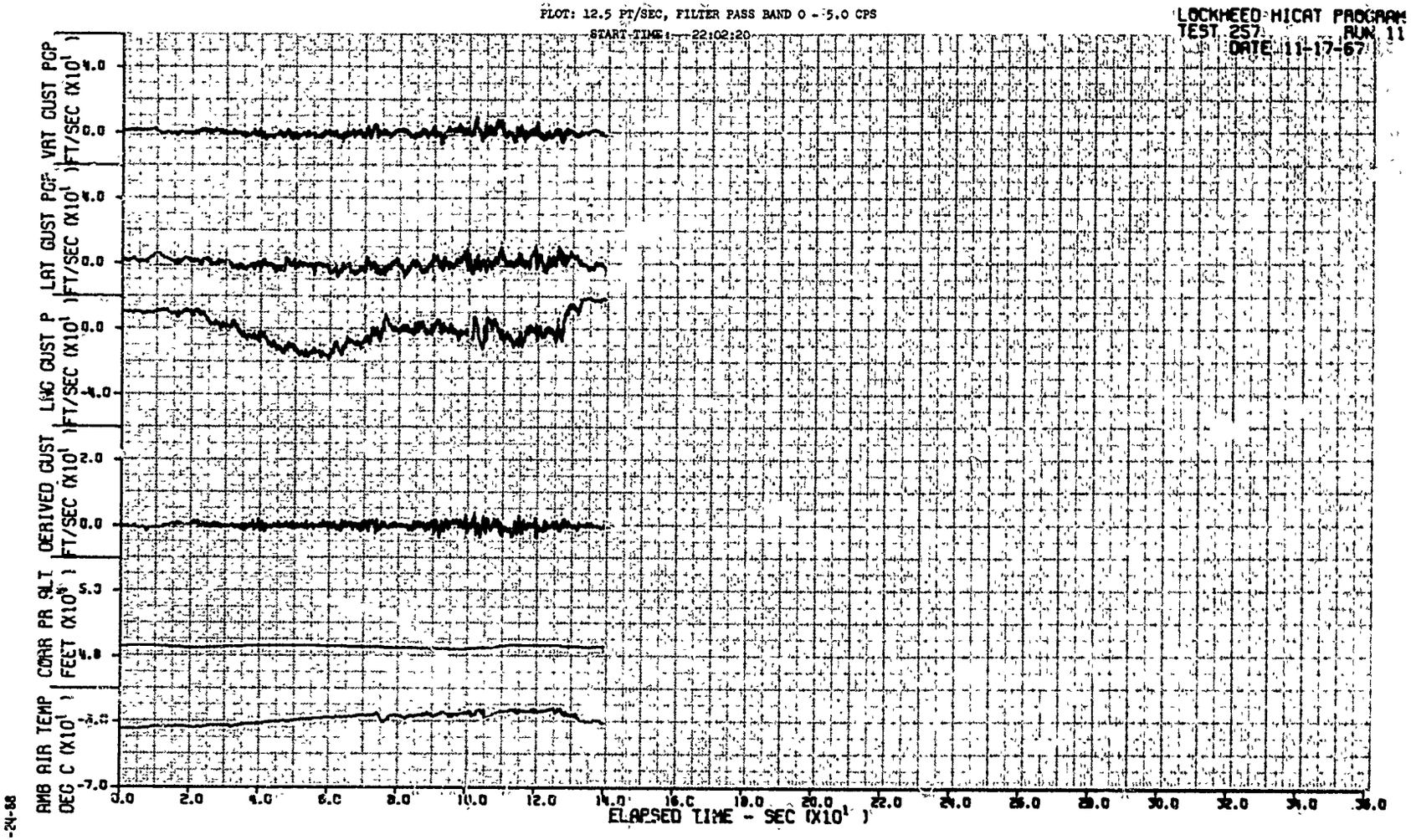


Figure 19A Gust Velocity Time Histories of Test 257, Run 11 - Edwards AFB, California, 17 Nov 67

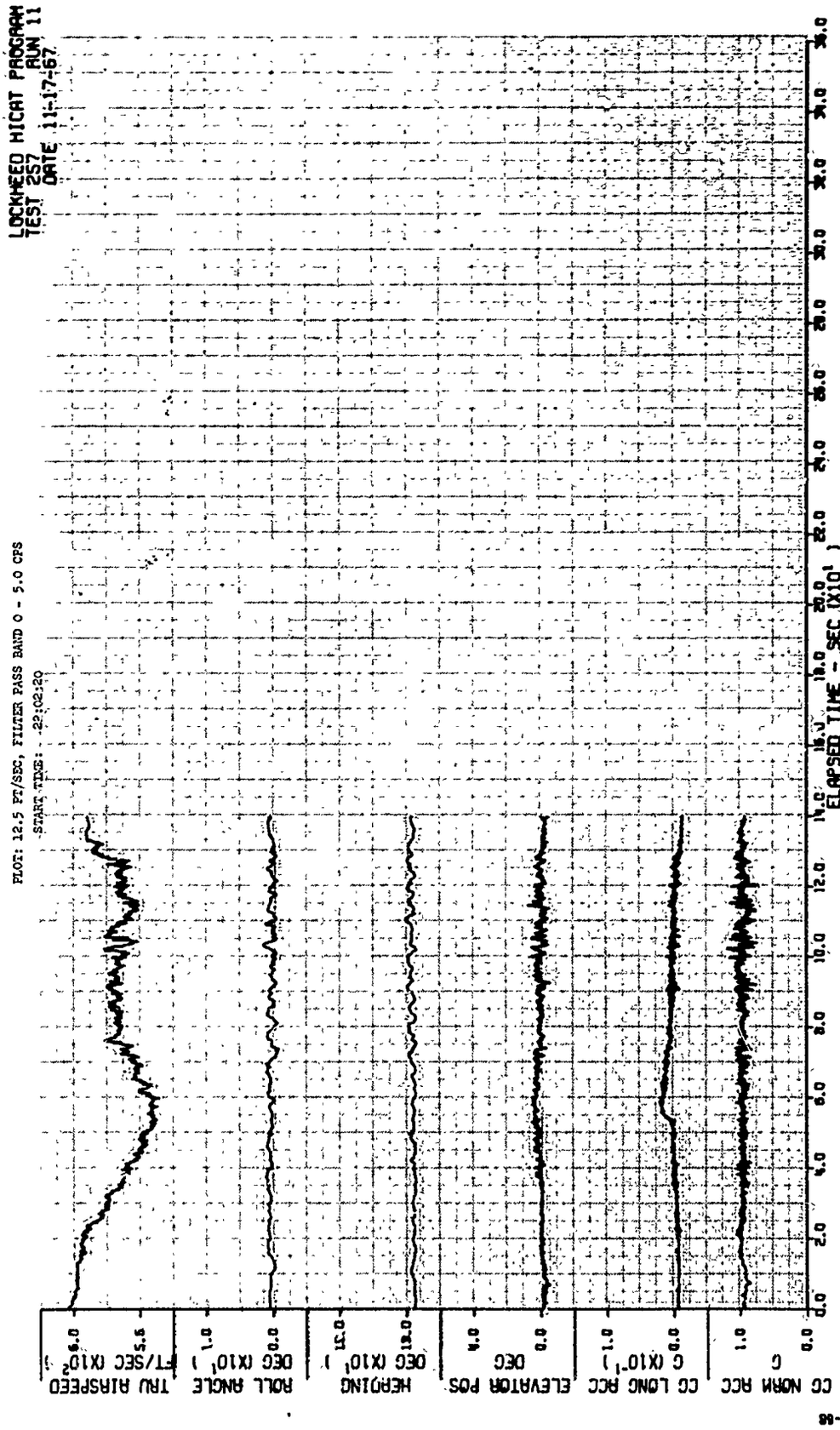


Figure 19B Flight Parameter Time Histories of Test 257, Run 11

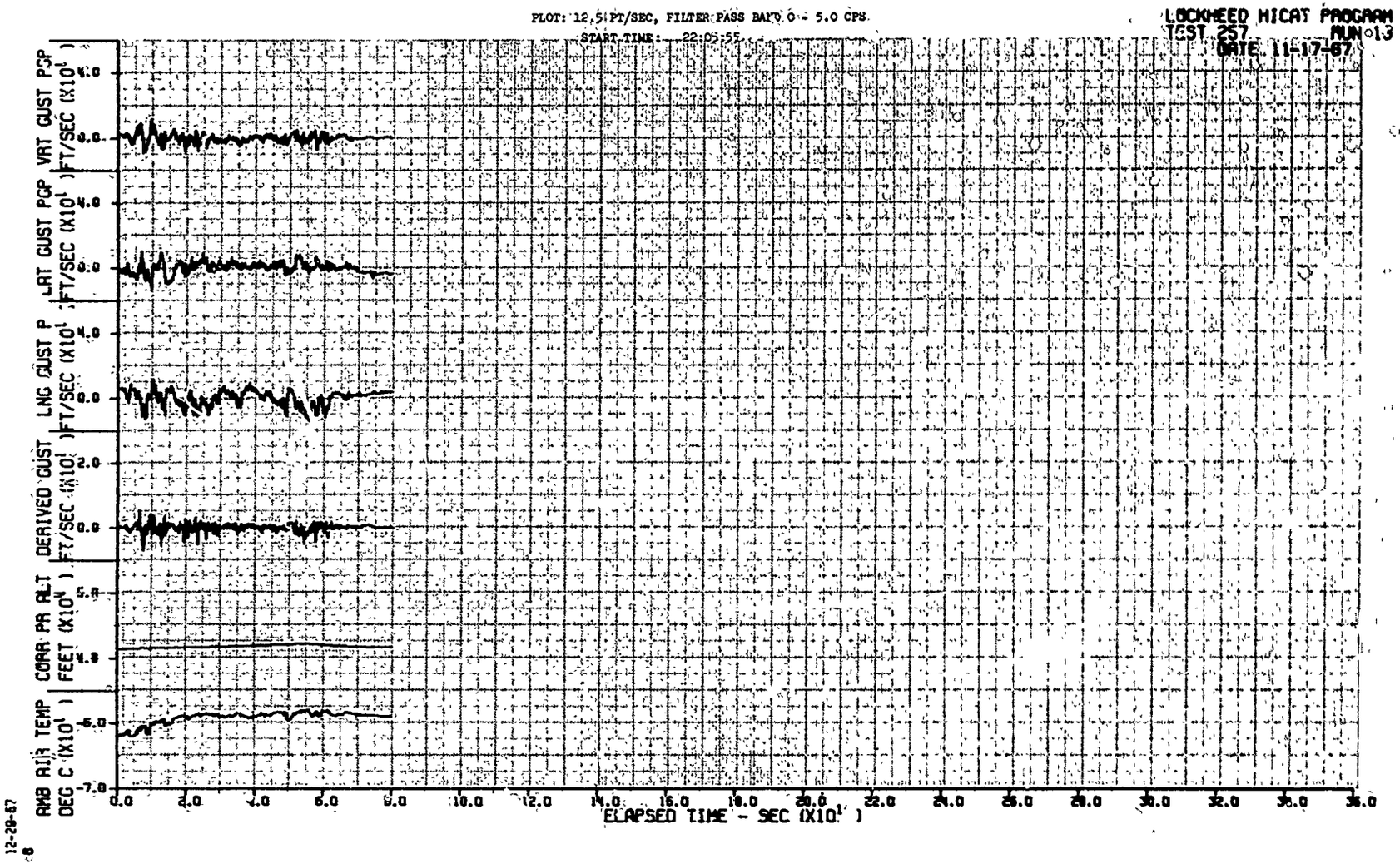


Figure 20A Gust Velocity Time Histories of Test 257, Run 13 - Edwards AFB, California, 17 Nov 67

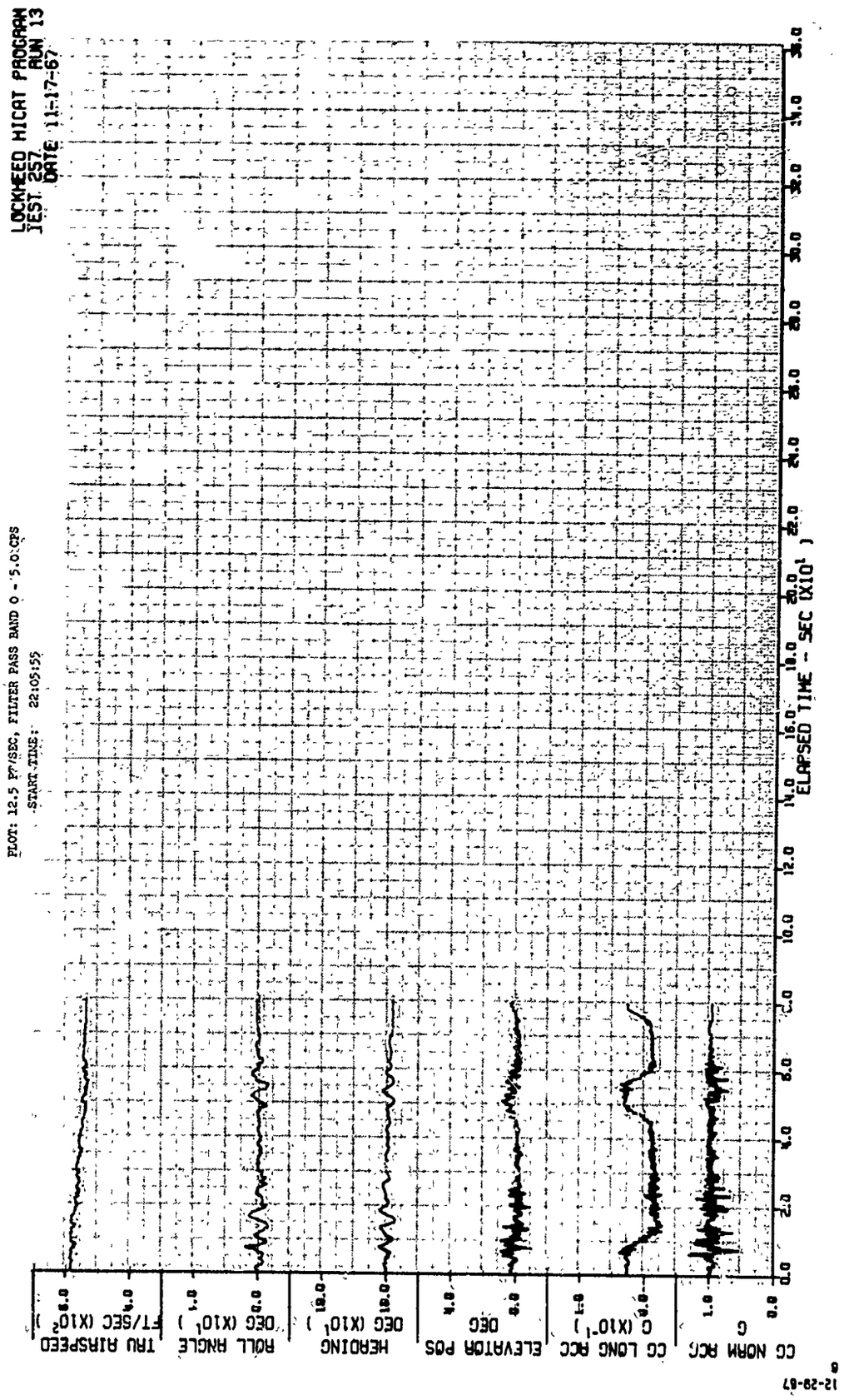


Figure 20B Flight Parameter Time Histories of Test 257, Run 13

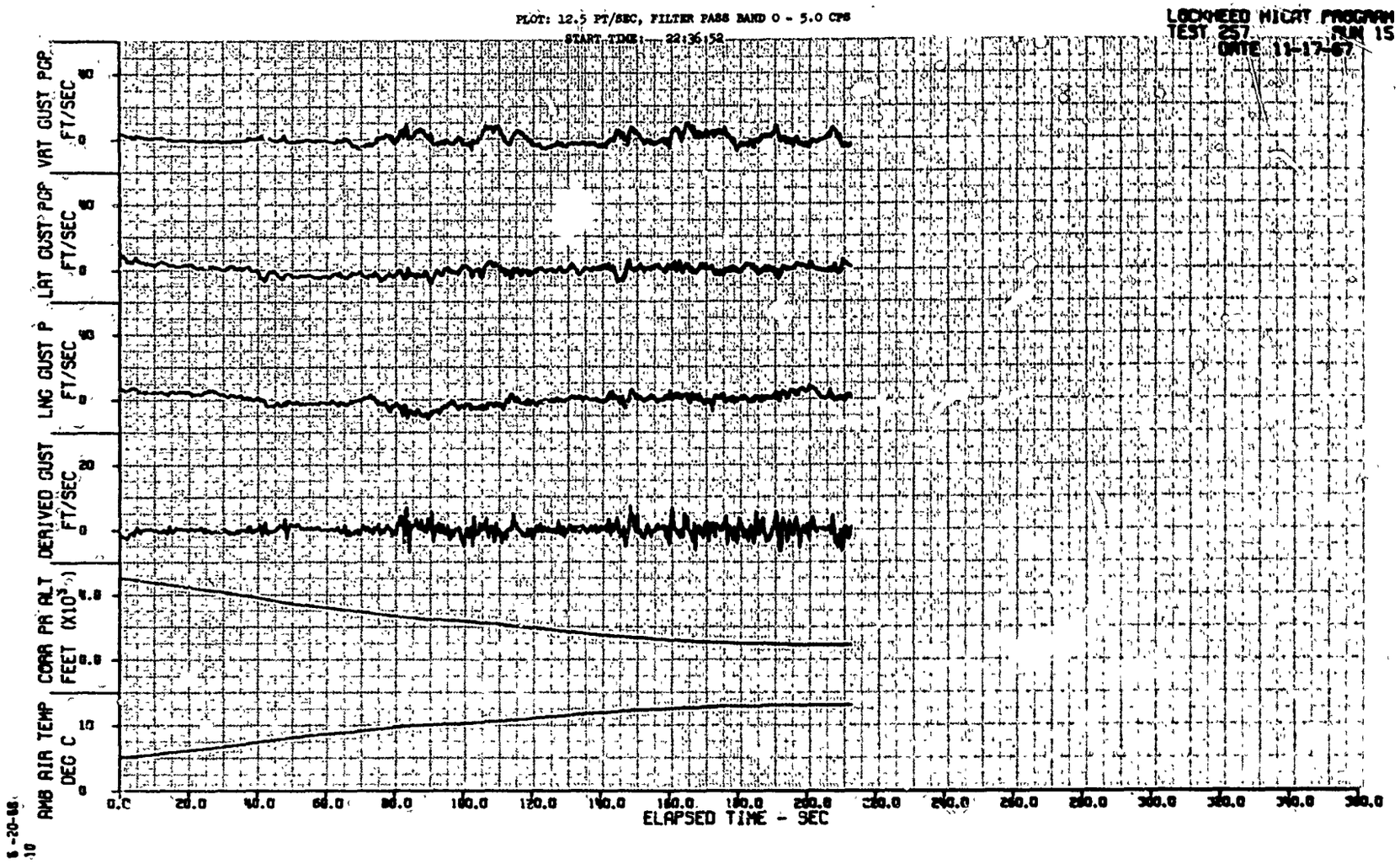


Figure 21A Gust Velocity Time Histories of Test 257, Run 15 (Landing Approach) - Edwards AFB, California, 17 Nov 67

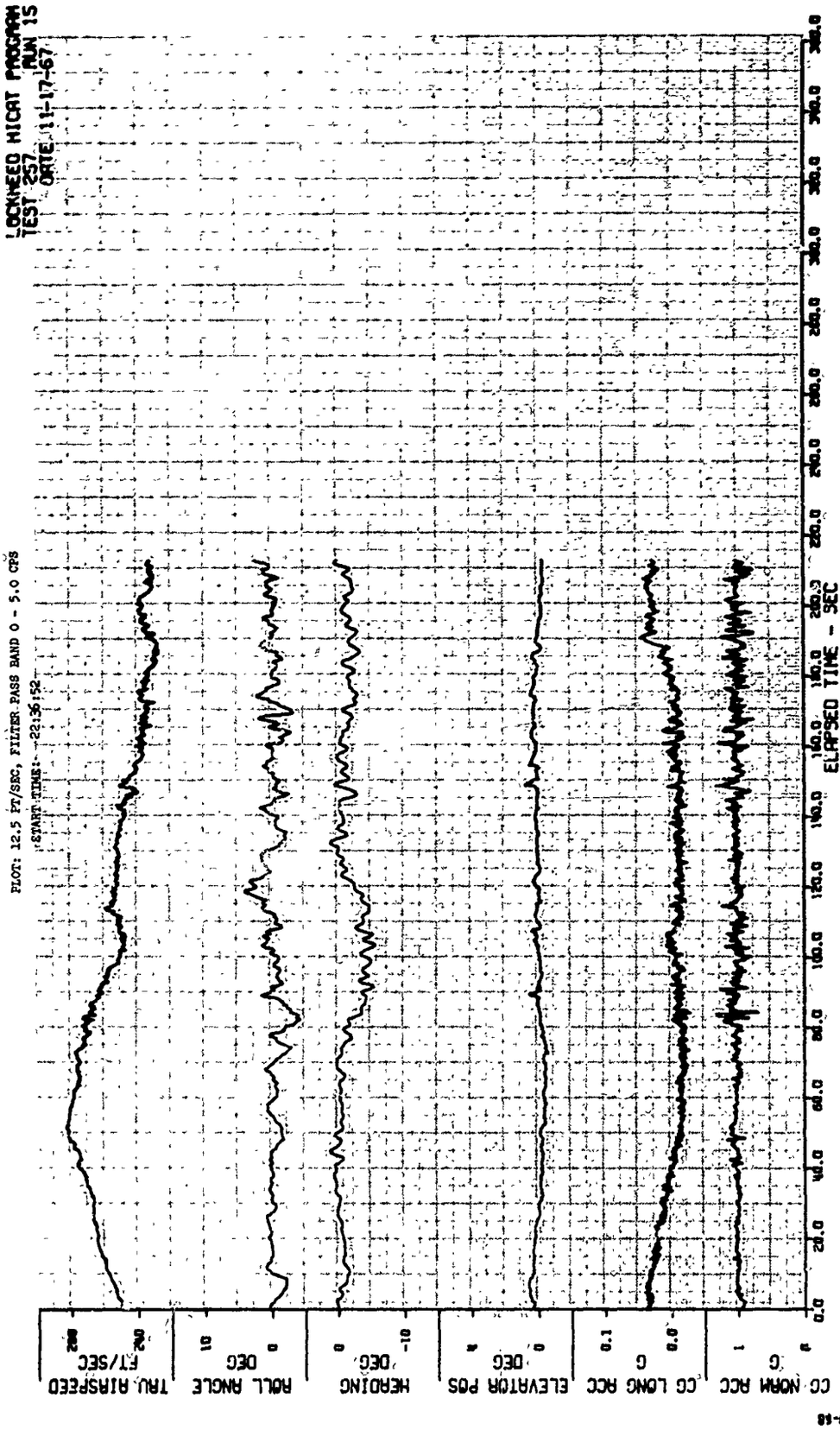


Figure 21B Flight Parameter Time Histories of Test 257, Run 15 (Landing Approach)

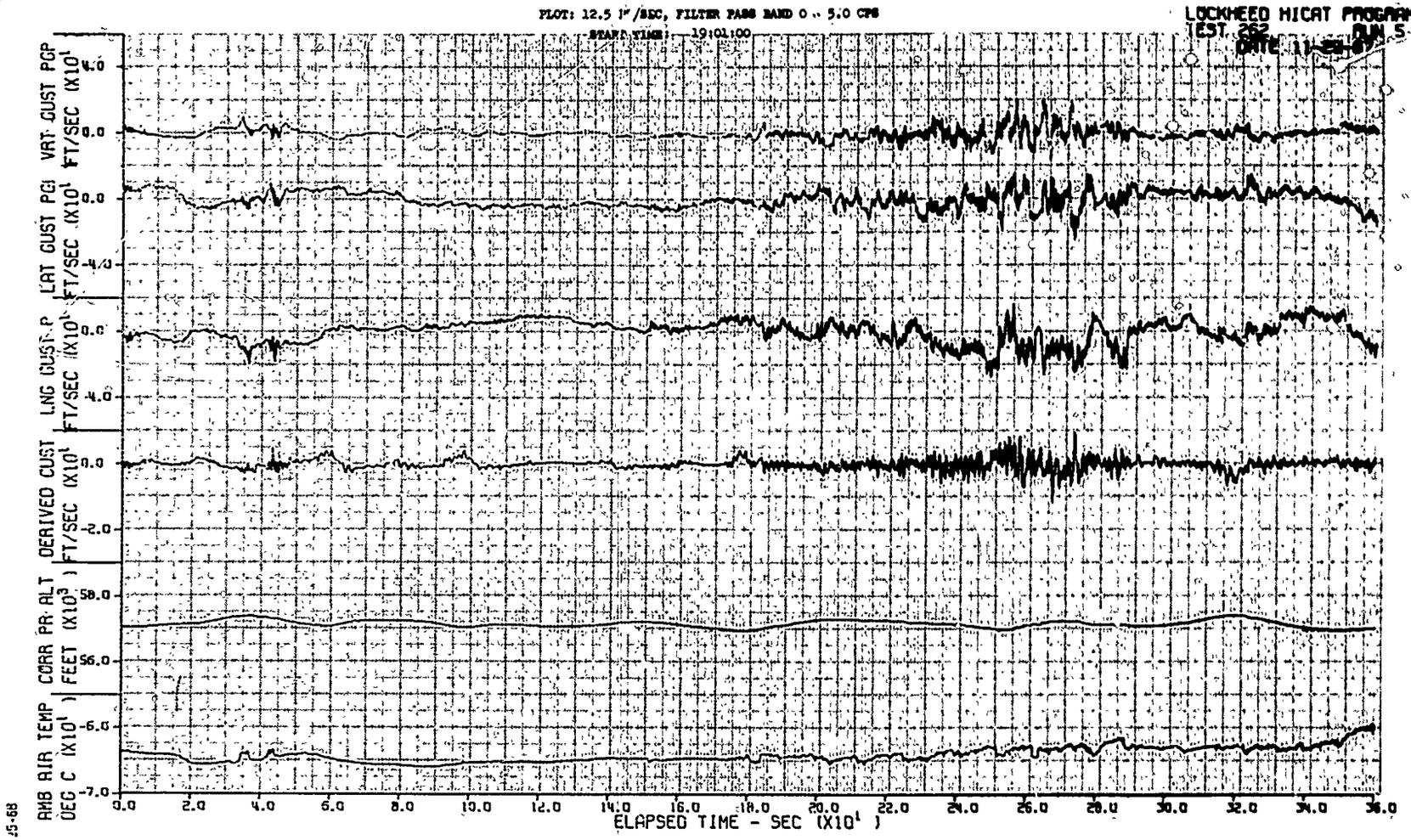


Figure 22A Gust Velocity Time Histories of Test 262, Run 5 - Edwards AFB, California, 29 Nov 67

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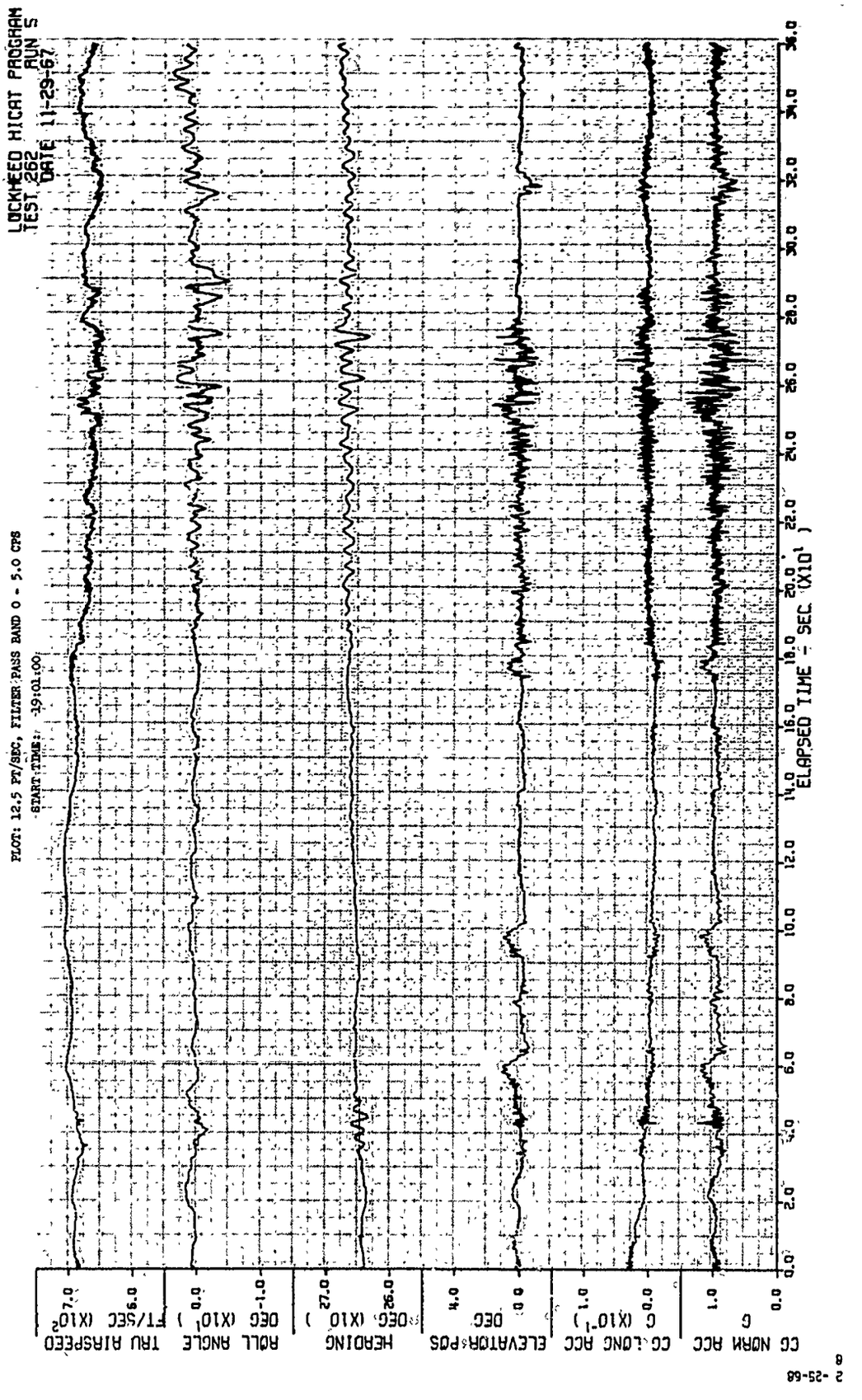


Figure 22B Flight Parameter Time Histories of Test 262, Run 5

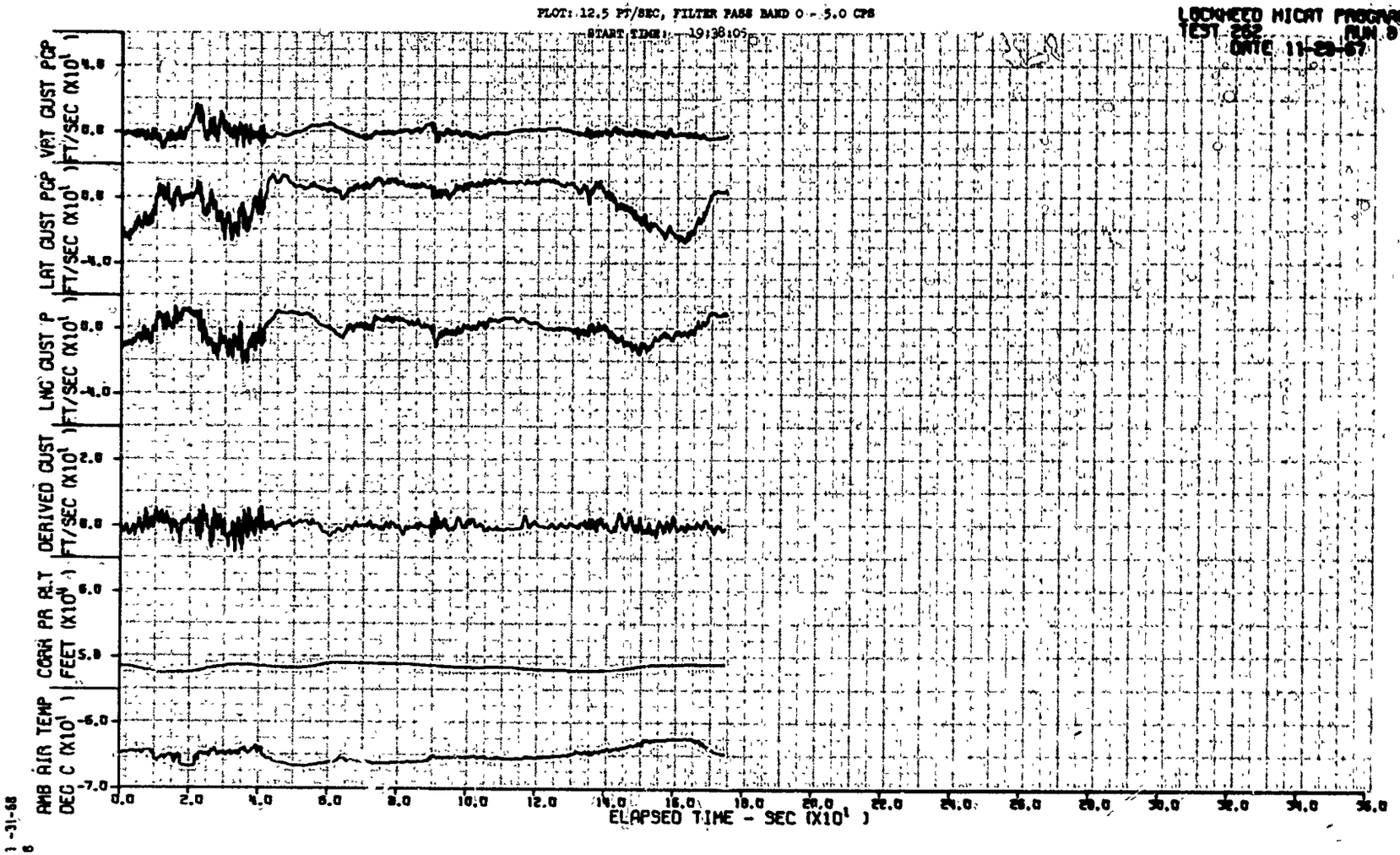


Figure 23A Gust Velocity Time Histories of Test 262, Run 8 - Edwards AFB, California, 29 Nov 67

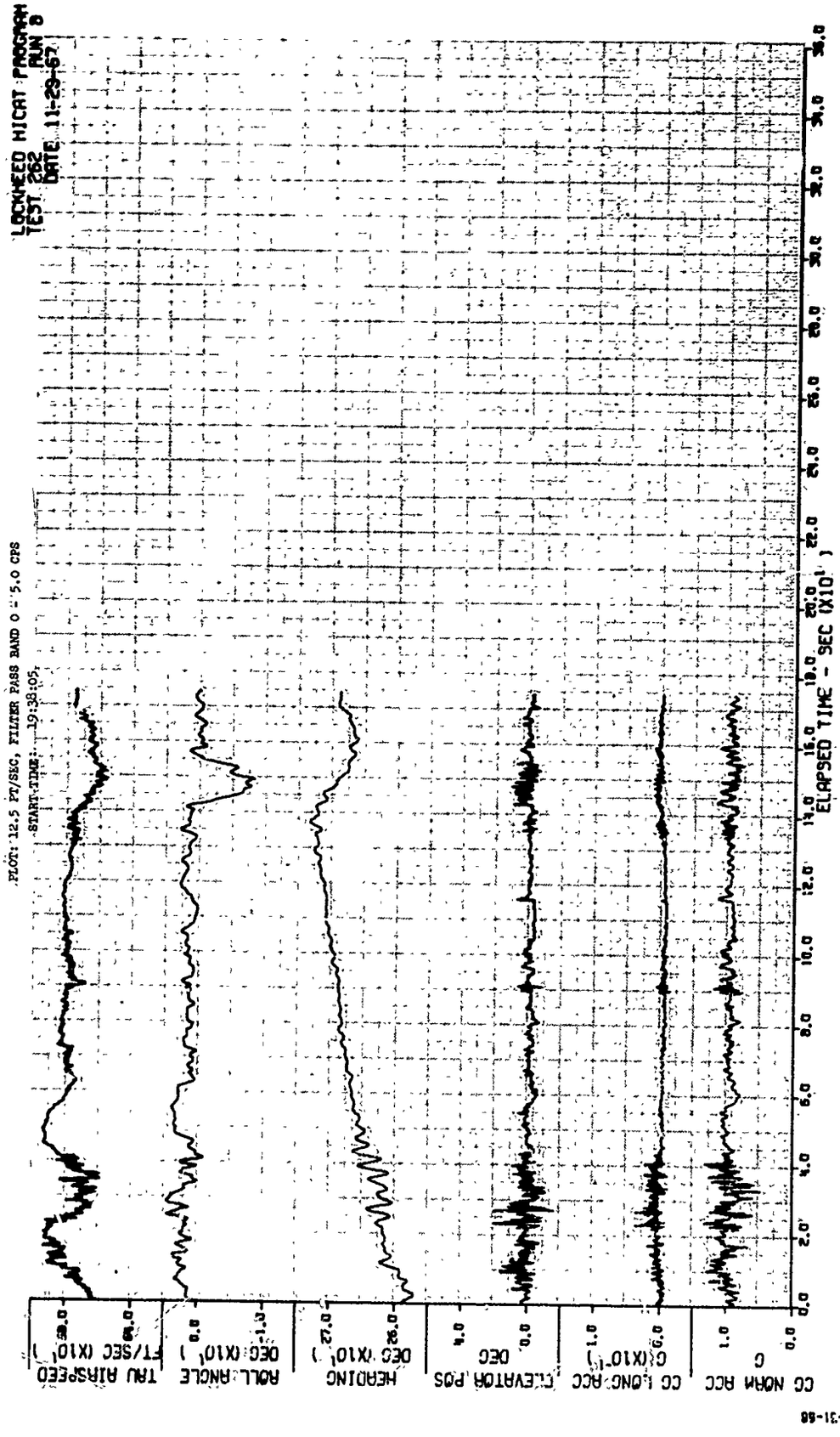


Figure 23B Flight Parameter Time Histories of Test 262, Run 8

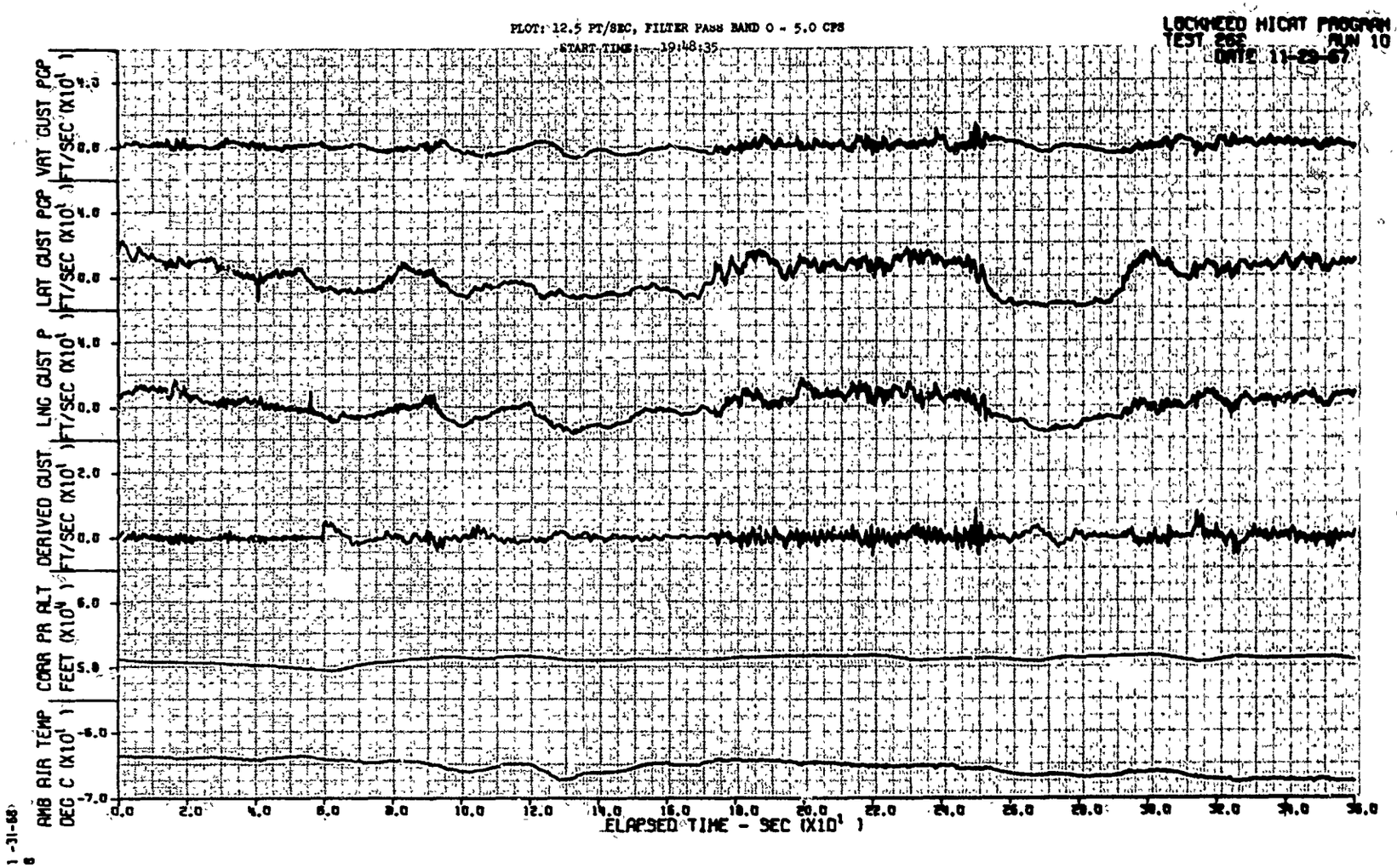


Figure 24A Gust Velocity Time Histories of Test 262, Run 10 - Edwards AFB, California, 29 Nov 67 (Sheet 1 of 2)

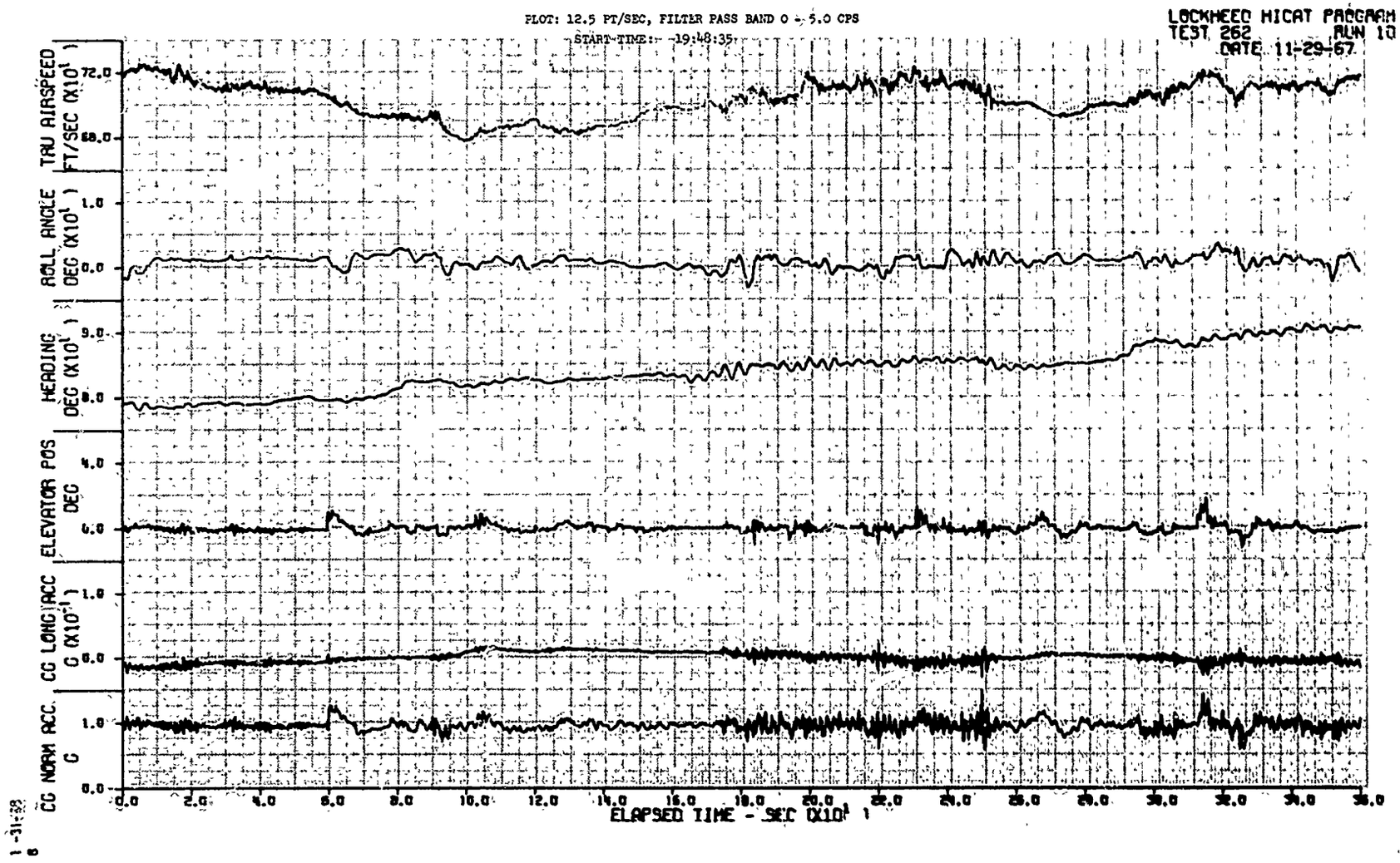


Figure 24B Flight Parameter Time Histories of Test 262, Run 10 (Sheet 1 of 2)

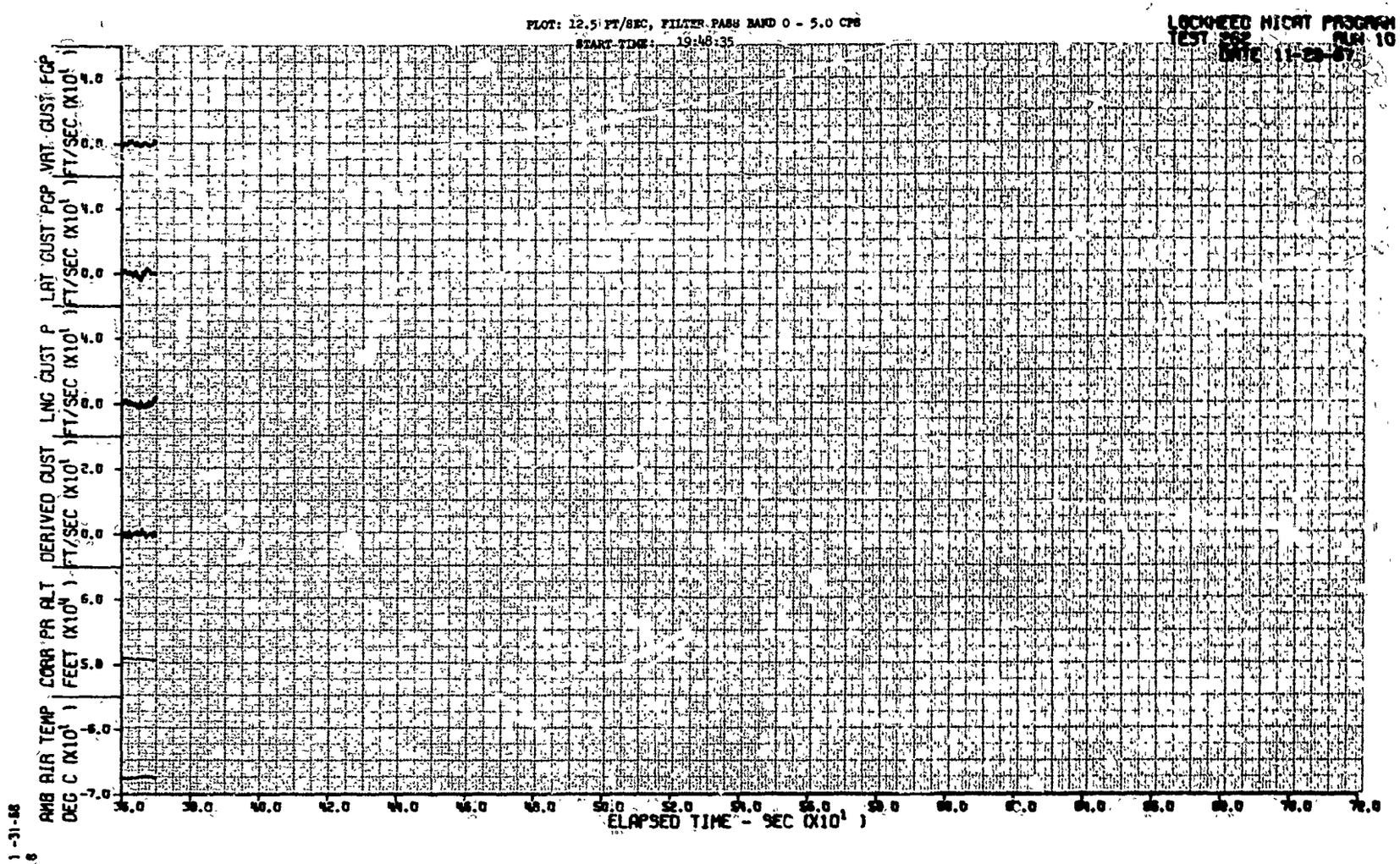


Figure 24A Gust Velocity Time Histories of Test 262, Run 10 - Edwards AFB, California, 29 Nov 67 (Sheet 2 of 2)

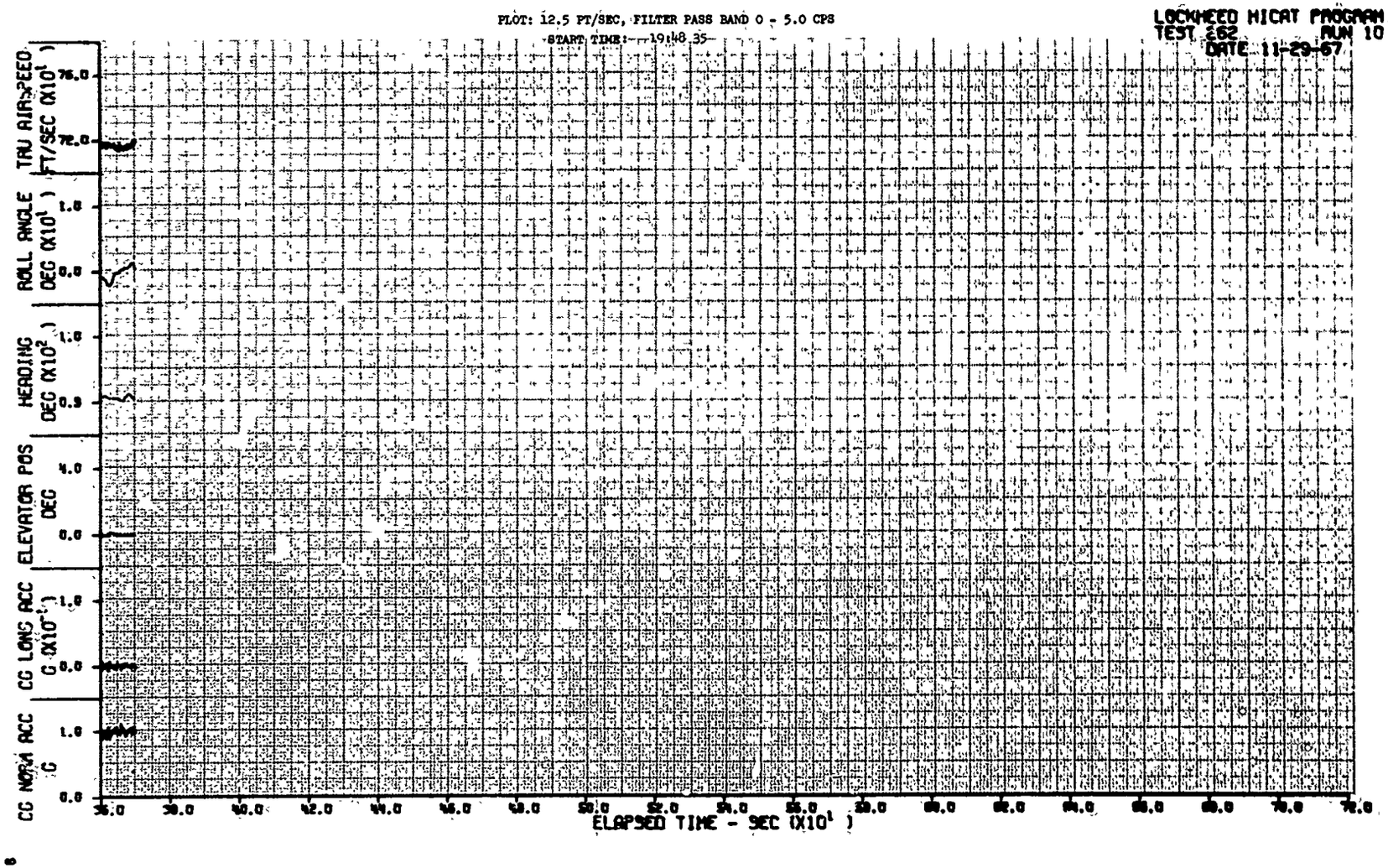


Figure 24B Flight Parameter Time Histories of Test 262, Run 10 (Sheet 2 of 2)

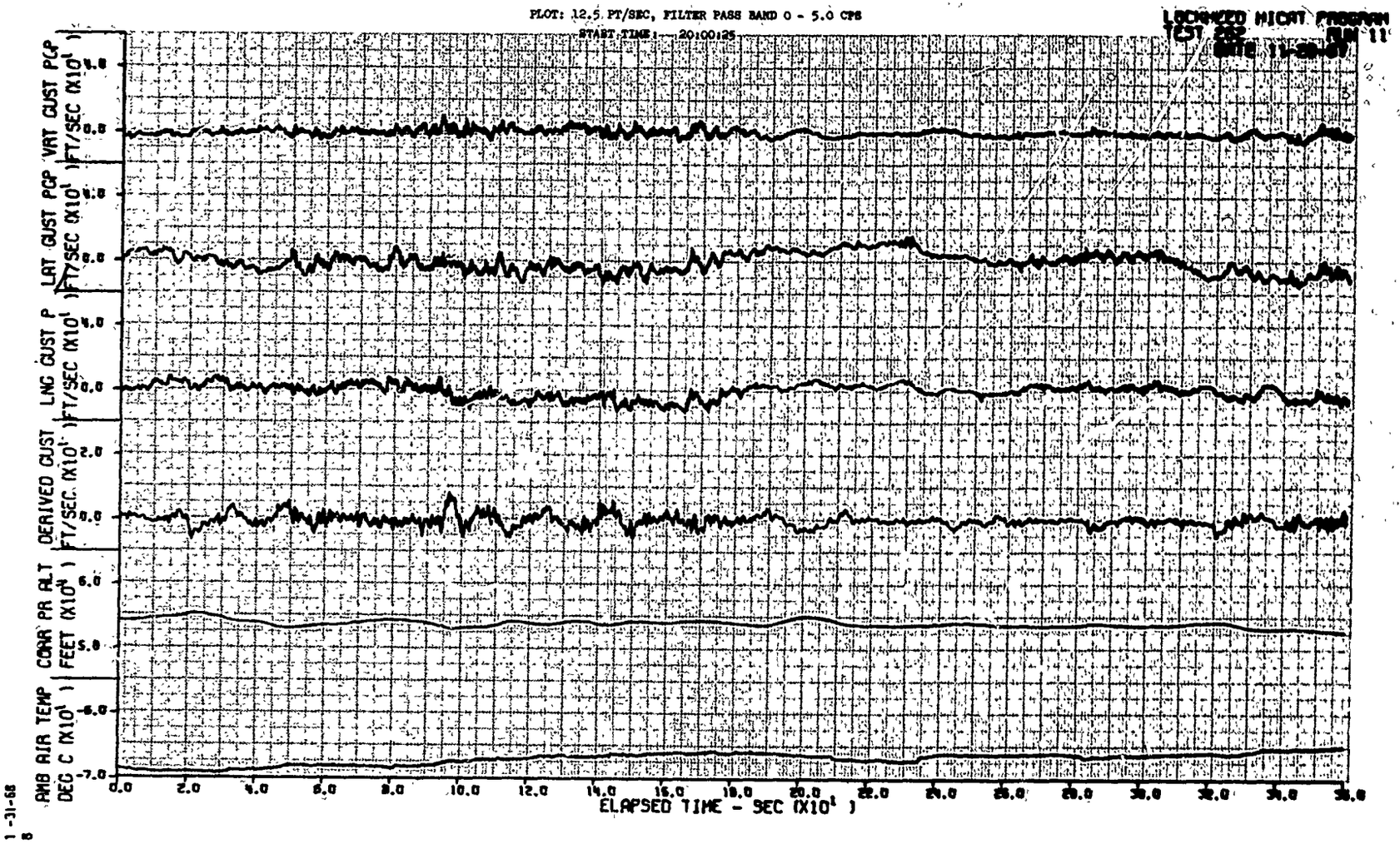


Figure 25A Gust Velocity Time Histories of Test 262, Run 11 - Edwards AFB, California, 29 Nov 67 (Sheet 1 of 2)

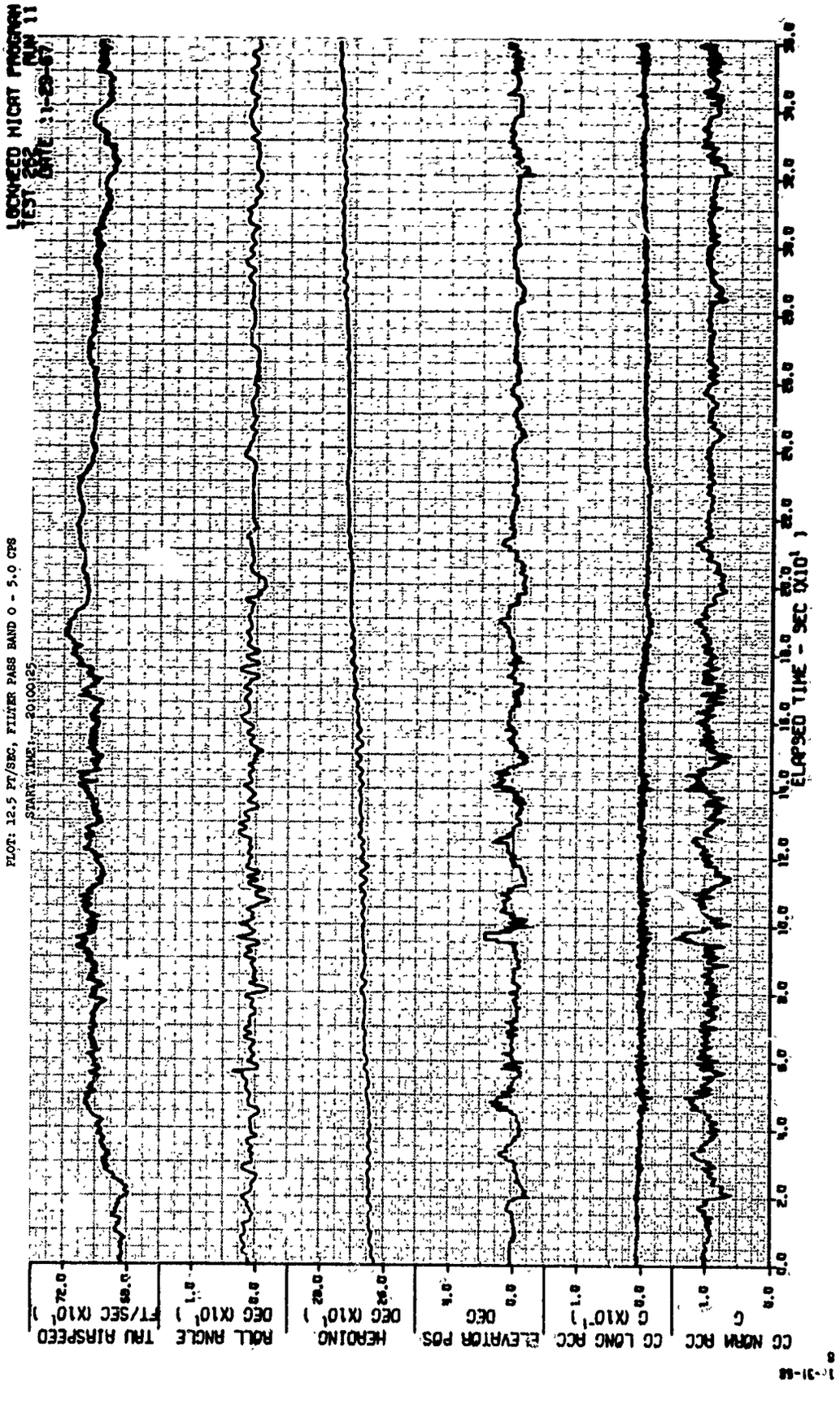


Figure 25B Flight Parameter Time Histories of Test 262, Run 11 (Sheet 1 of 2)

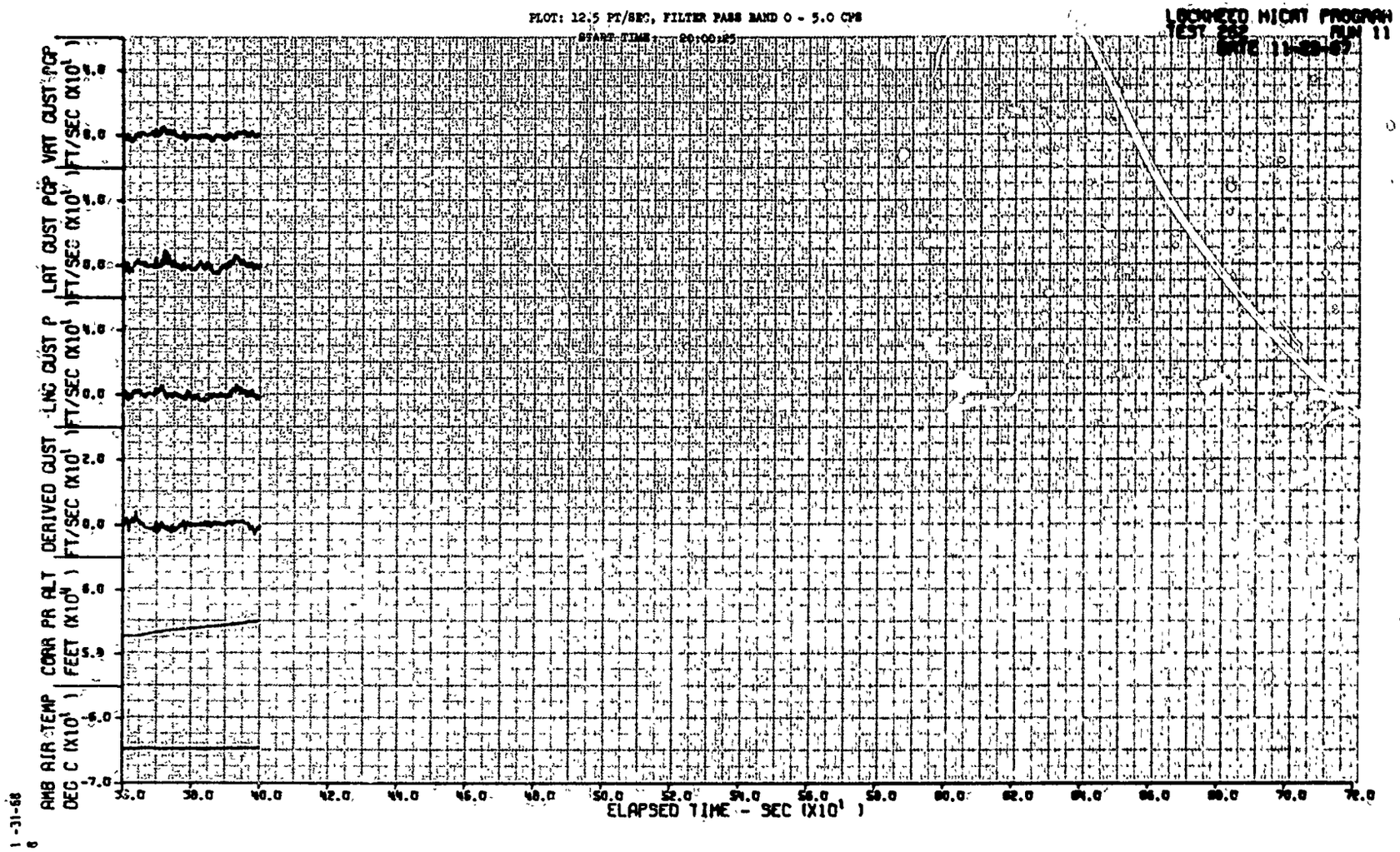


Figure 25A Gust Velocity Time Histories of Test 262, Run 11 - Edwards AFB, California. 29 Nov 67 (Sheet 2 of 2)

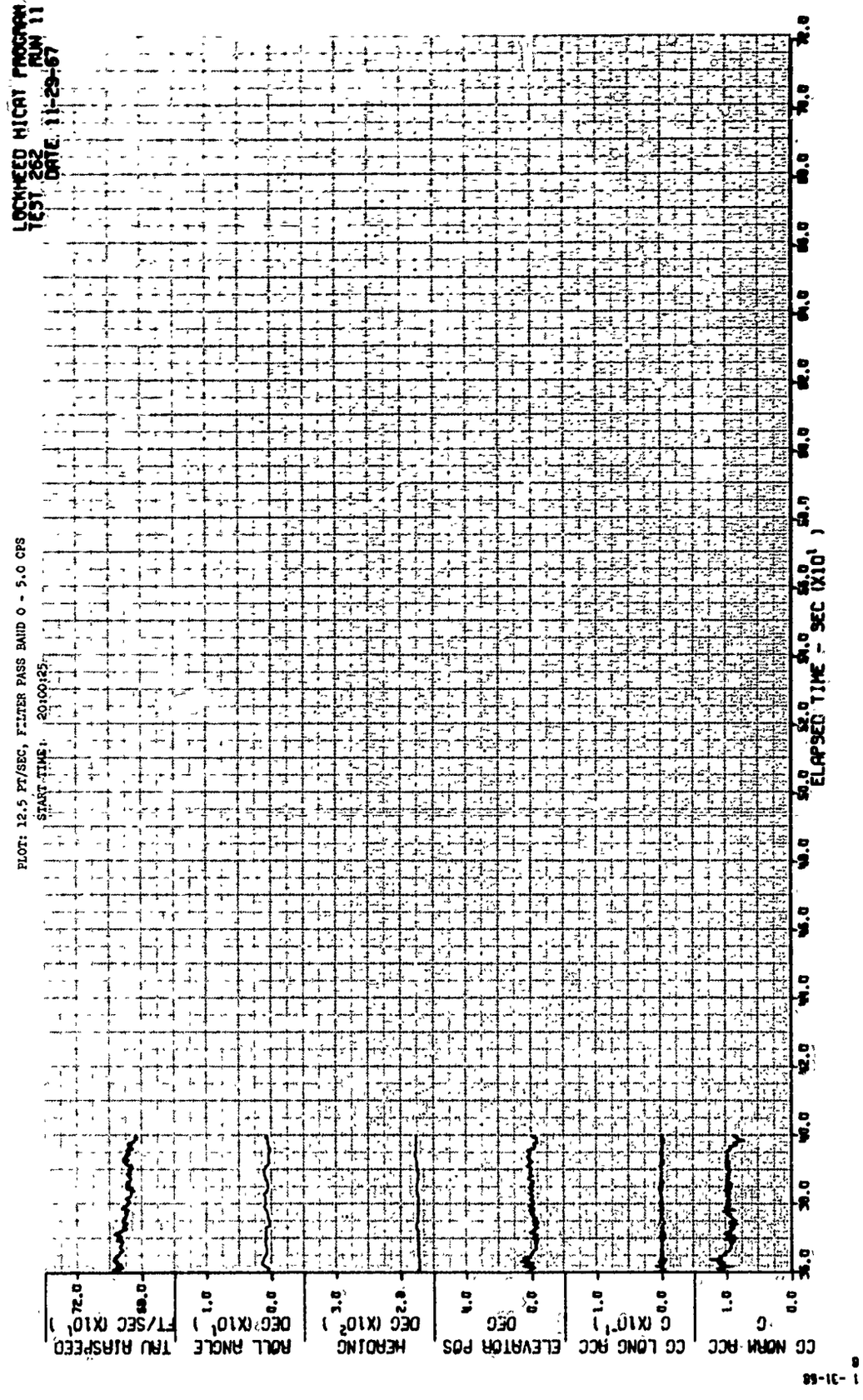


Figure 25B Flight Parameter Time Histories of Test 262, Run 11 (Sheet 2 of 2)

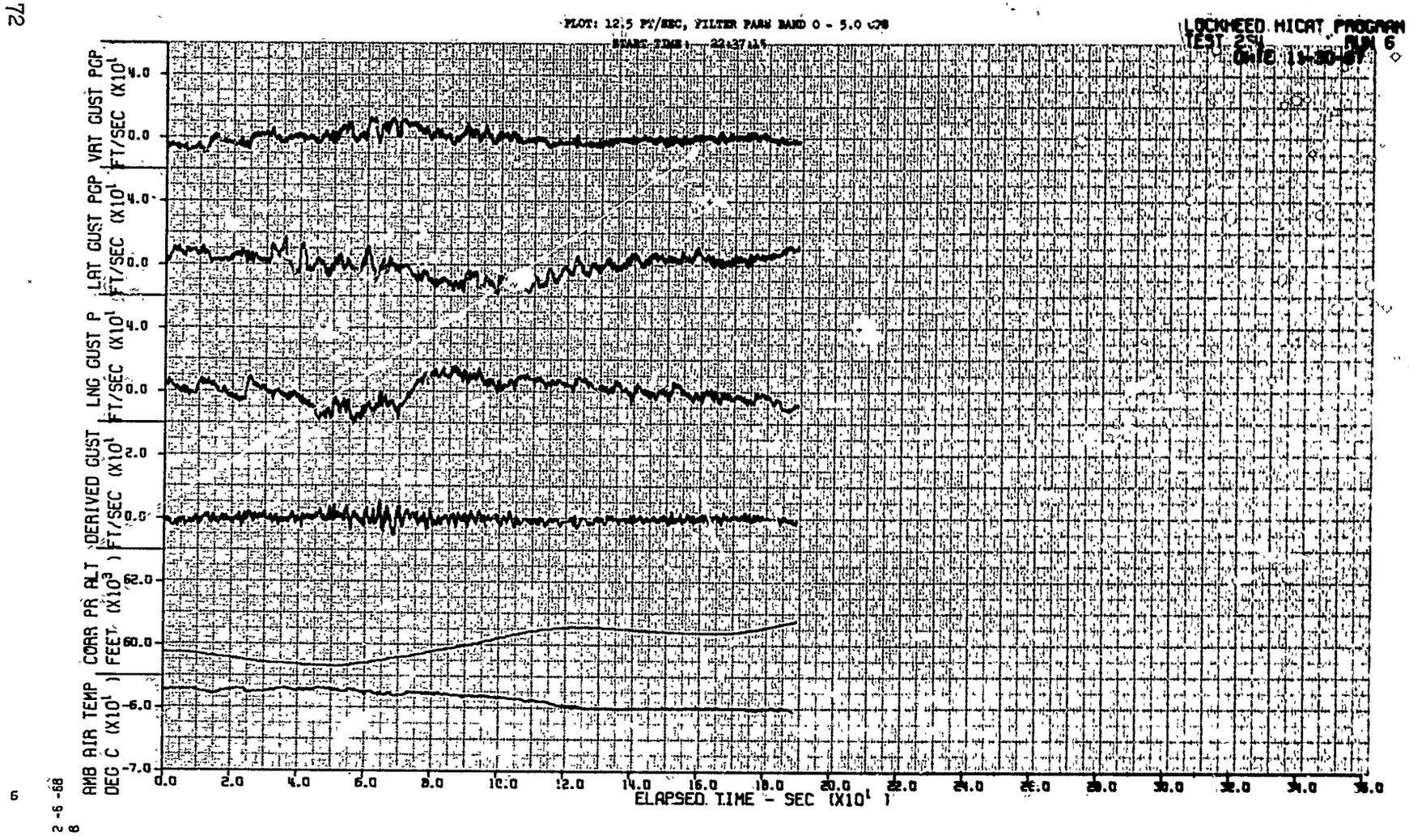


Figure 26A Gust Velocity Time Histories of Test 264, Run 6 - Edwards AFB, California, 30 Nov 67

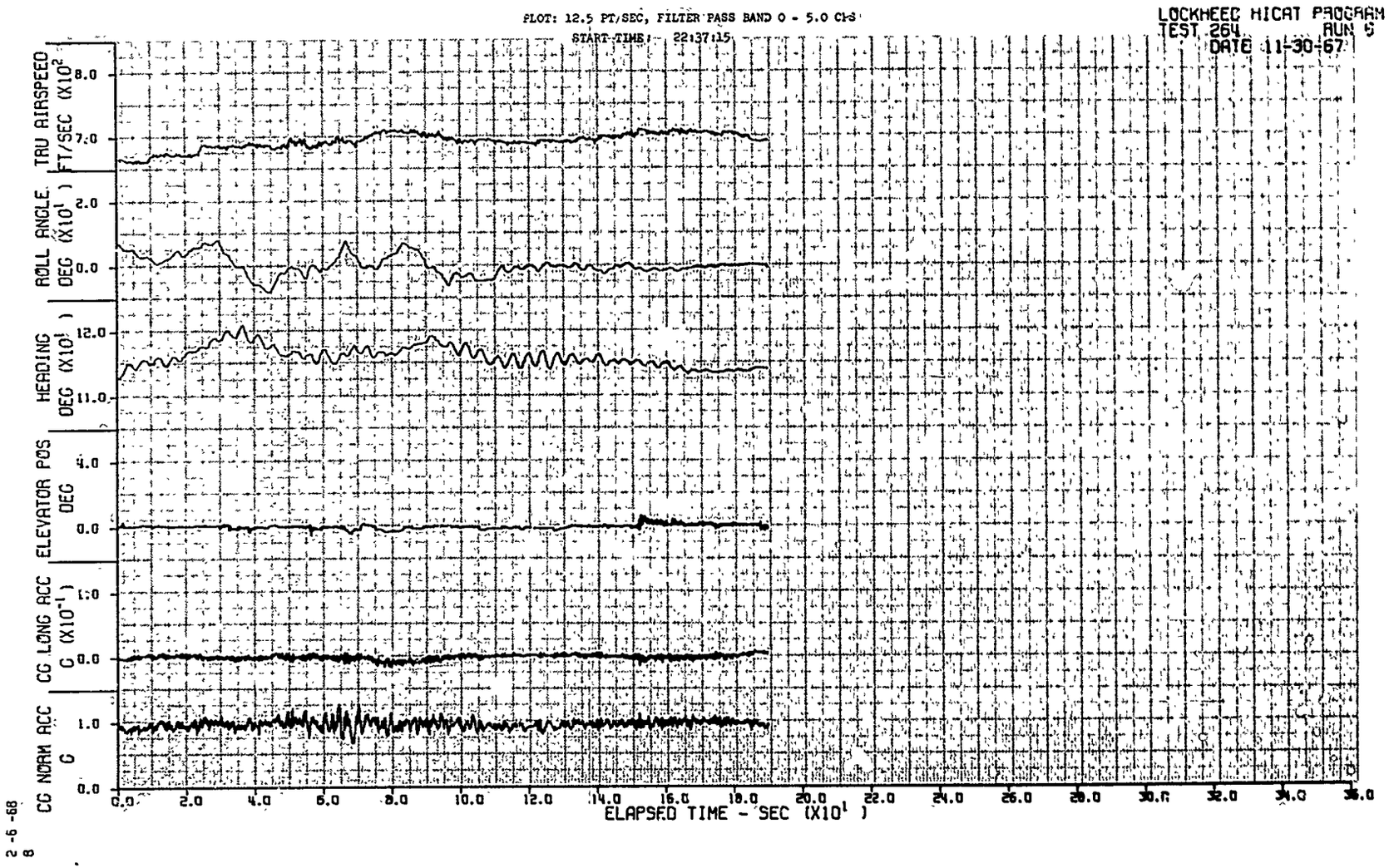


Figure 26B Flight Parameter Time Histories of Test 264, Run 6

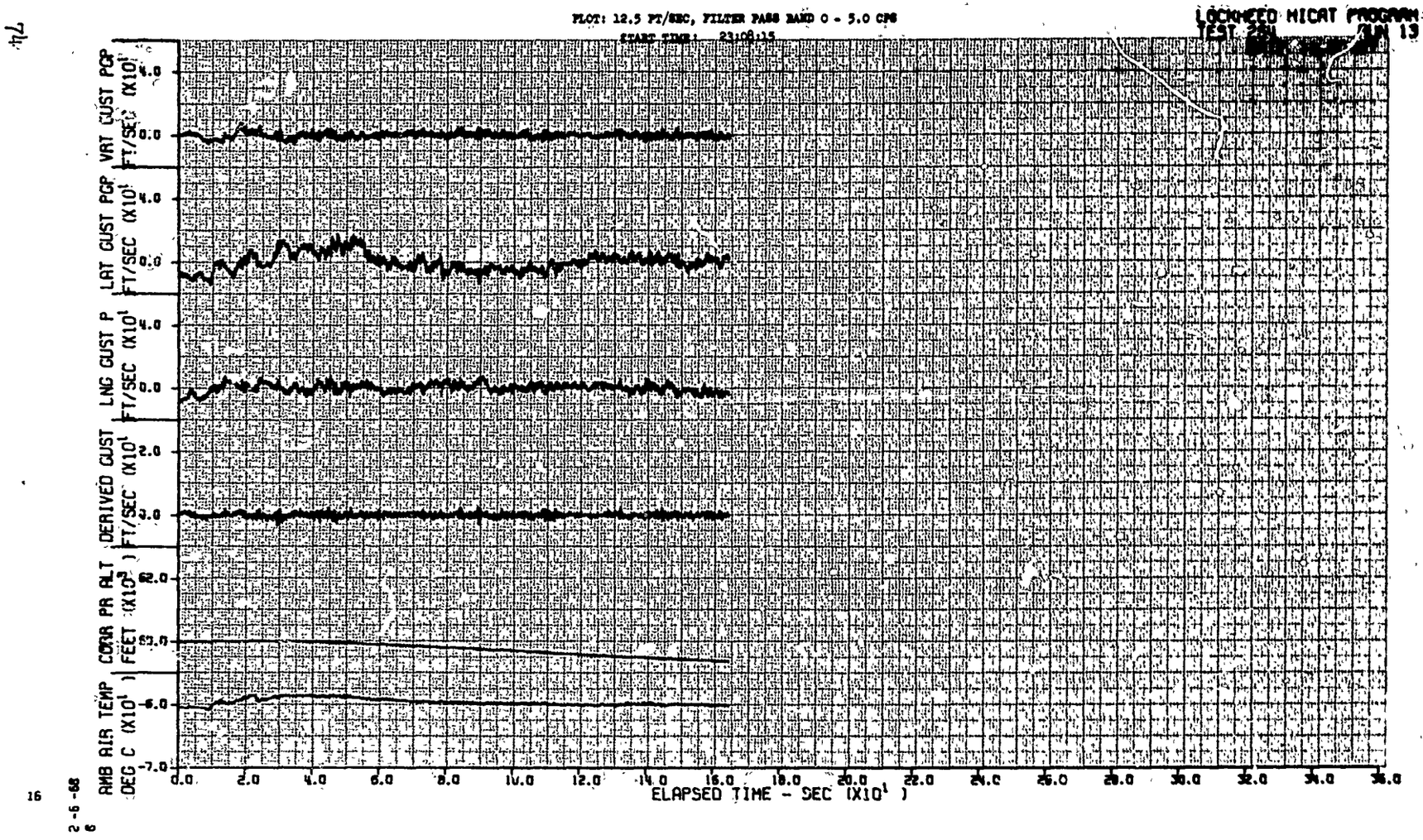


Figure 27A Gust Velocity Time Histories of Test 264, Run 13 - Edwards AFB, California, 30 Nov 67

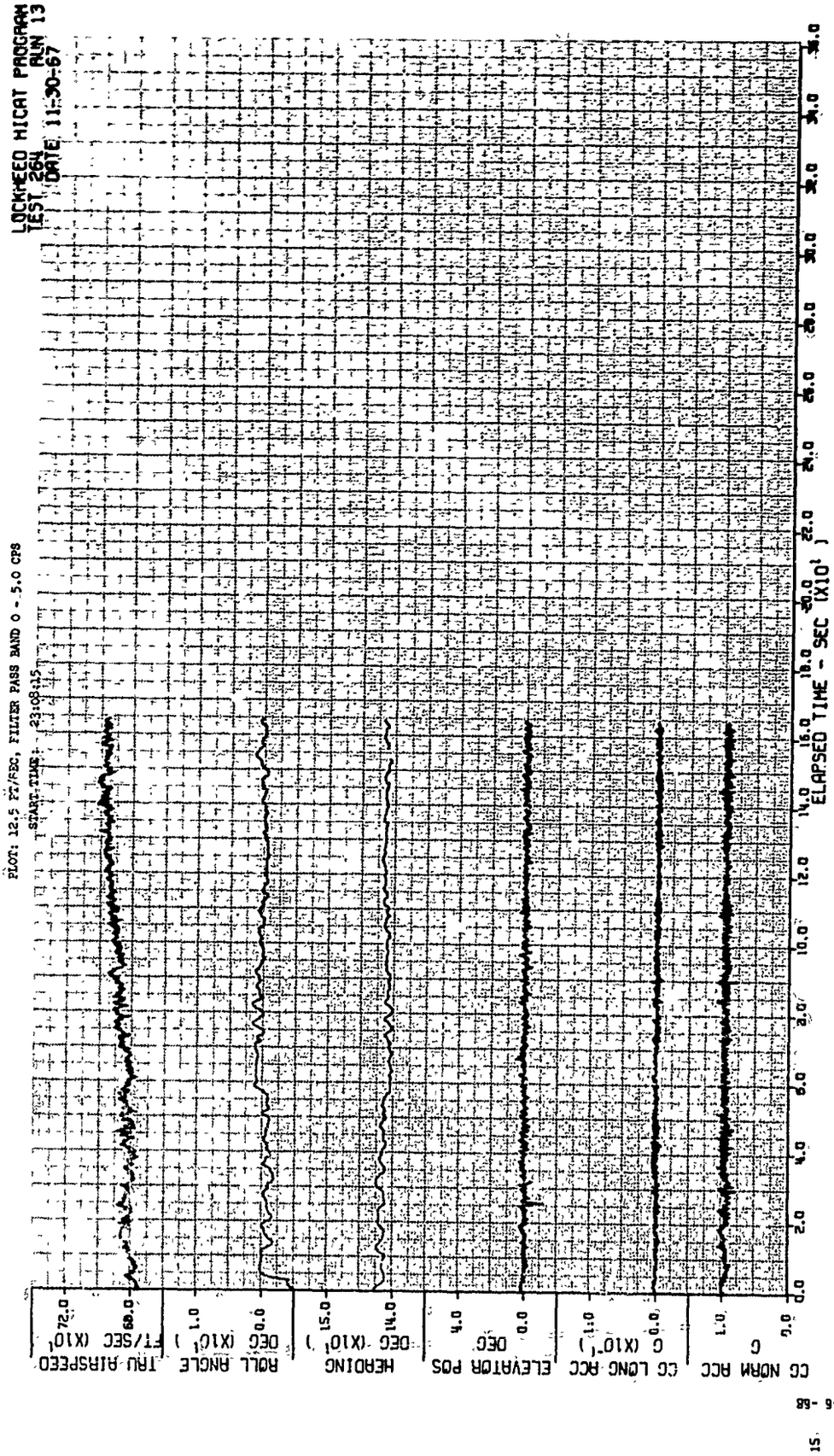


Figure 27B Flight Parameter Time Histories of Test 264, Run 13

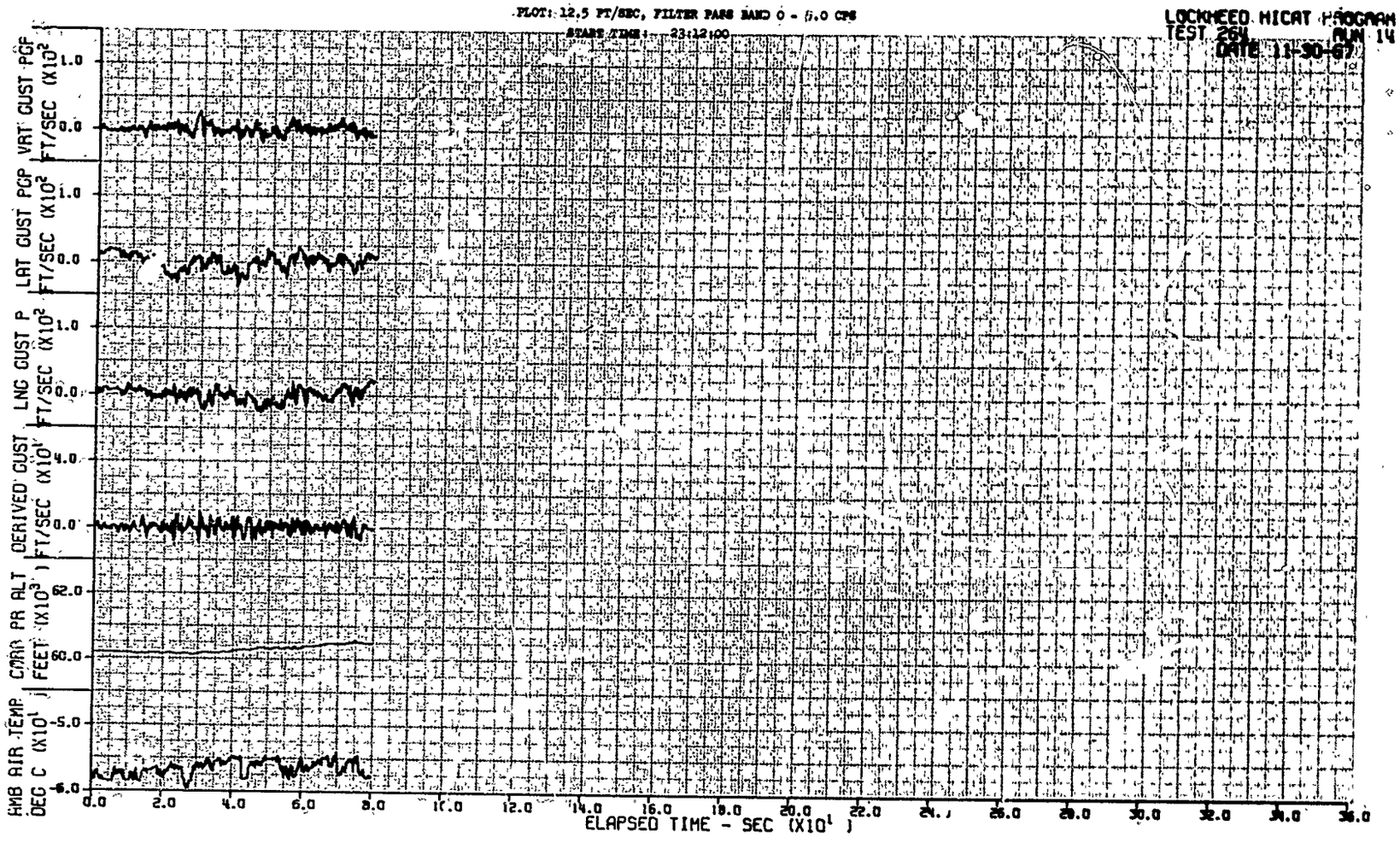


Figure 28A Gust Velocity Time Histories of Test 264, Run 14 - Edwards AFB, California, 30 Nov 67

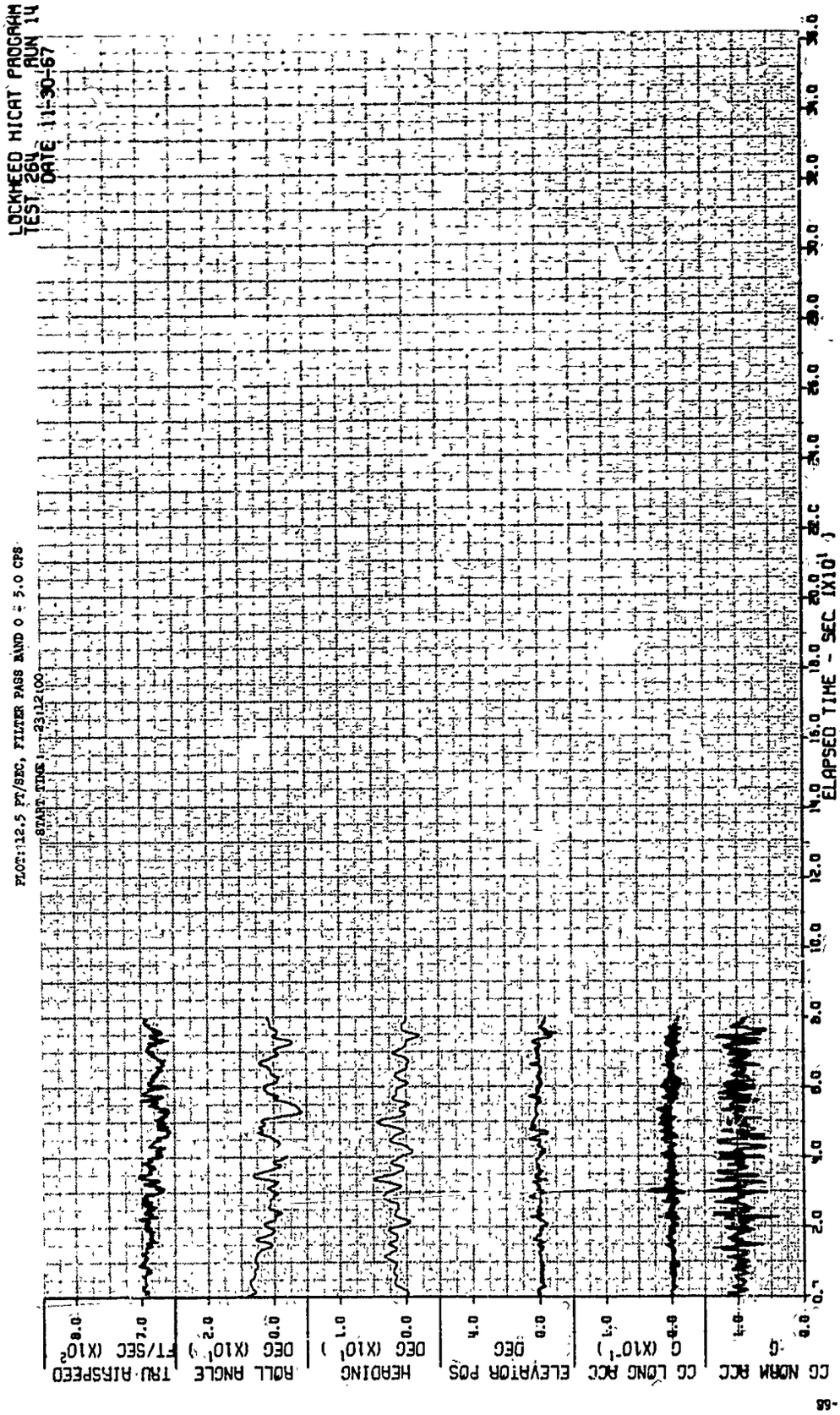


Figure 28B Flight Parameter Time Histories of Test 264, Run 14

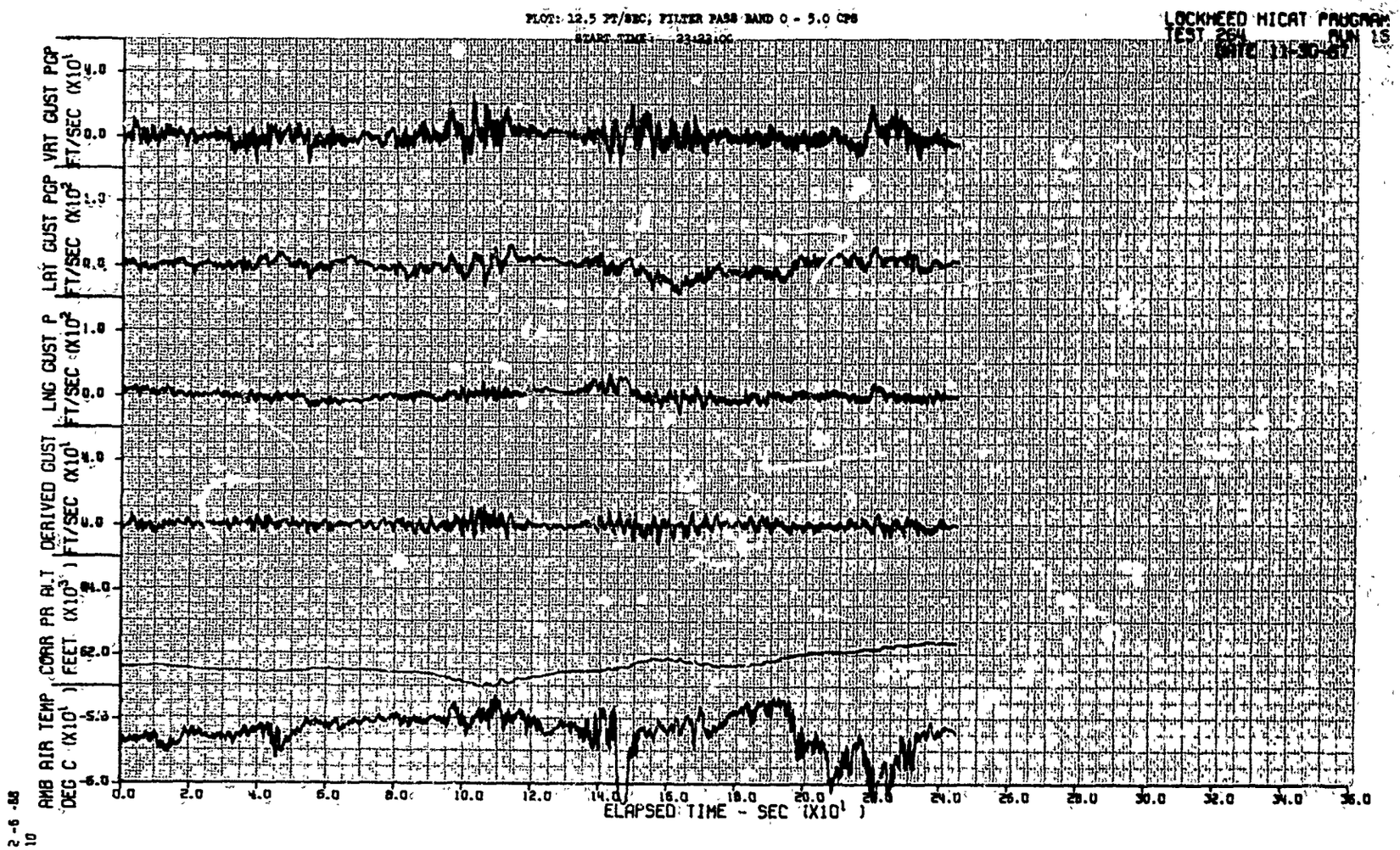


Figure 29A Gust Velocity Time Histories of Test 264, Run 16 - Edwards AFB, California, 30 Nov 67

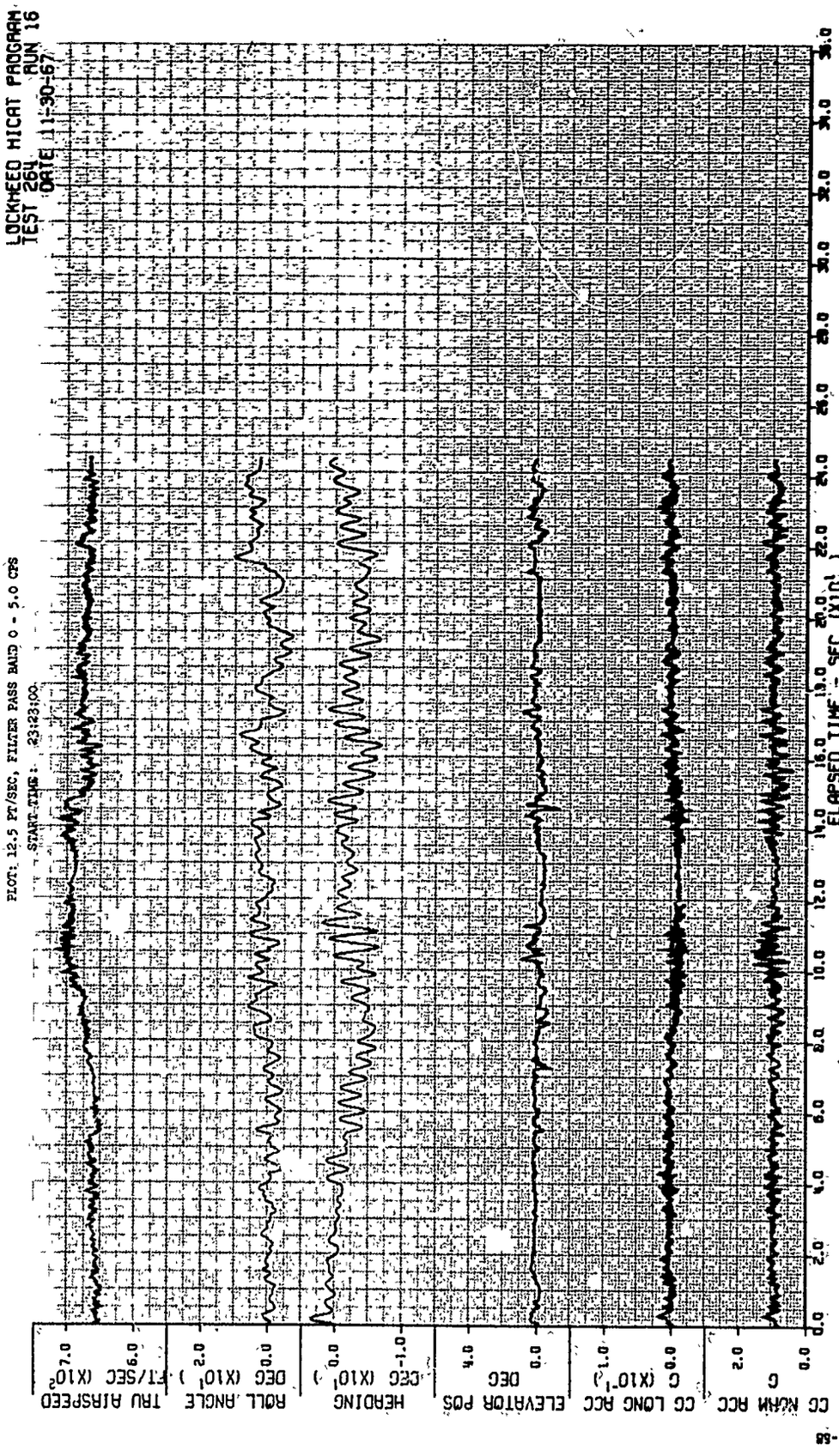


Figure 29B Flight Parameter Time Histories of Test 264, Run 16

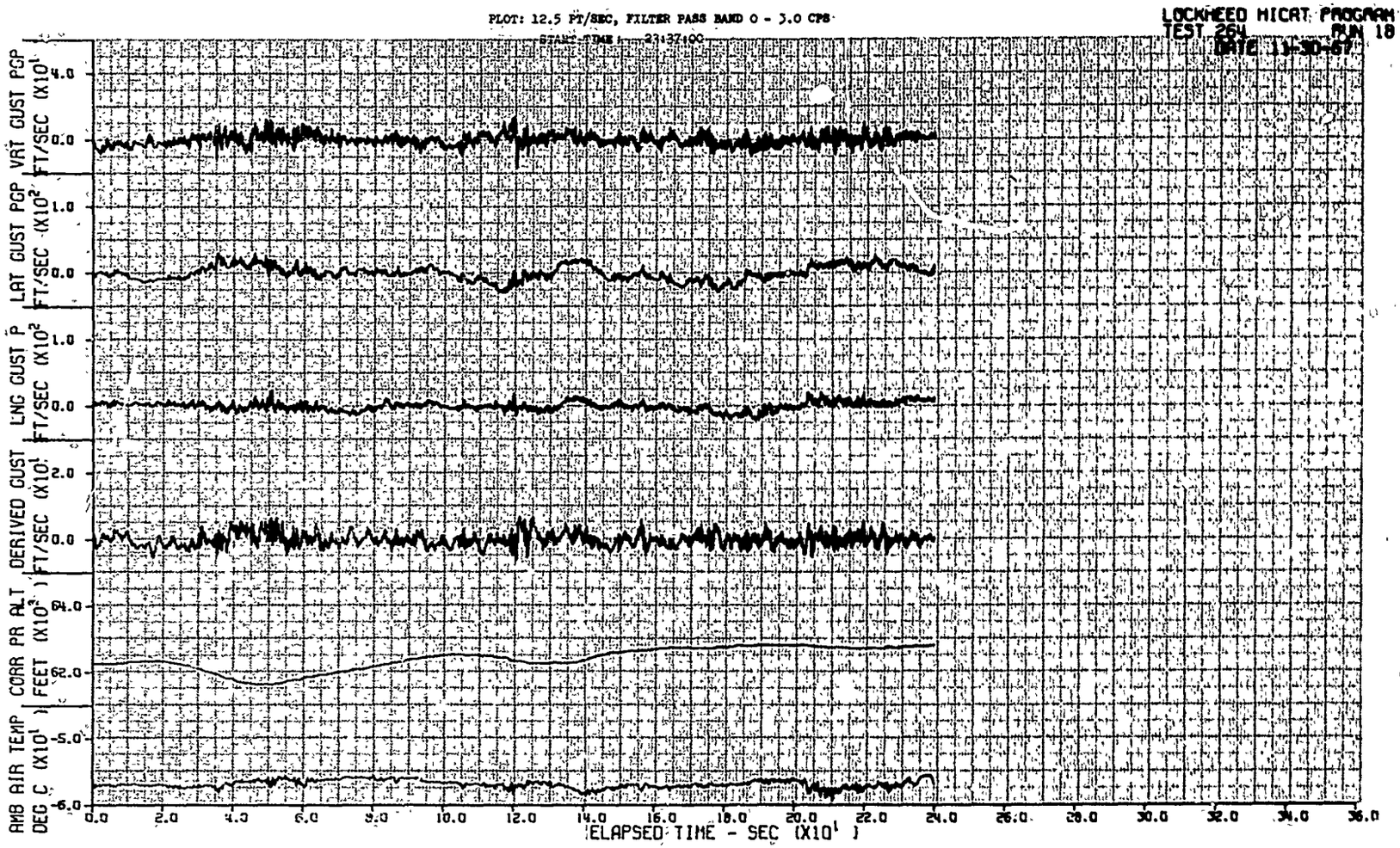


Figure 30A Gust Velocity Time Histories of Test 264, Run 18 - Edwards AFB, California, 30 Nov 67

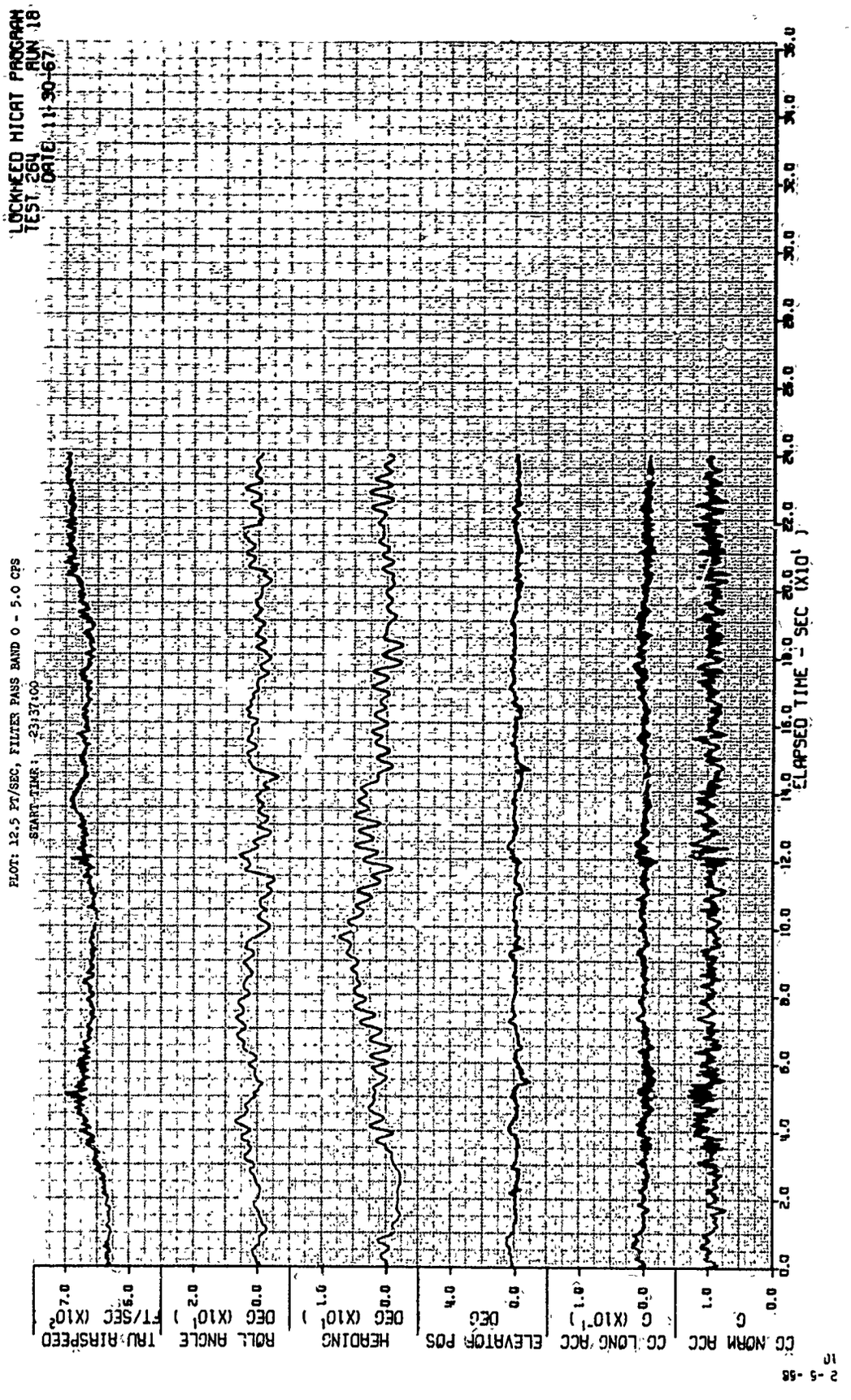


Figure 30B Flight Parameter Time Histories of Test 264, Run 18

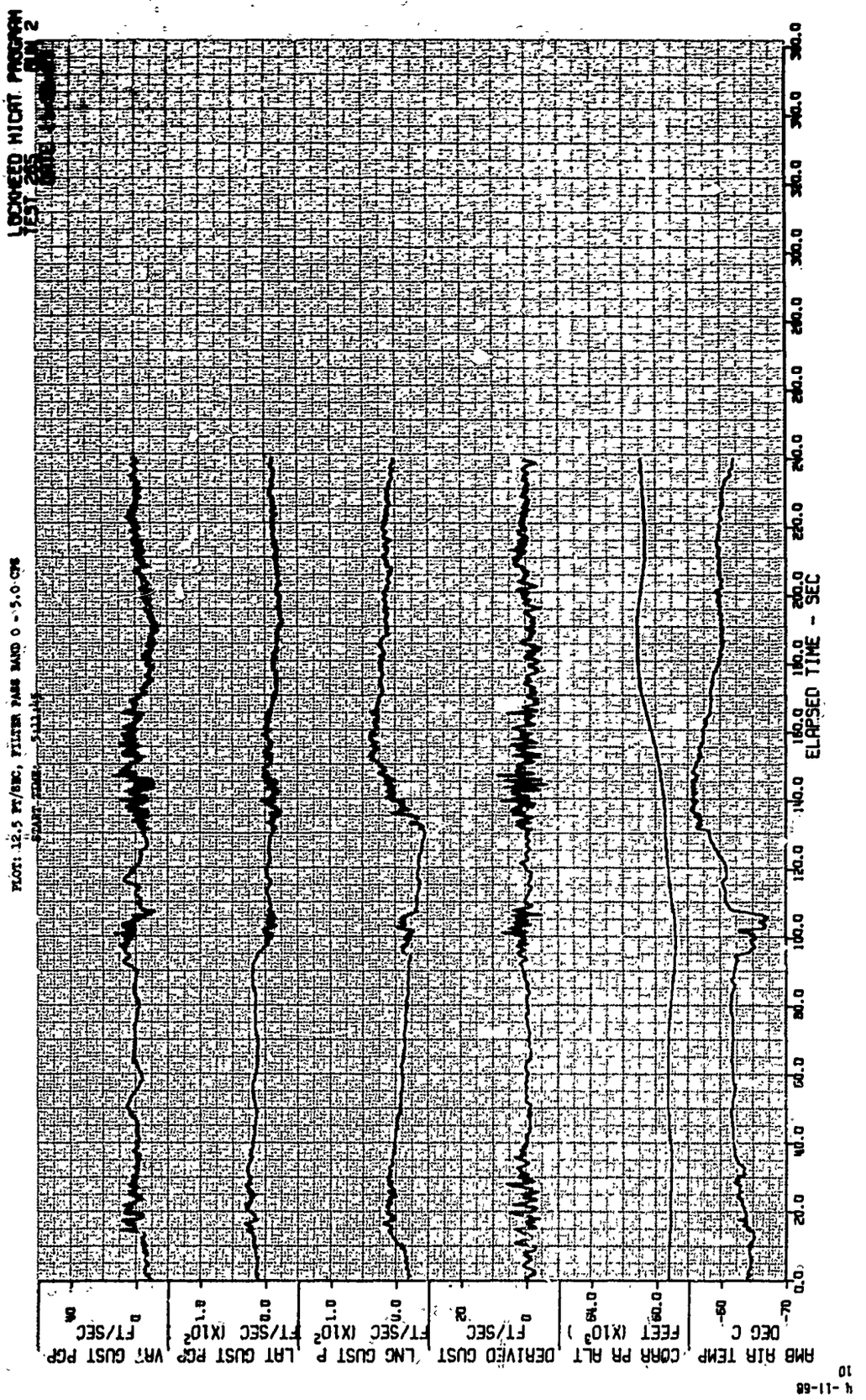


Figure 31A Gust Velocity Time Histories of Test 265, Run 2 - Edwards AFB, California, 1 Dec 67

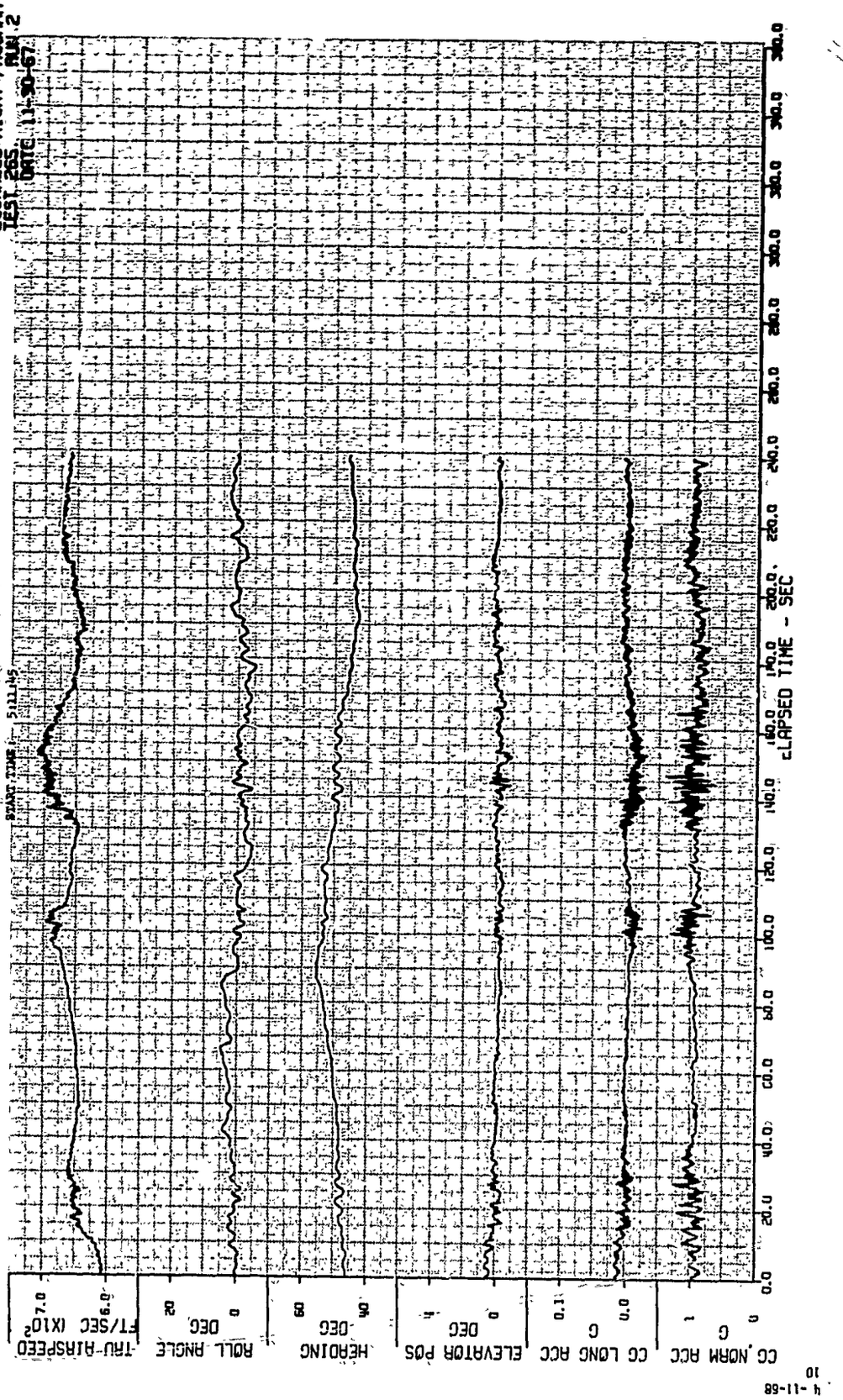


Figure 31B Flight Parameter Time Histories of Test 265, Run 2

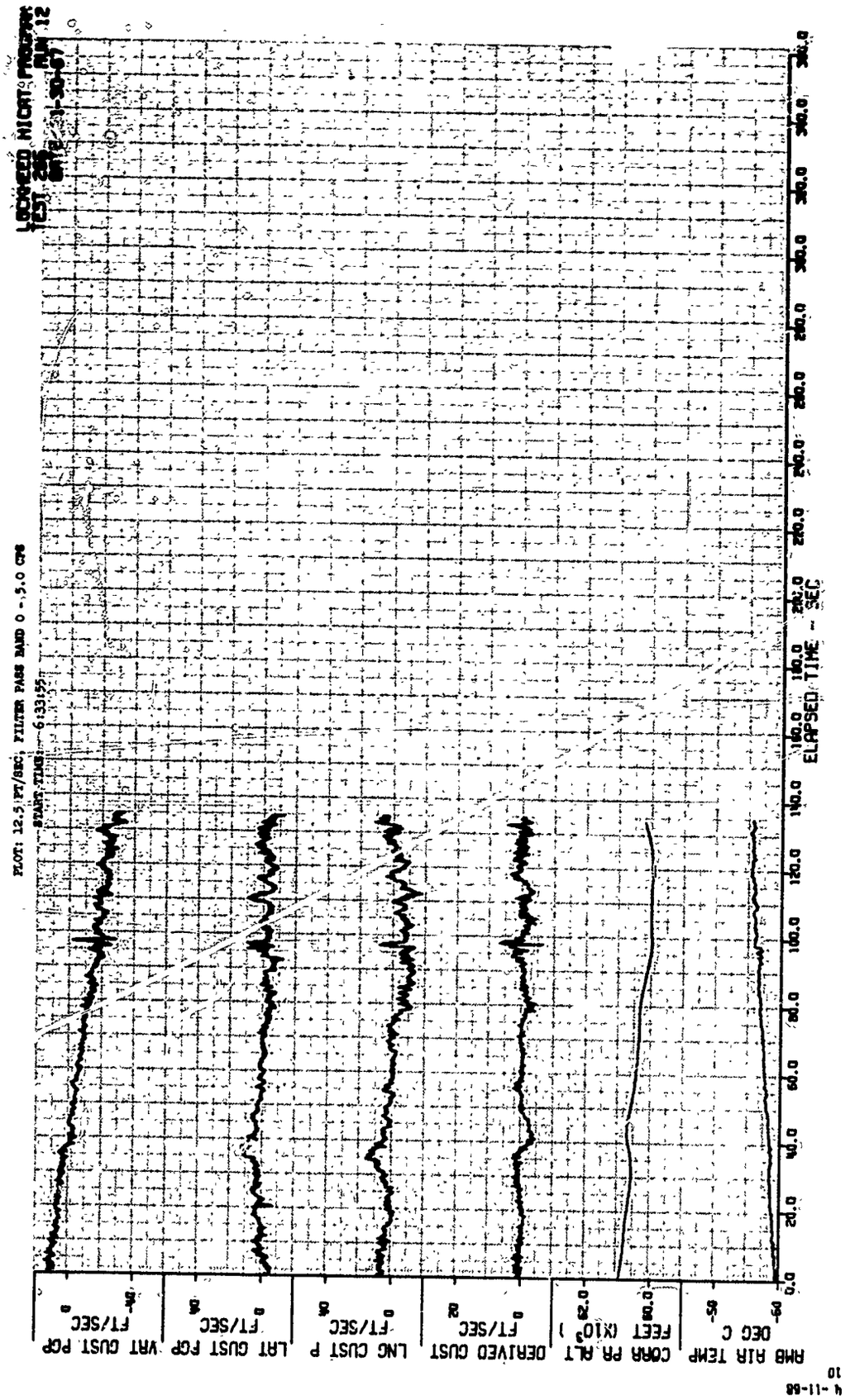


Figure 32A Gust Velocity Time Histories of Test 265, Run 12 - Edwards AFB, California, 1 Dec 67

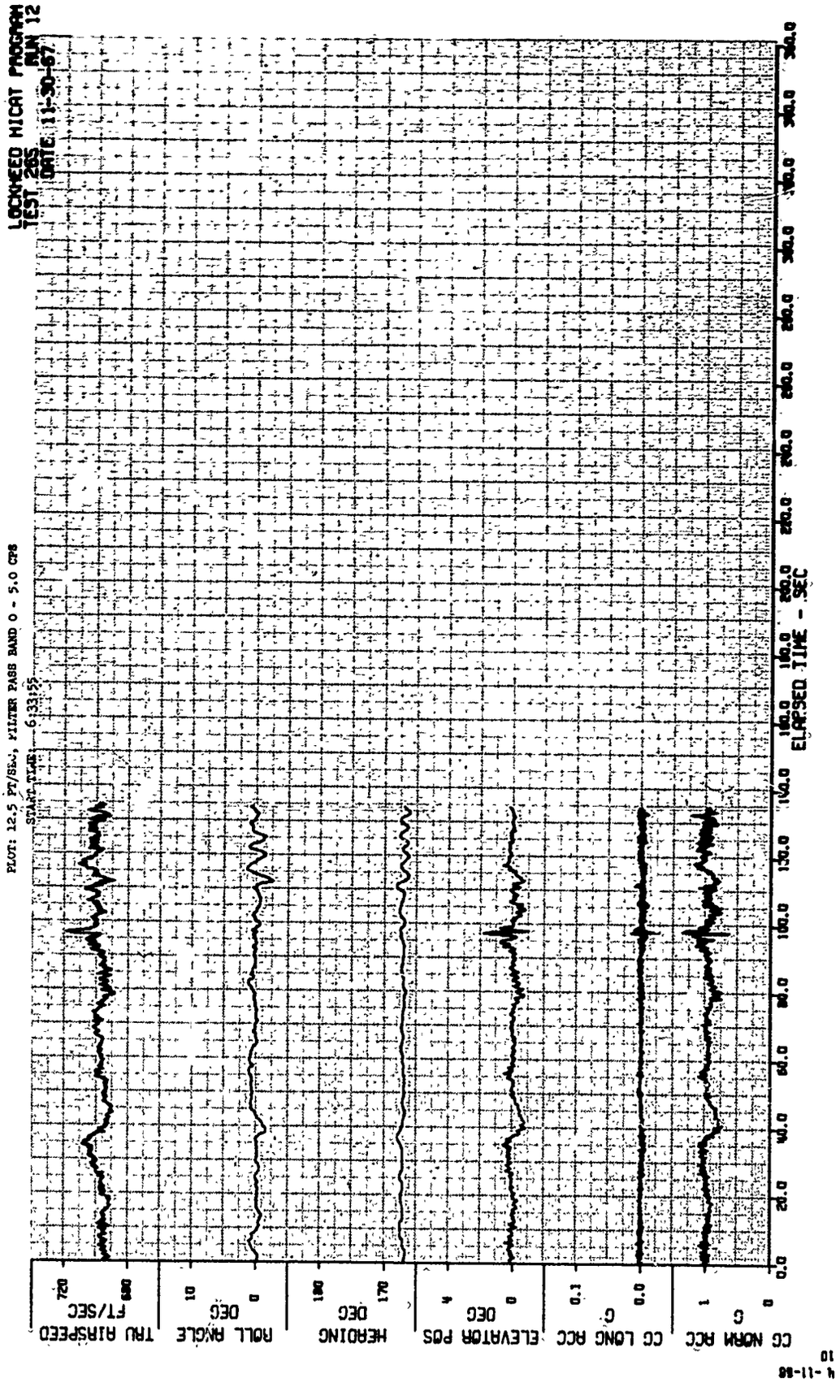


Figure 32B Flight Parameter Time Histories of Test 265, Run 12

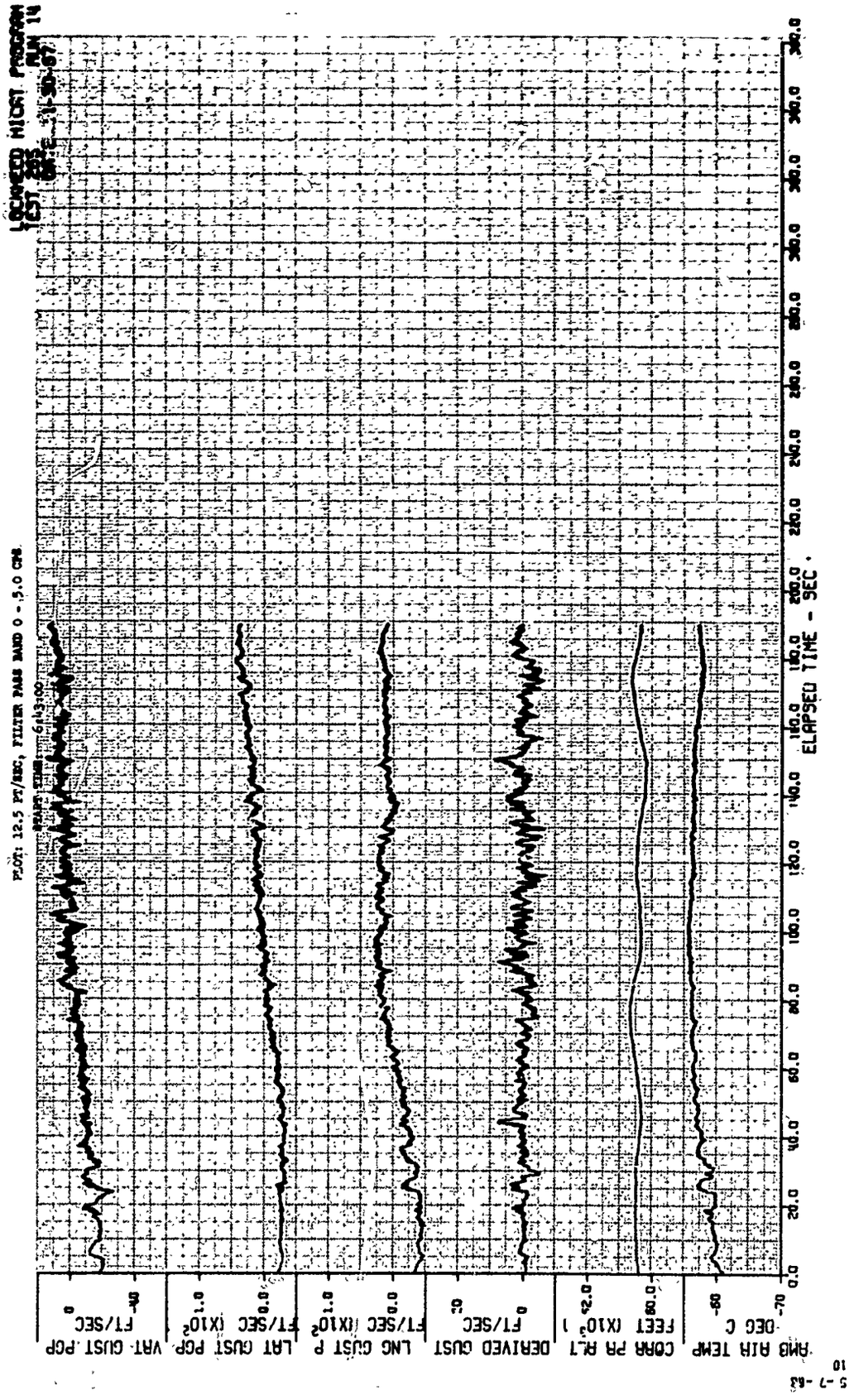


Figure 33A Gust Velocity Time Histories of Test 265, Run 14 - Edwards AFB, California, 1 Dec 67

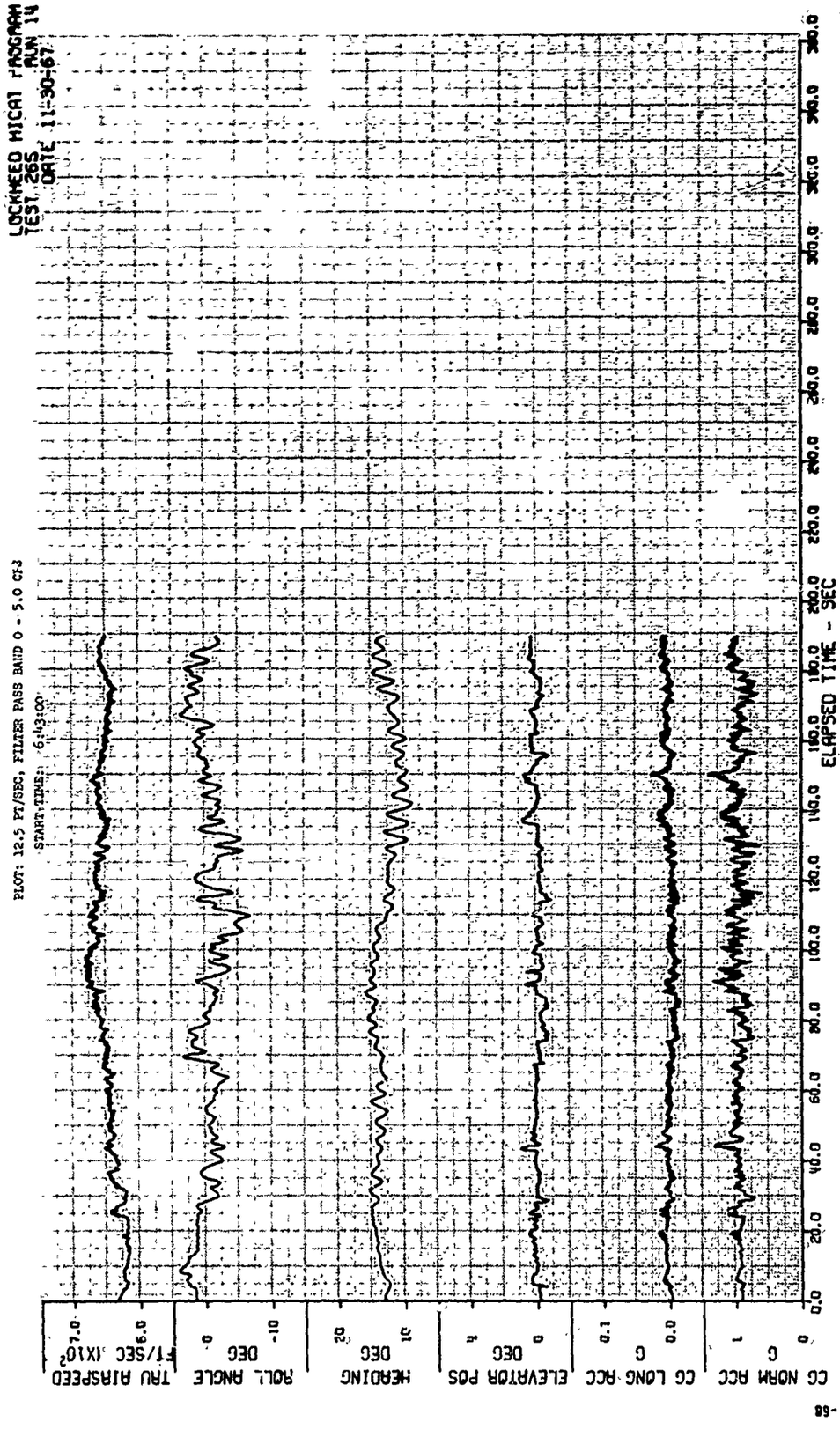


Figure 33B Flight Parameter Time Histories of Test 265, Run 14

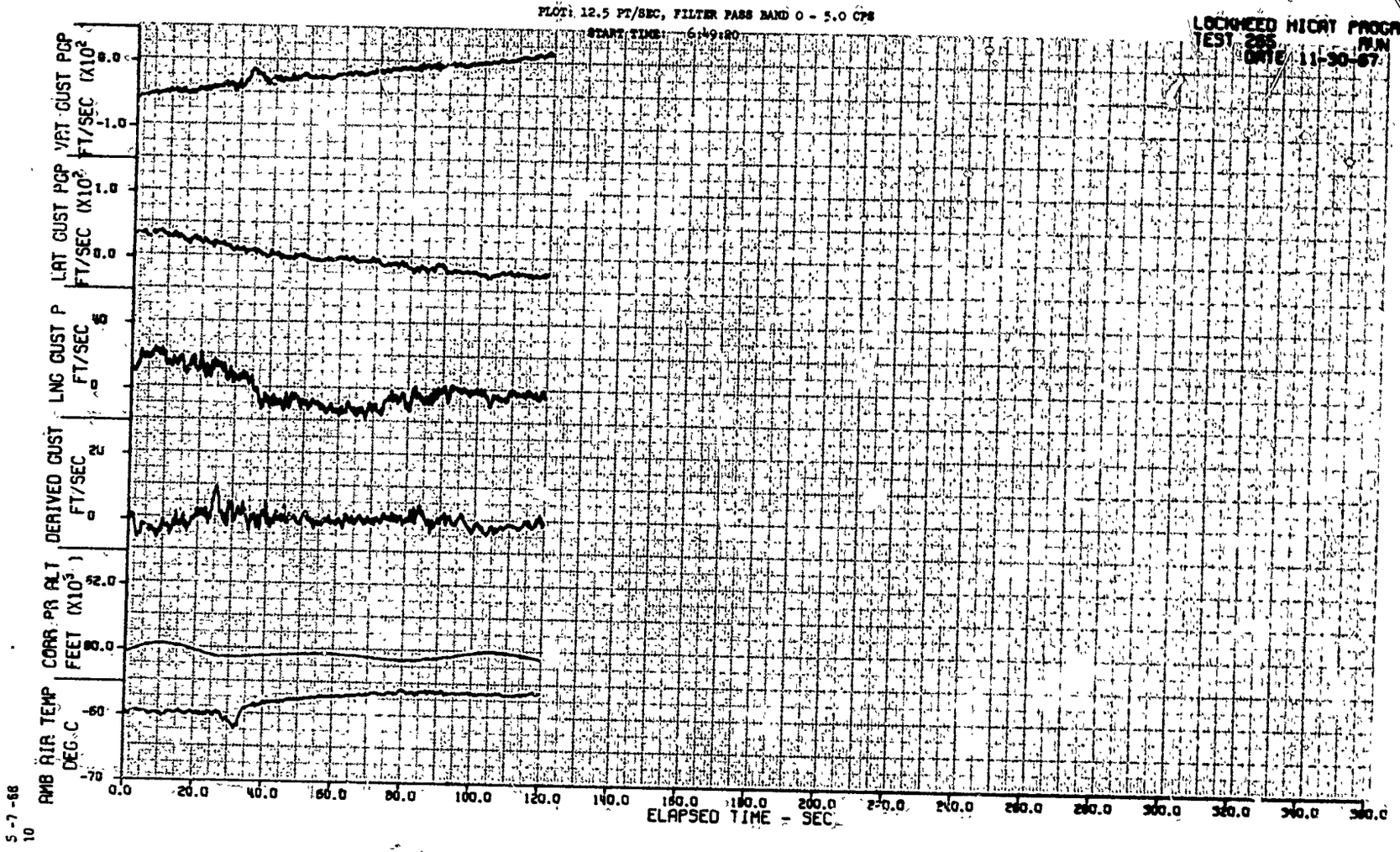


Figure 34A Gust Velocity Time Histories of Test 265, Run 15 - Edwards AFB, California, 1 Dec 67

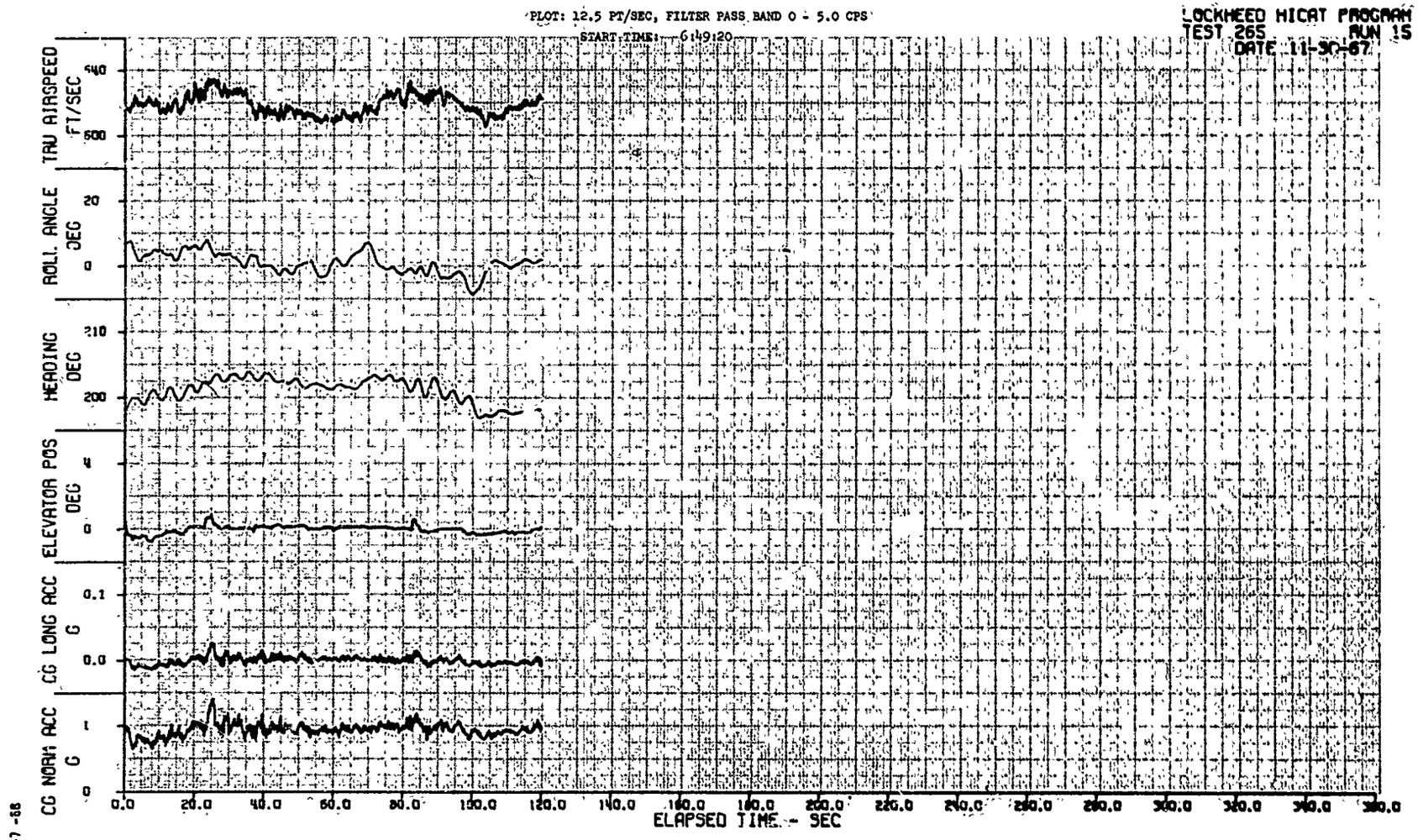


Figure 34B Flight Parameter Time Histories of Test 265, Run 15

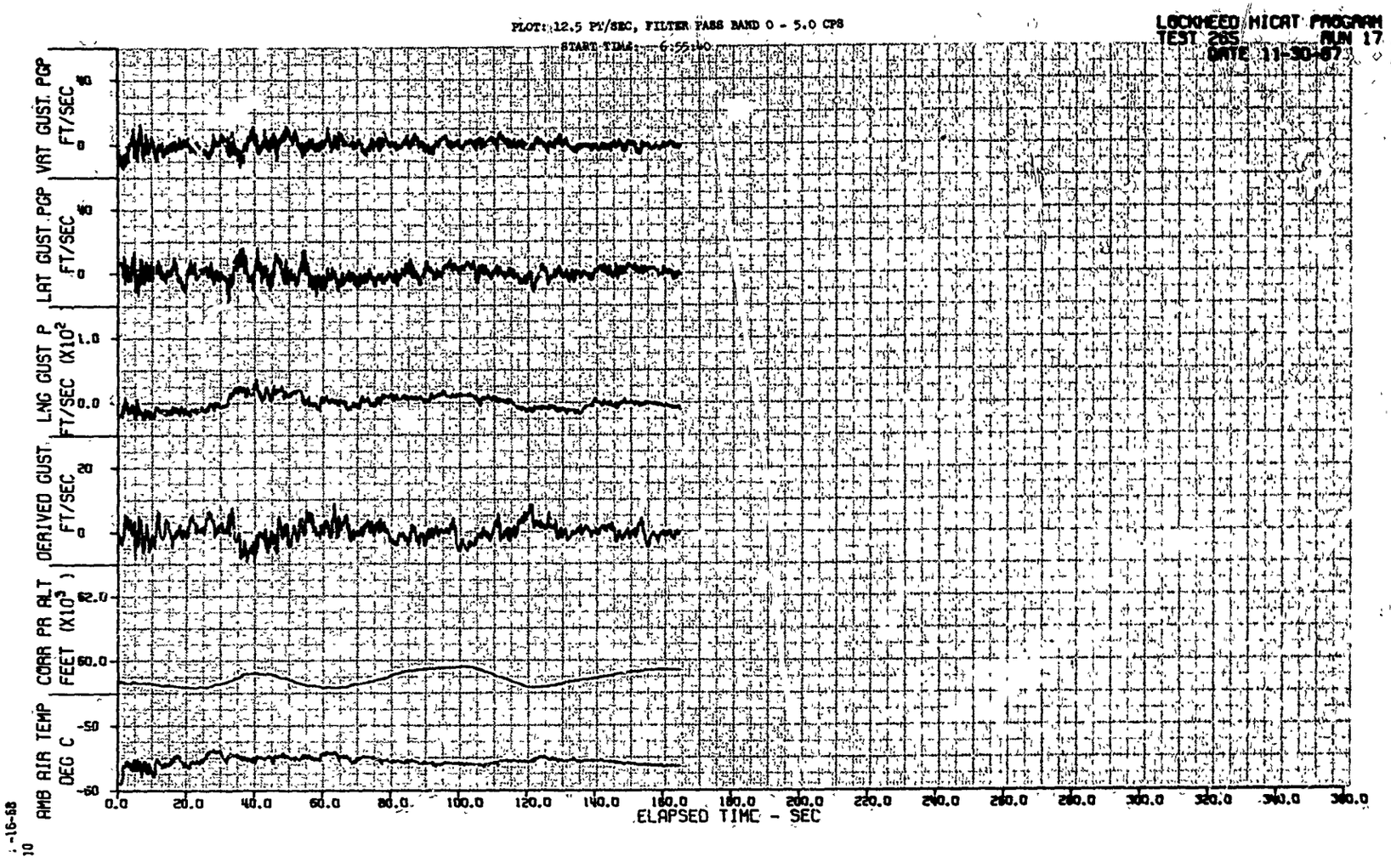


Figure 35A Gust Velocity Time Histories of Test 265, Run 17 – Edwards AFB, California, 1 Dec 67

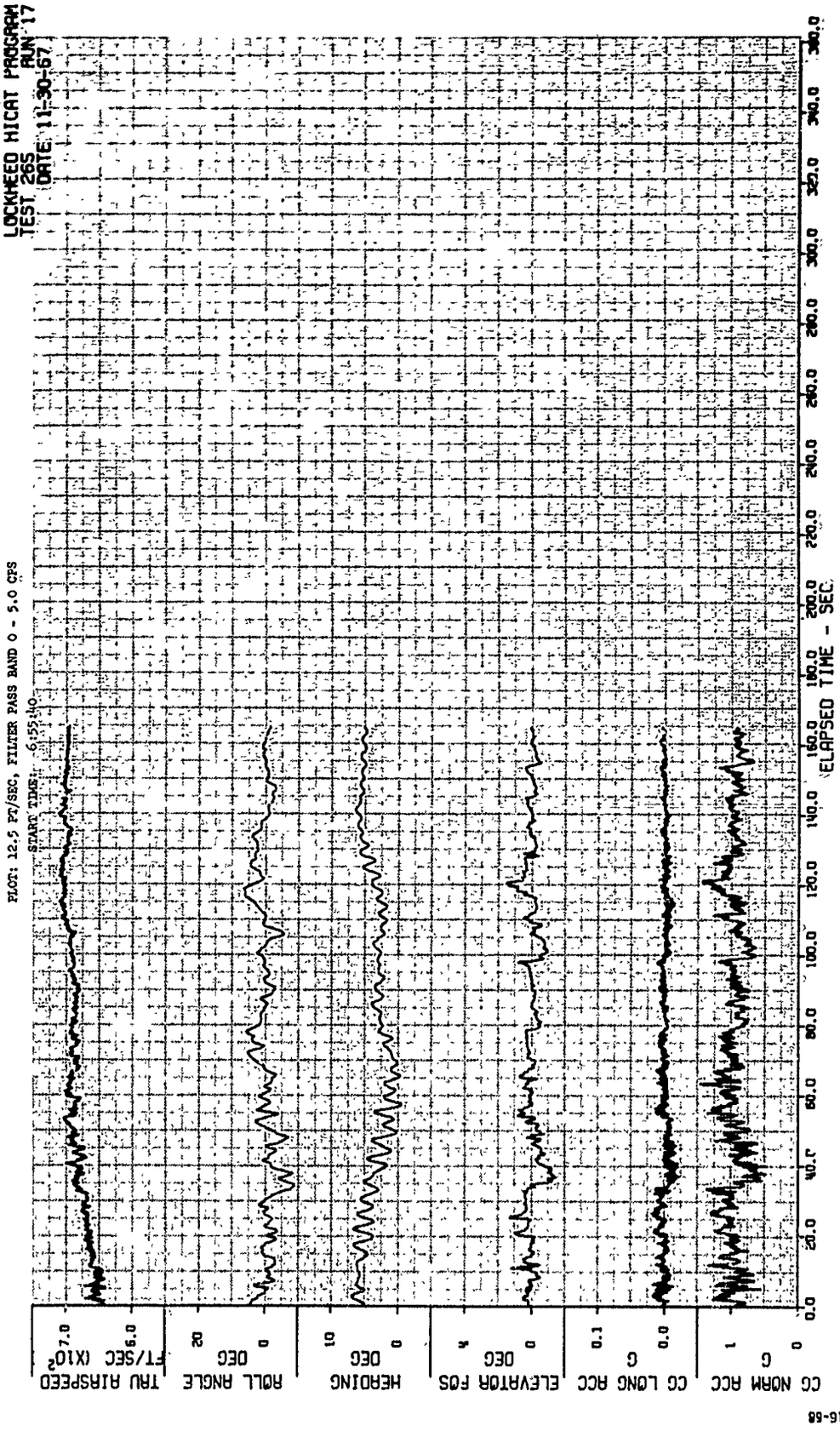


Figure 35B Flight Parameter Time Histories of Test 265, Run 17

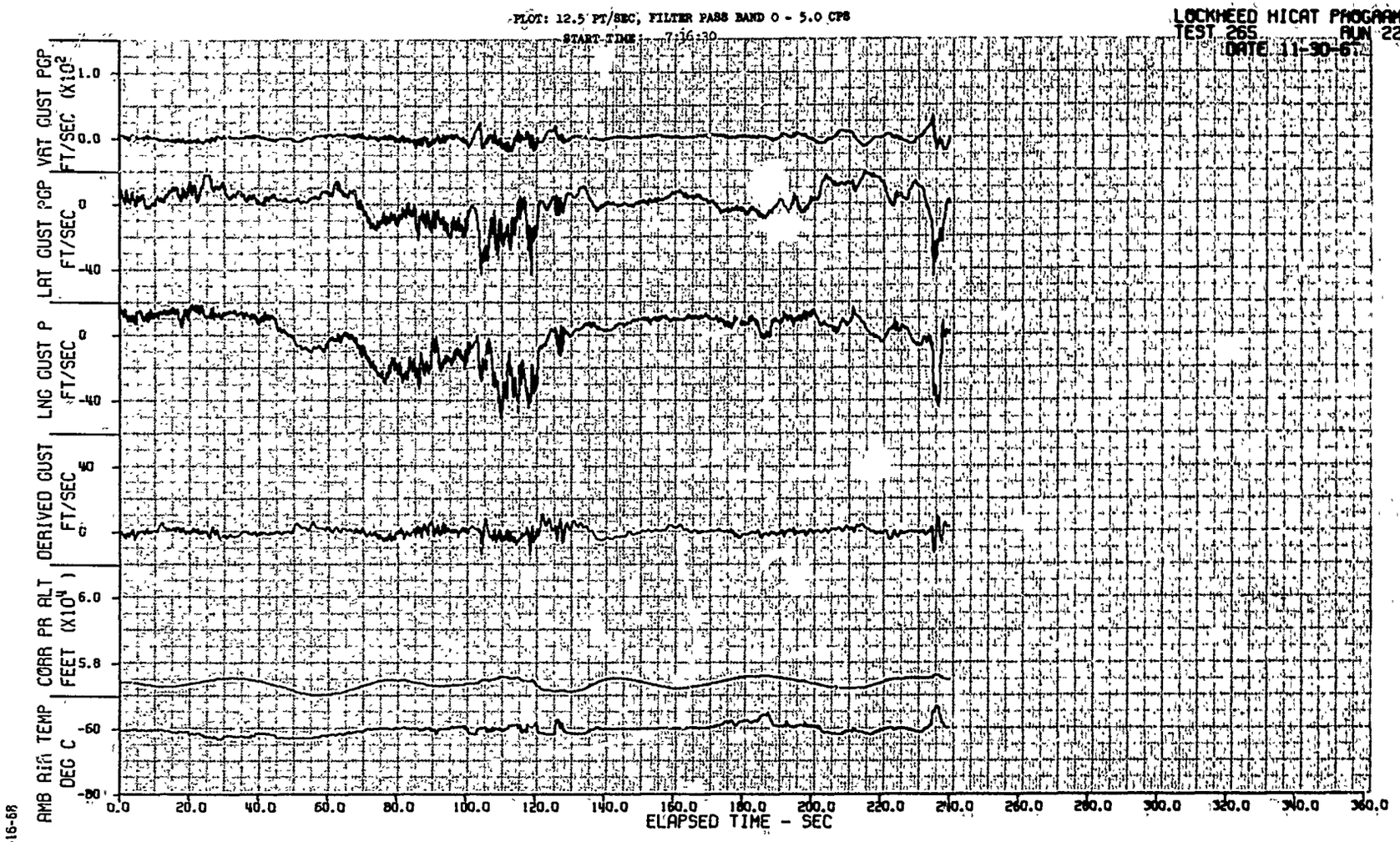


Figure 36A Gust Velocity Time Histories of Test 265, Run 22 - Edwards AFB, California, 1 Dec 67

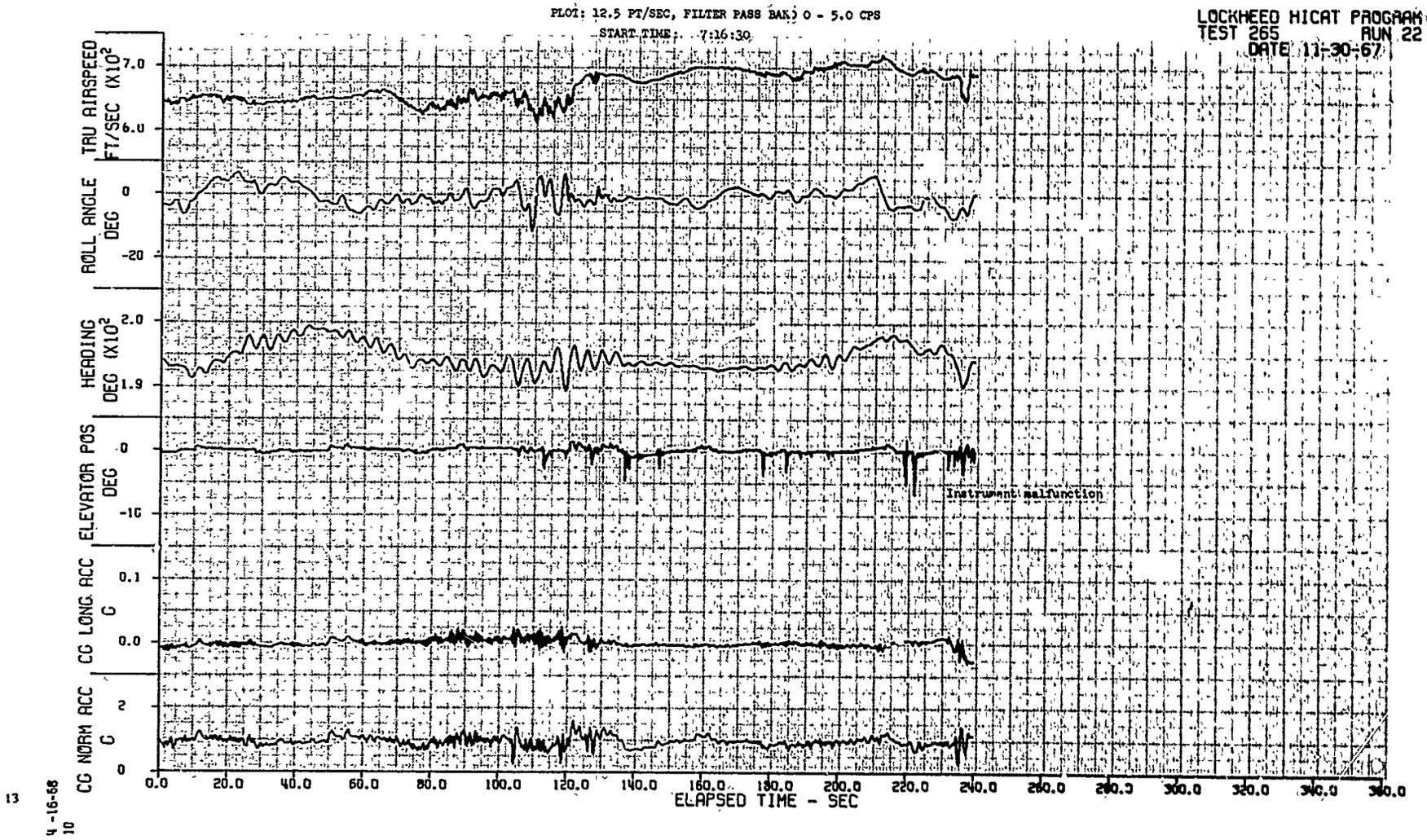


Figure 36B Flight Parameter Time Histories of Test 265, Run 22

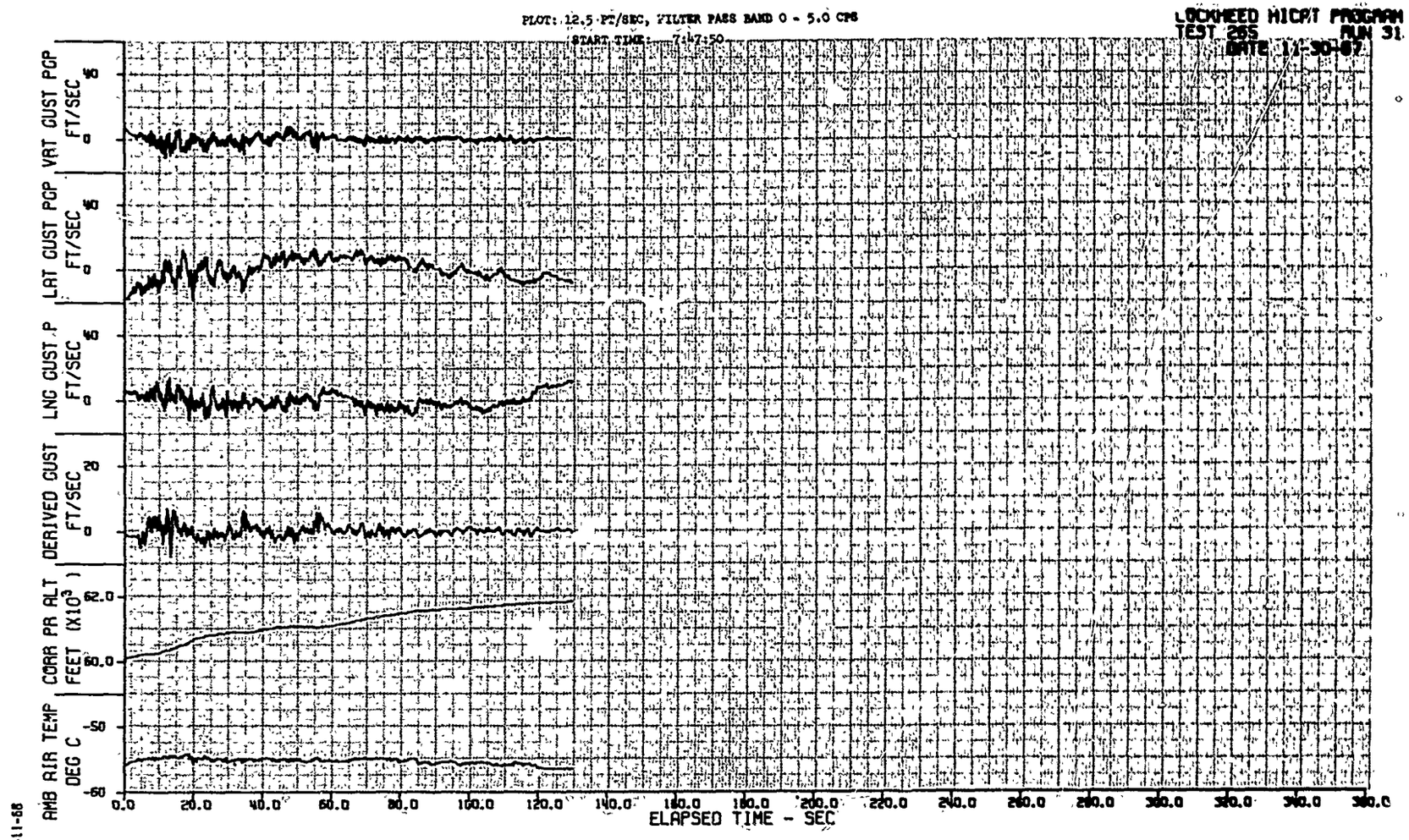


Figure 37A Gust Velocity Time Histories of Test 265, Run 31 - Edwards AFB, California, 1 Dec 67

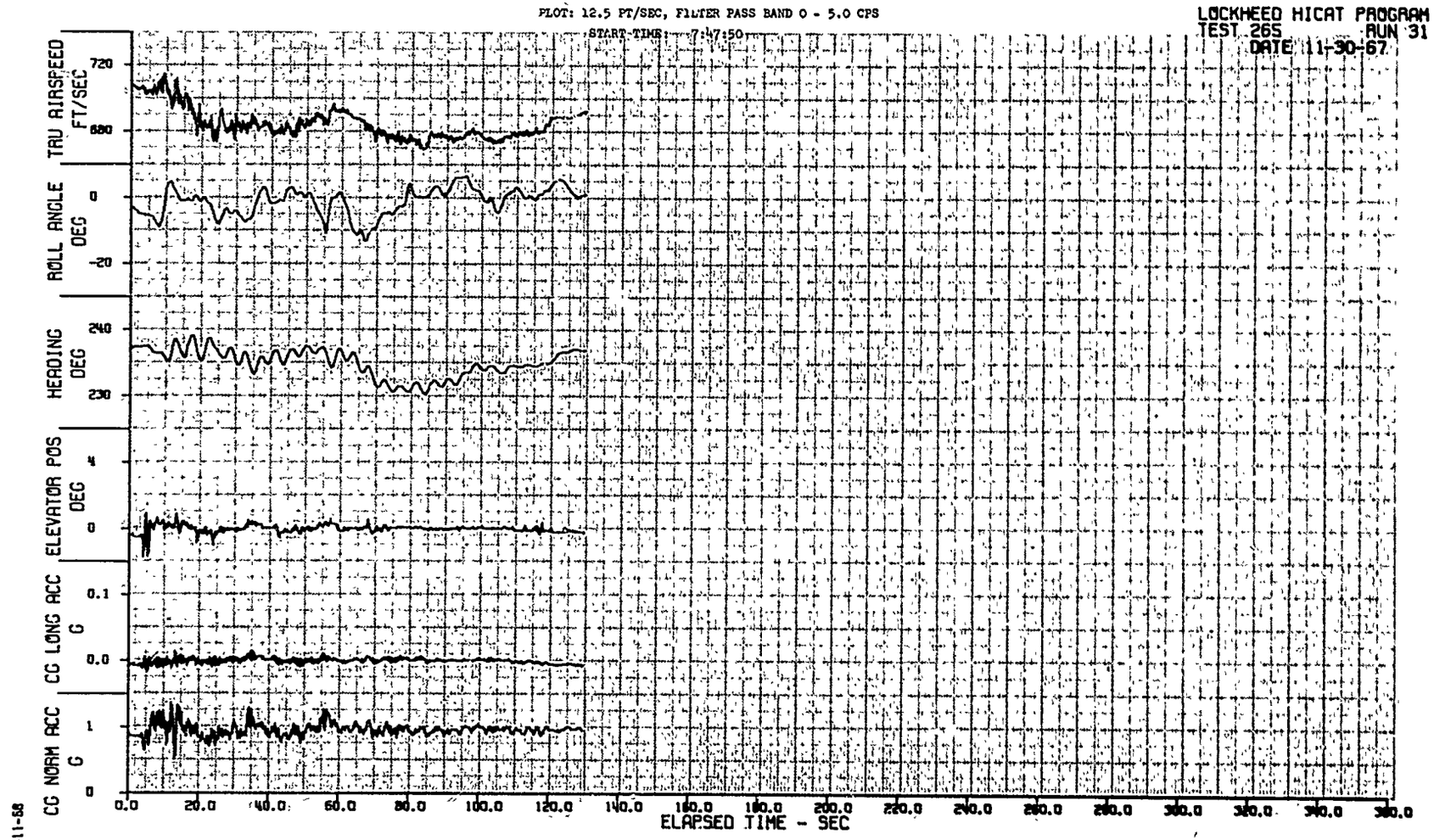


Figure 37B Flight Parameter Time Histories of Test 265, Run 31

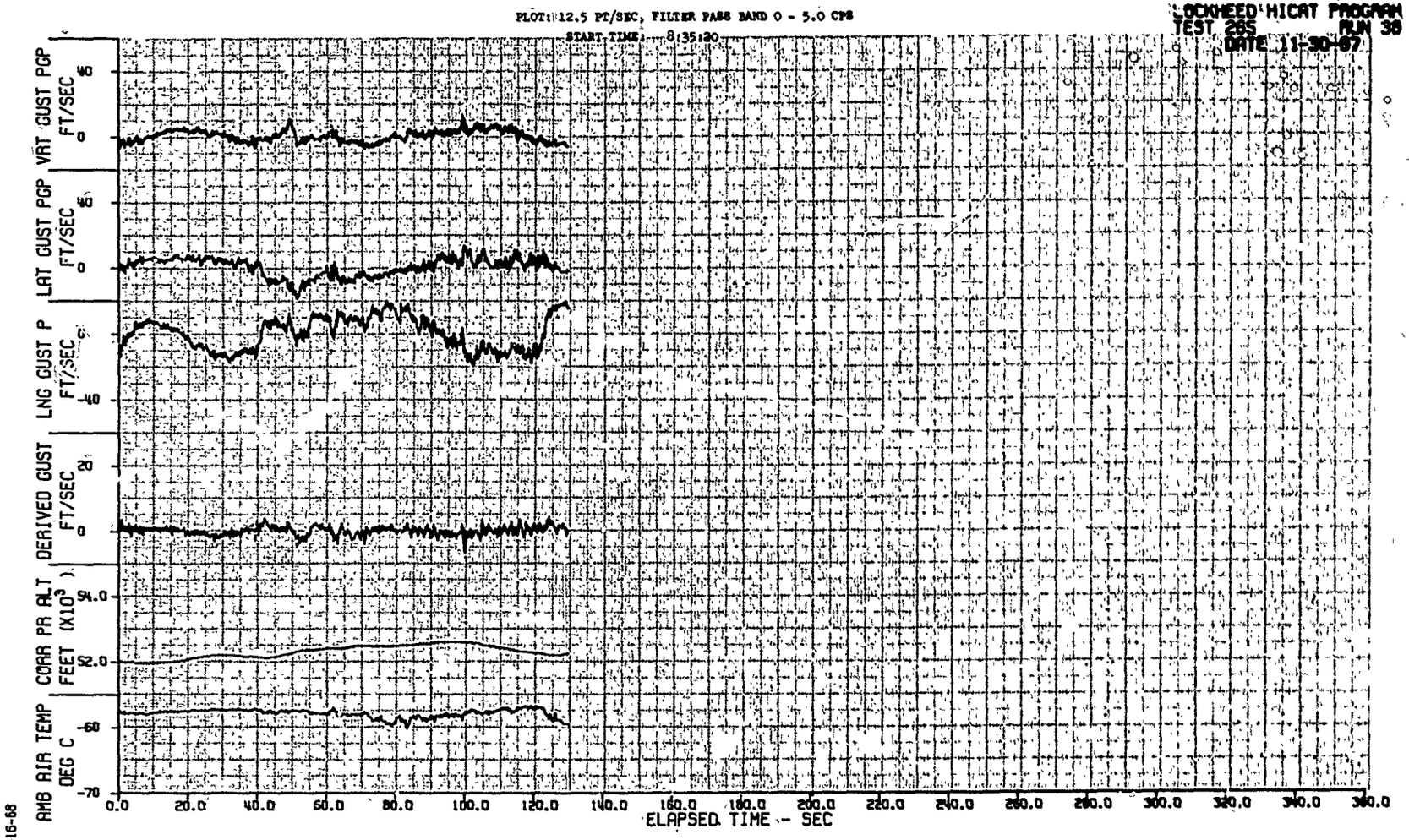


Figure 38A. Gust Velocity Time Histories of Test 265, Run 38 - Edwards AFB, California, 1 Dec 67

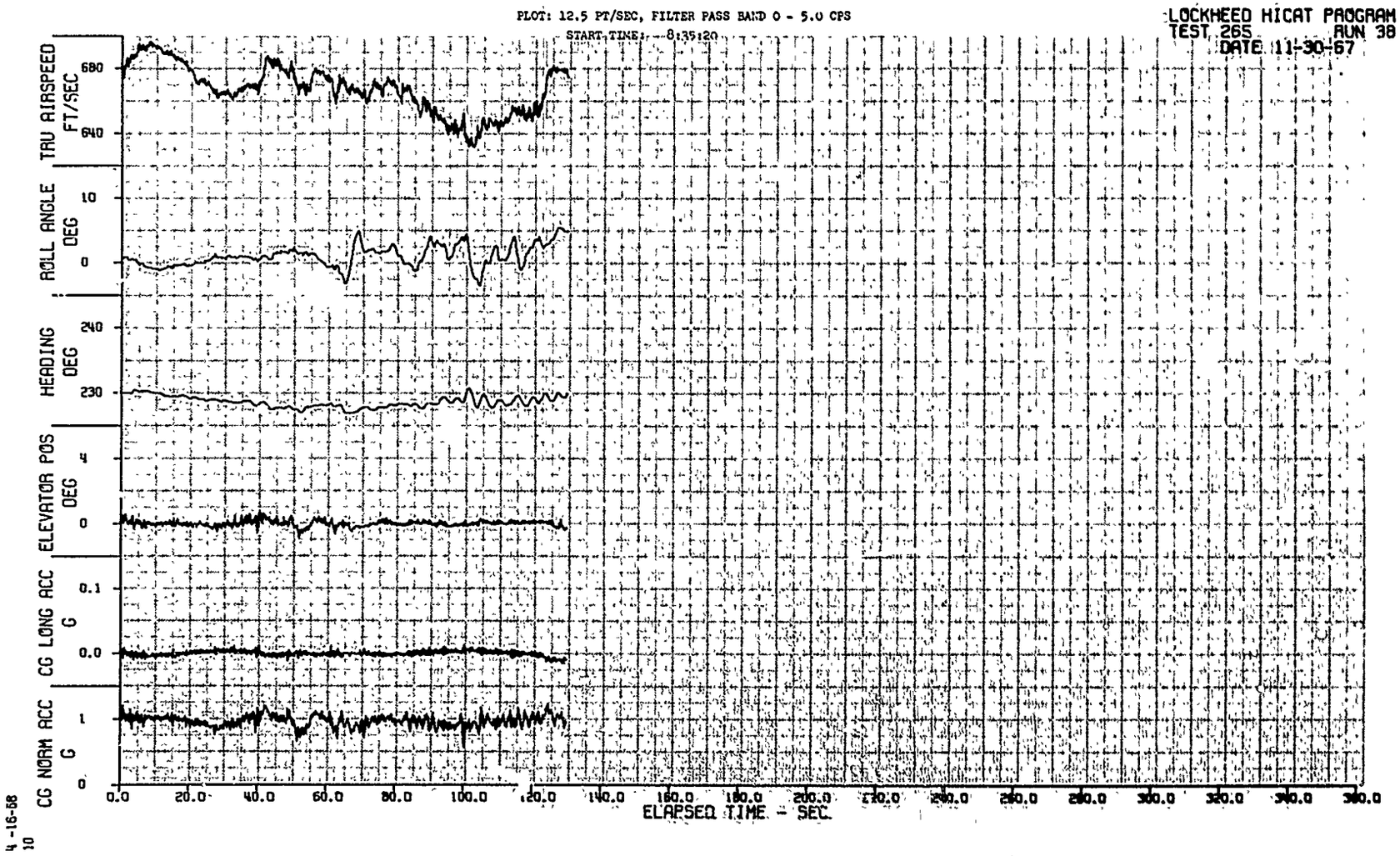


Figure 38B Flight Parameter Time Histories of Test 265, Run 38

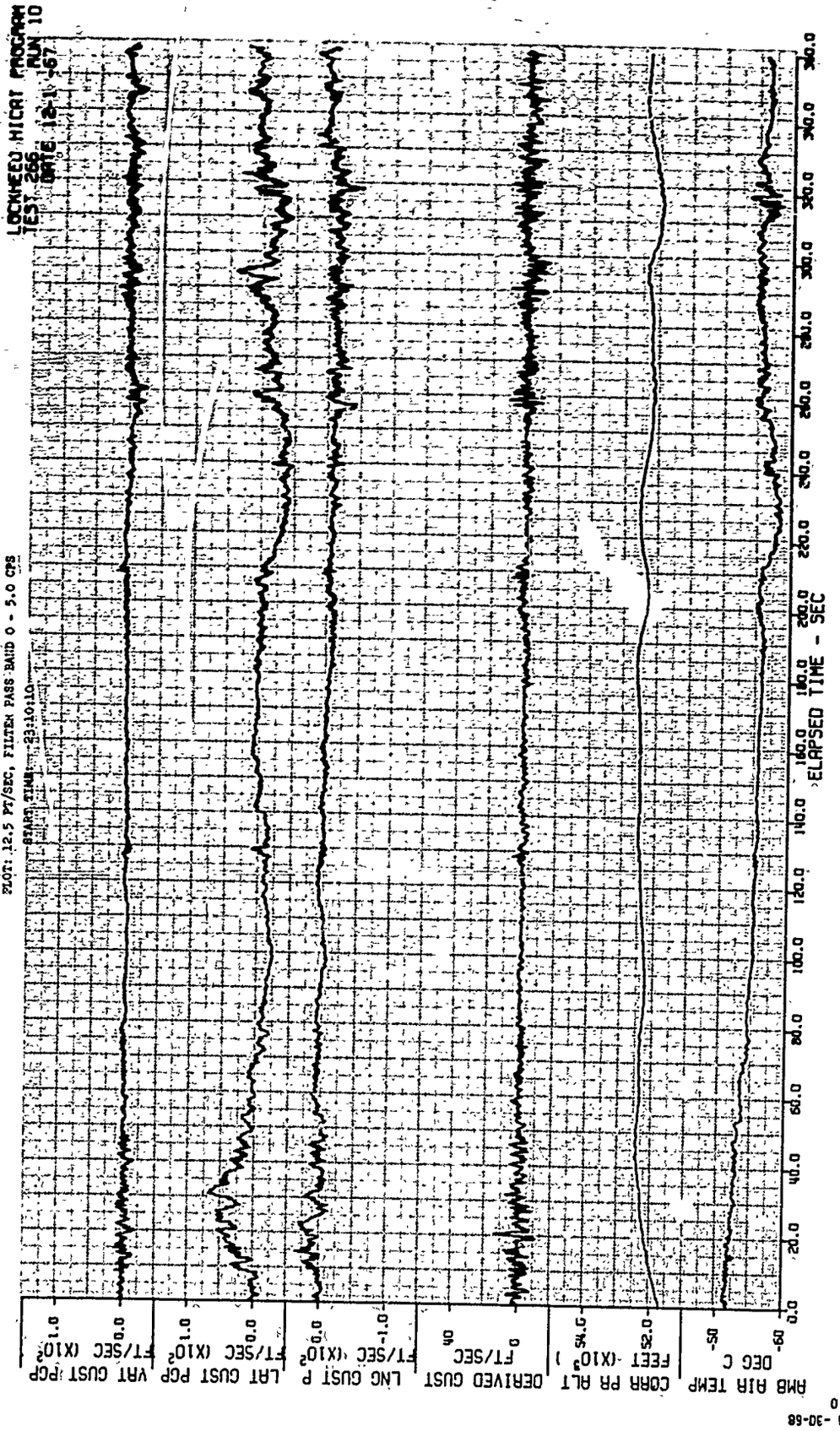


Figure 39A Gust Velocity Time Histories of Test 266, Run 10 - Edwards AFB, California, 1 Dec 67 (Sheet 1 of 2)

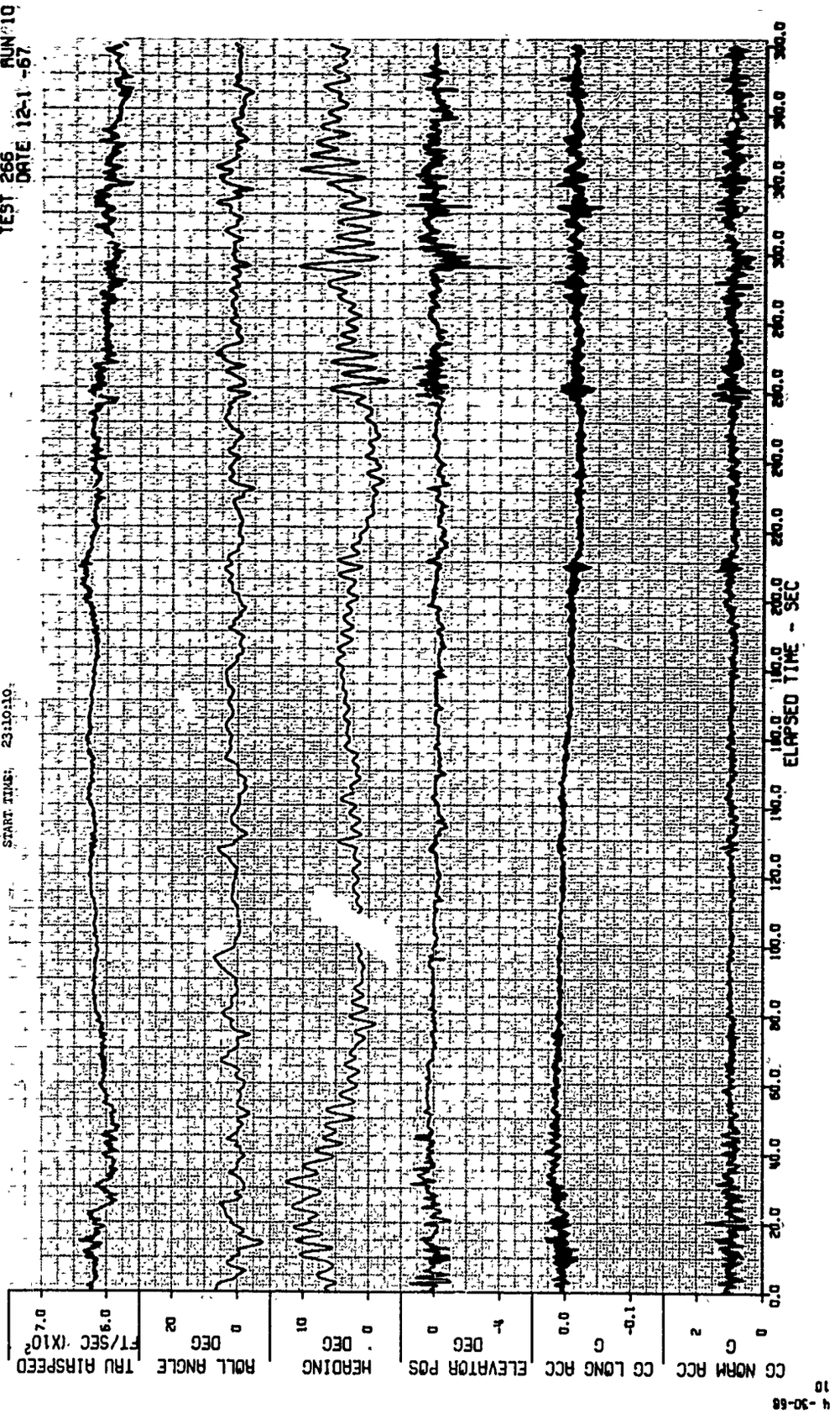


Figure 39B Flight Parameter Time Histories of Test 266, Run 10 (Sheet 1 of 2)

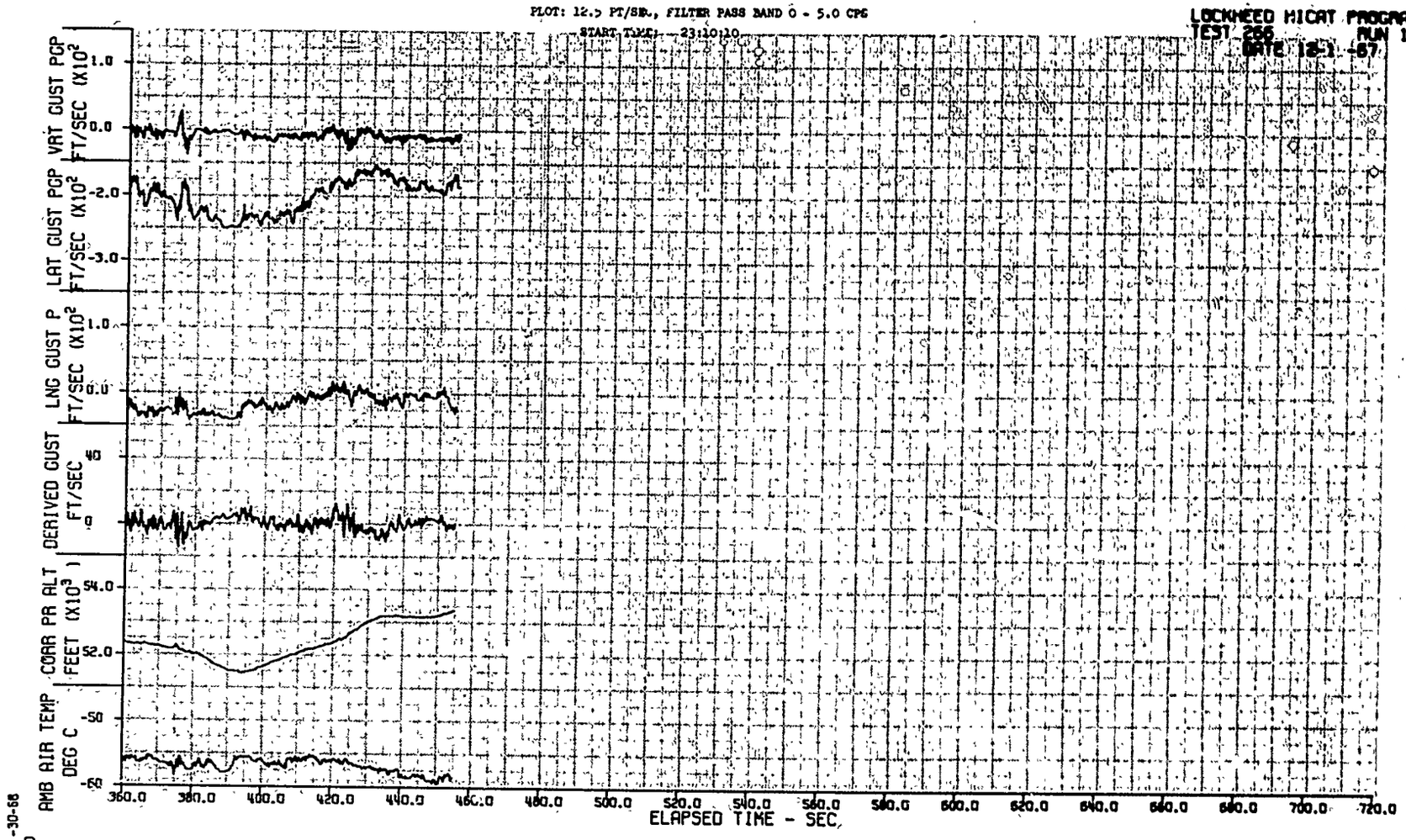


Figure 39A Gust Velocity Time Histories of Test 266, Run 10 - Edwards AFB, California, 1 Dec 67 (Sheet 2 of 2)

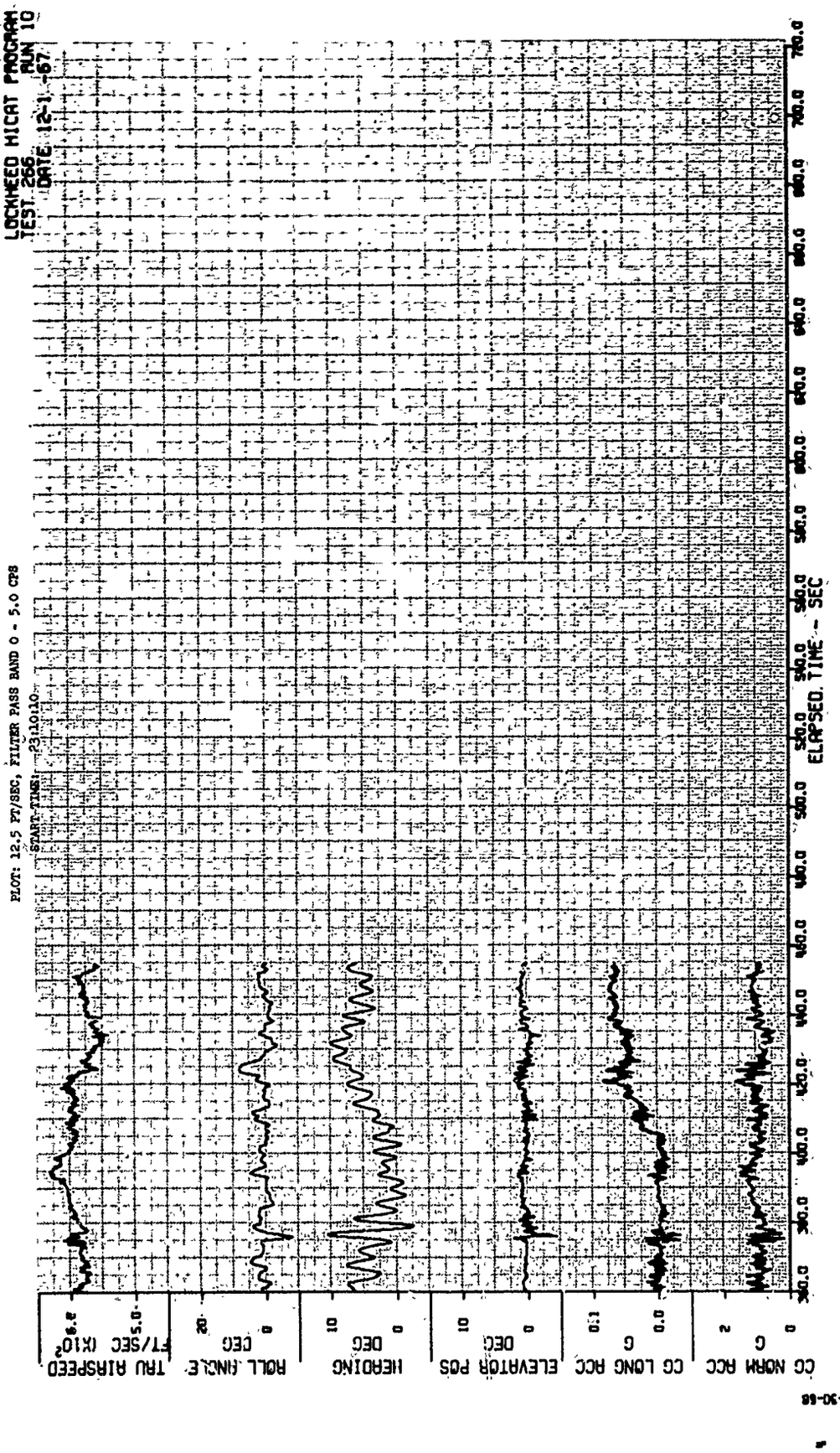


Figure 39B Flight Parameter Time Histories of Test 266, Run 10 (Sheet 2 of 2)

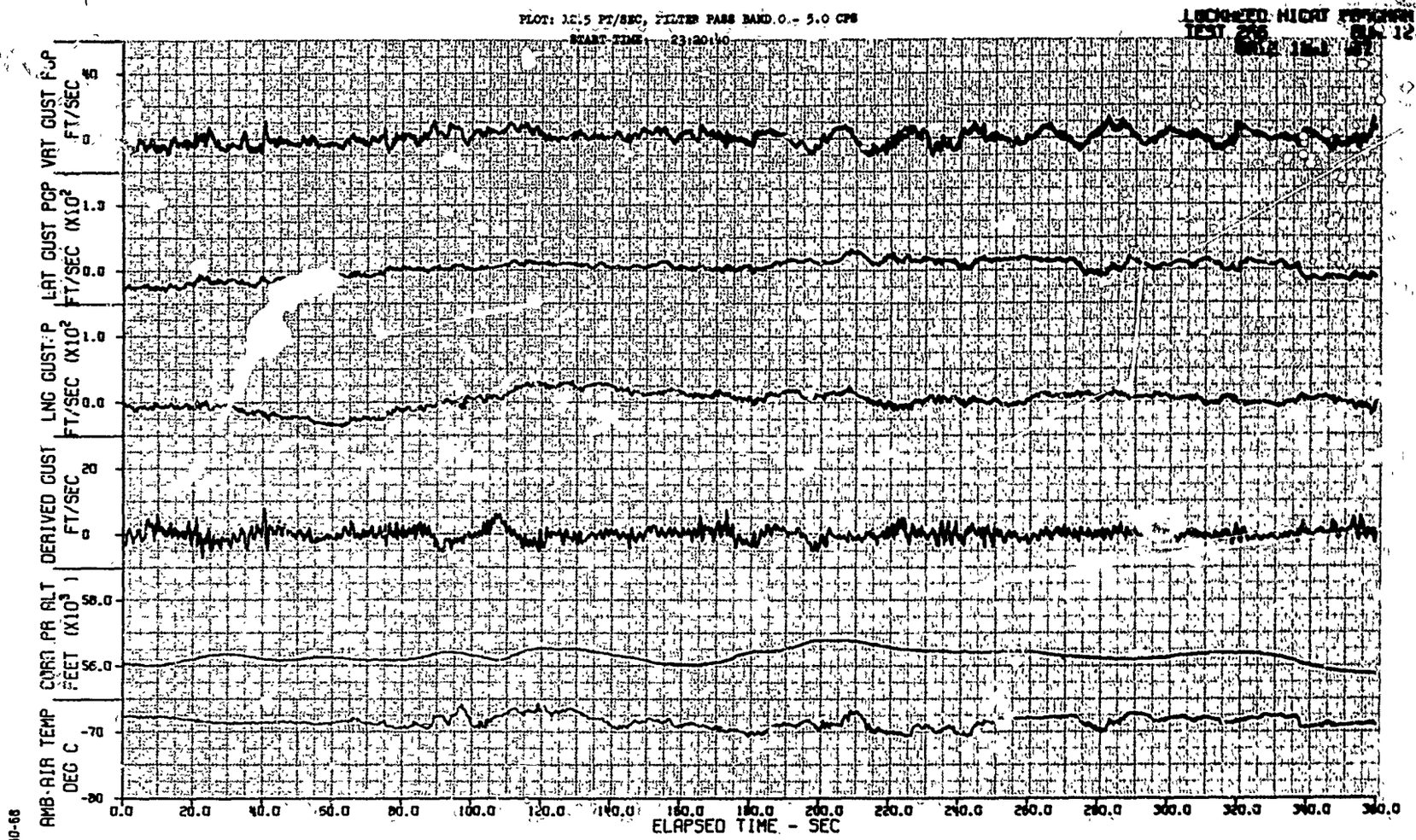


Figure 40A Gust Velocity Time Histories of Test 266, Run 12 - Edwards AFB, California, 1 Dec 67 (Sheet 1 of 2)



Figure 40B Flight Parameter Time Histories of Test 266, Run 12 (Sheet 1 of 2)

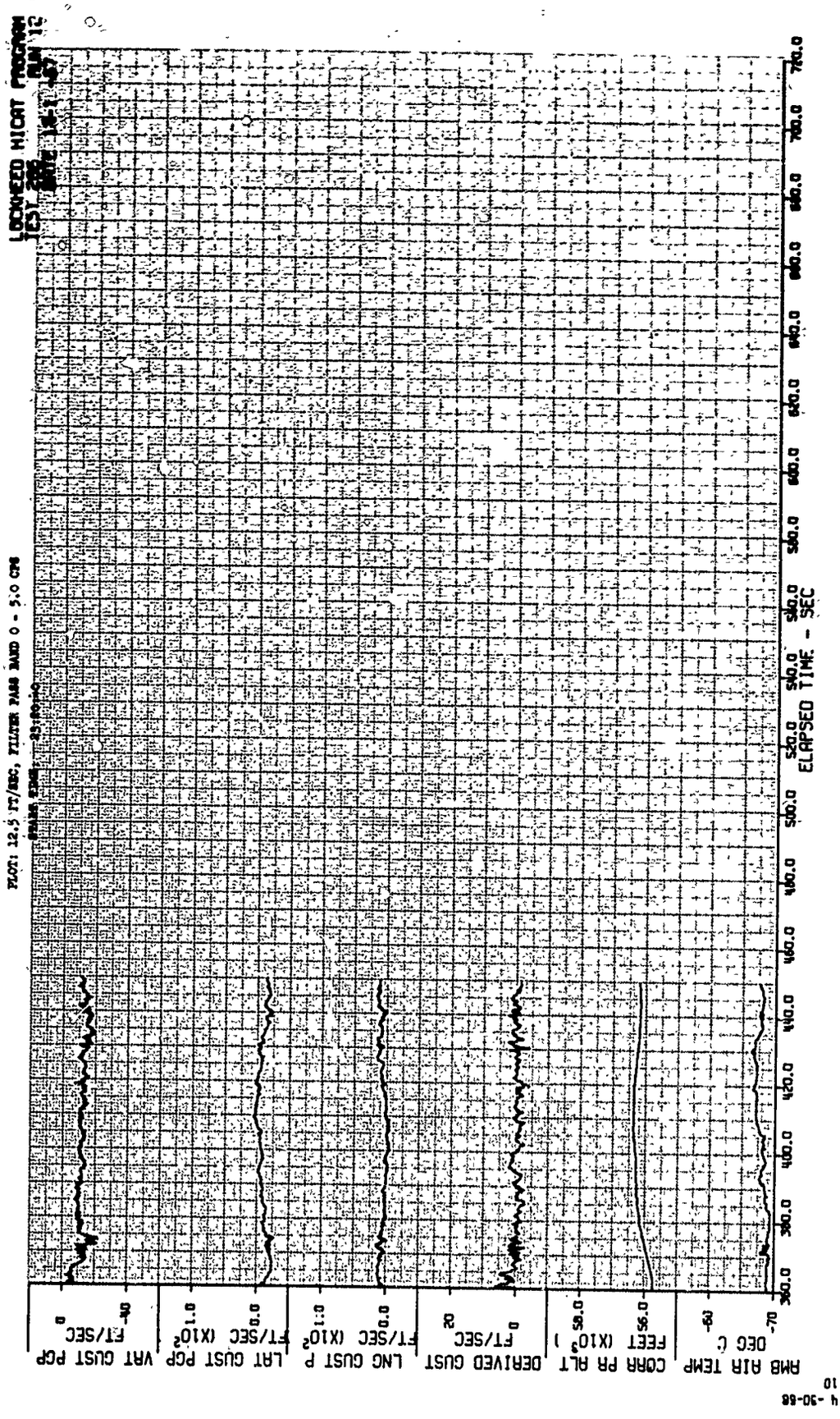


Figure 40A Gust Velocity Time Histories of Test 266, Run 12 - Edwards AFB, California, 1 Dec 67 (Sheet 2 of 2)

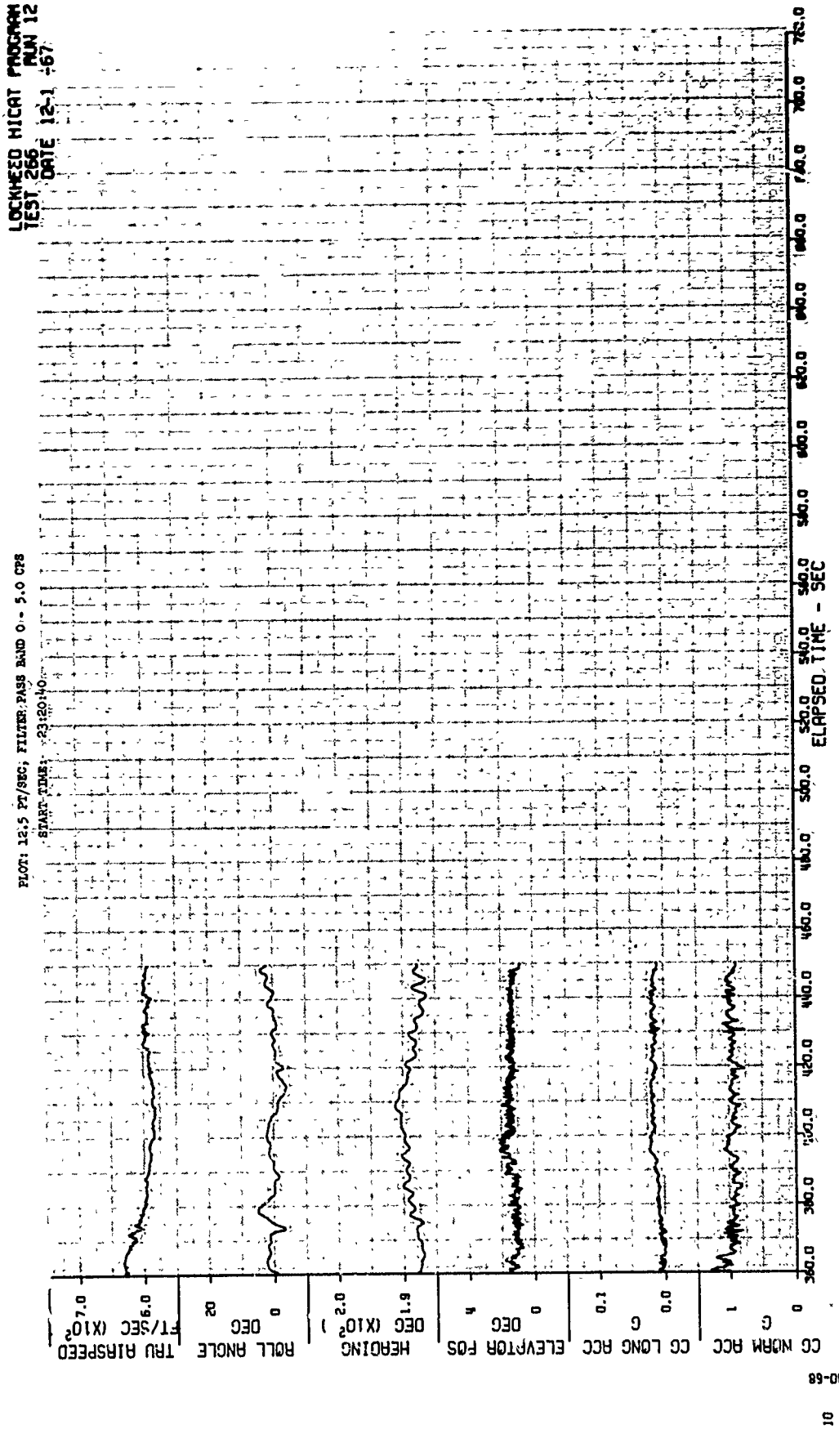


Figure 40B Flight Parameter Time Histories of Test 266, Run 12 (Sheet 2 of 2)

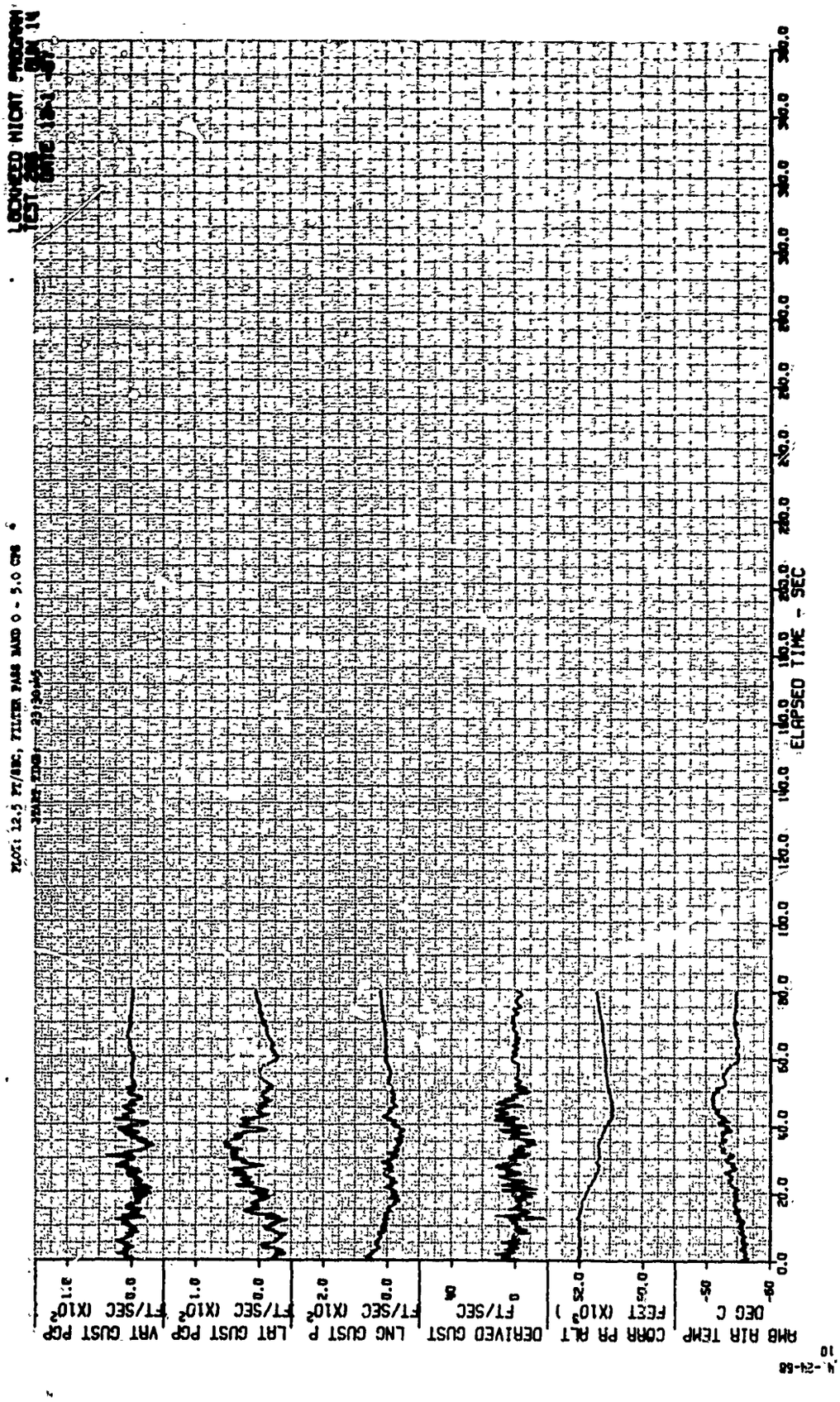


Figure 41A Gust Velocity Time Histories of Test 266, Run 14 - Edwards AFB, California, 1 Dec '67

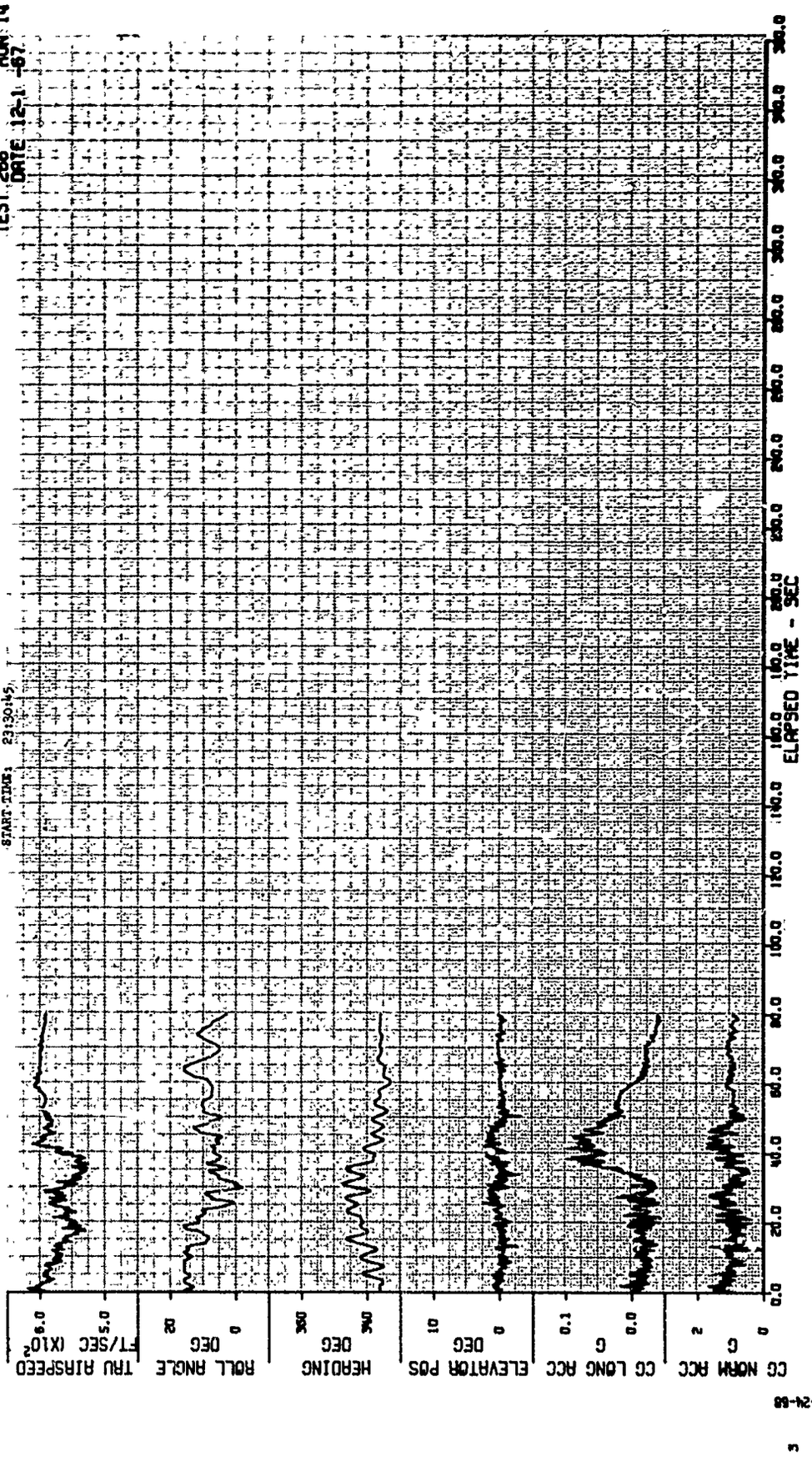


Figure 41B Flight Parameter Time Histories of Test 266, Run 14

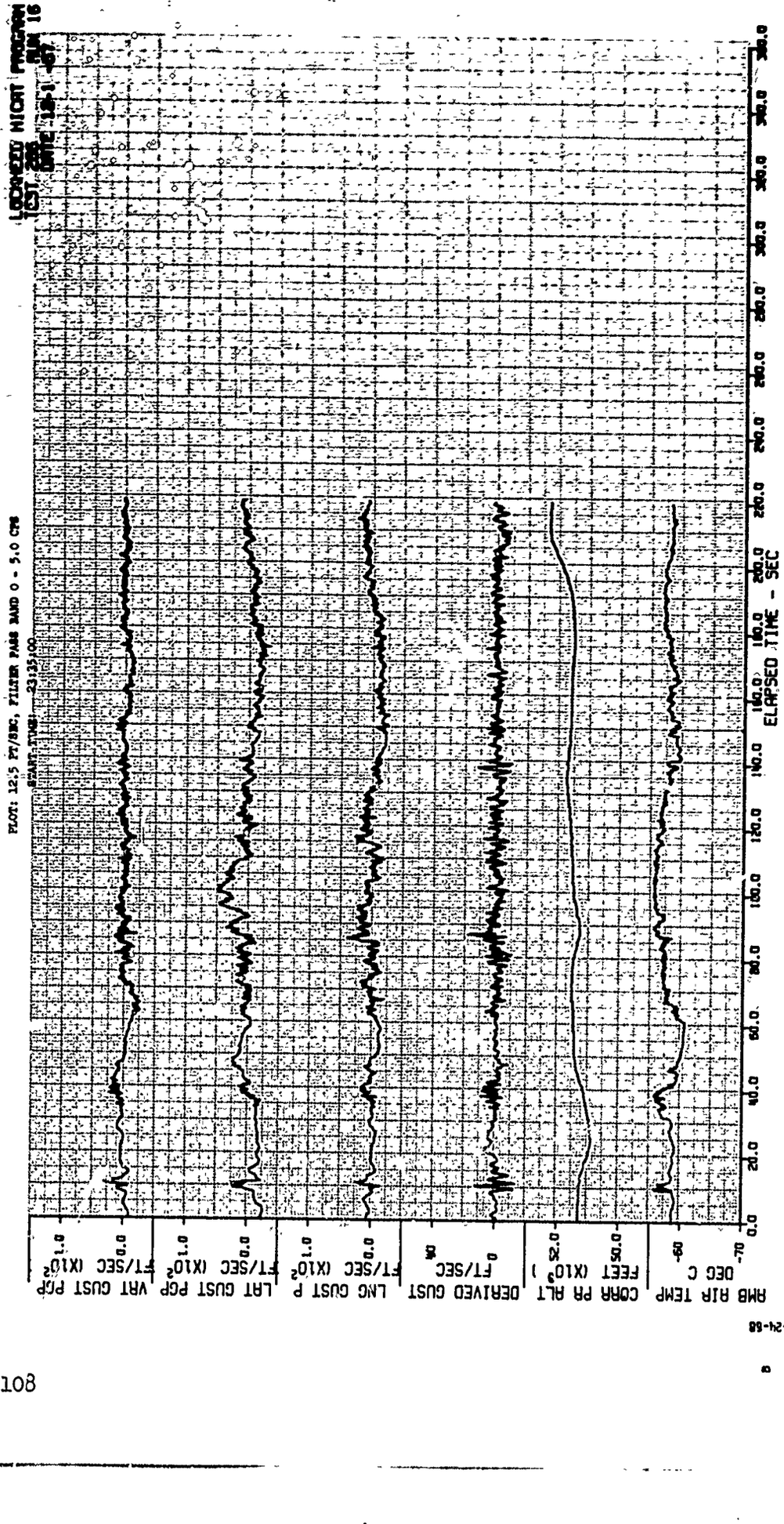


Figure 42A Gust Velocity Time Histories of Test 266, Run 16 - Edwards AFB, California, 1 Dec 67

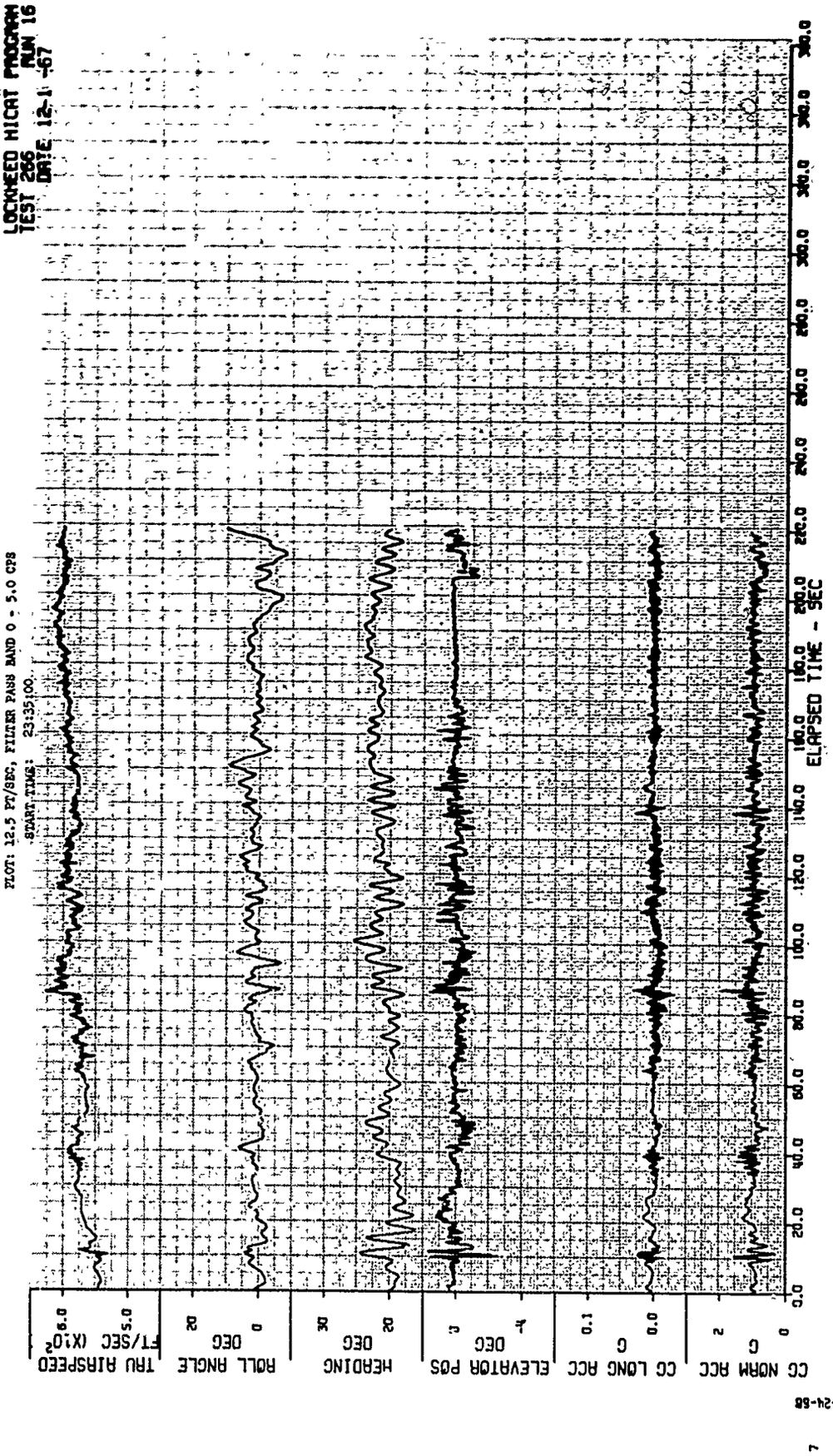


Figure 42B Flight Parameter Time Histories of Test 266, Run 16

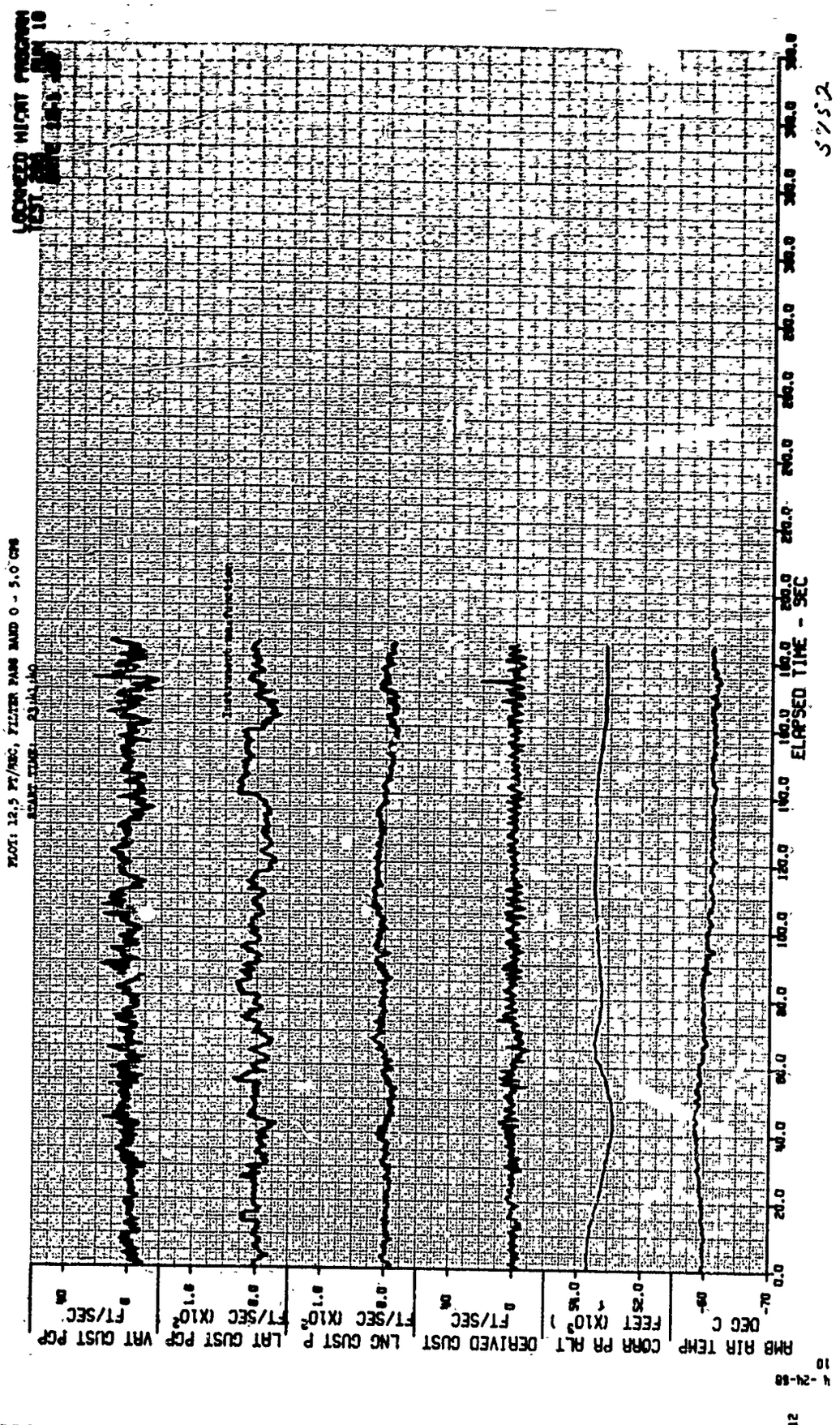


Figure 43A Gust Velocity Time Histories of Test 266, Run 18 - Edwards AFB, California, 1 Dec 67

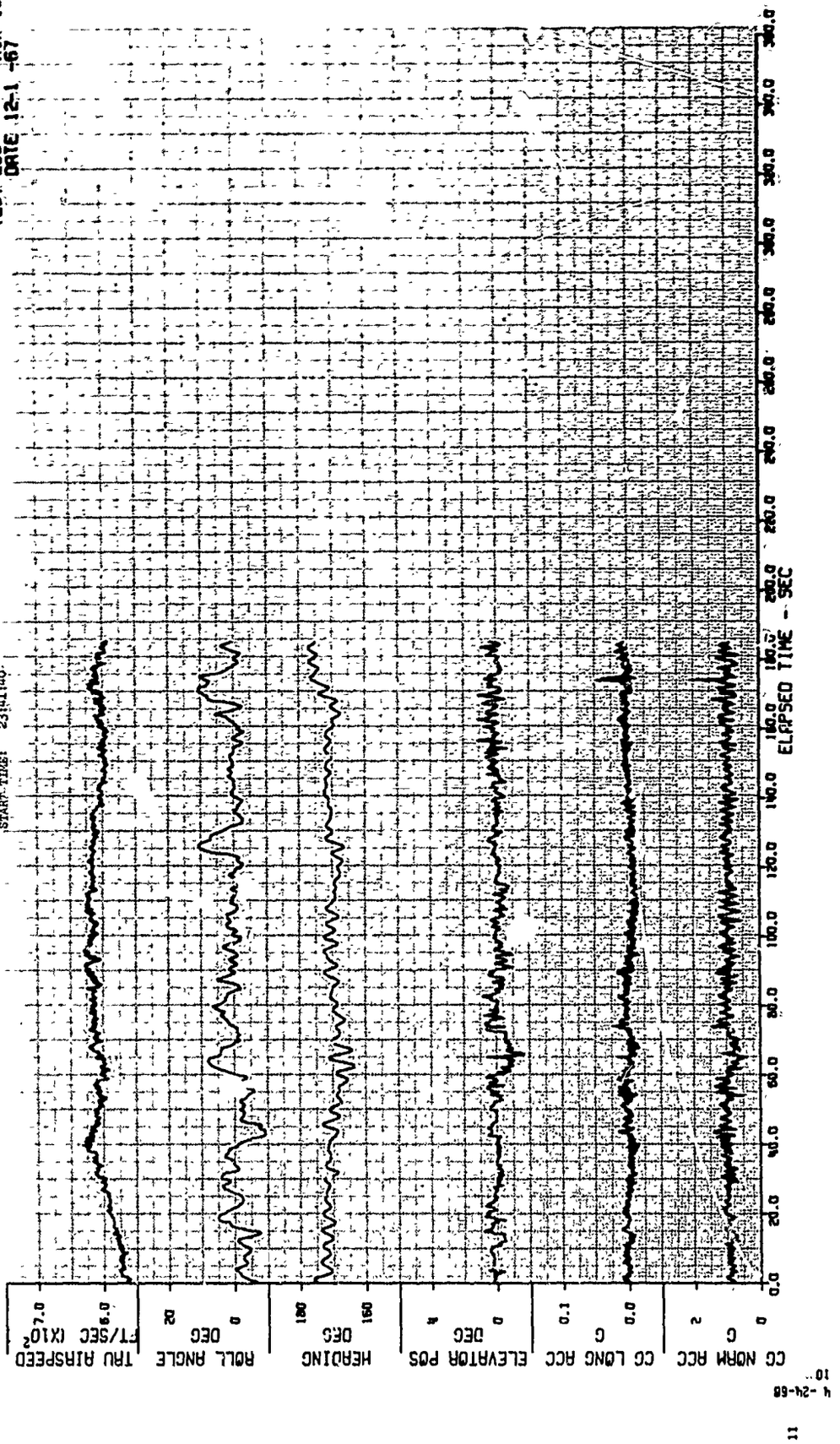


Figure 43B Flight Parameter Time Histories of Test 266, Run 18

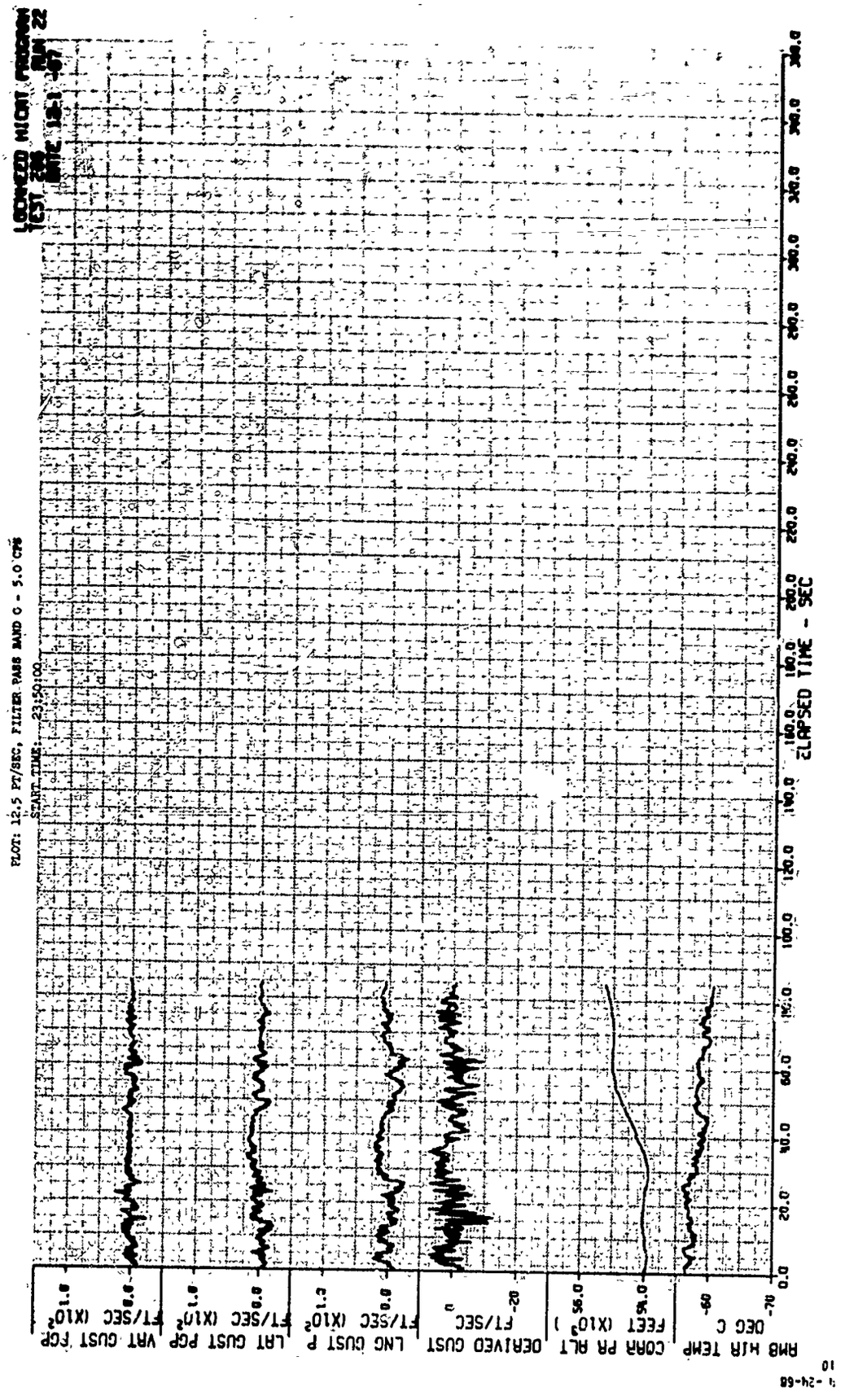


Figure 44A Gust Velocity Time Histories of Test 266, Run 22 - Edwards AFB, California, 1 Dec 67

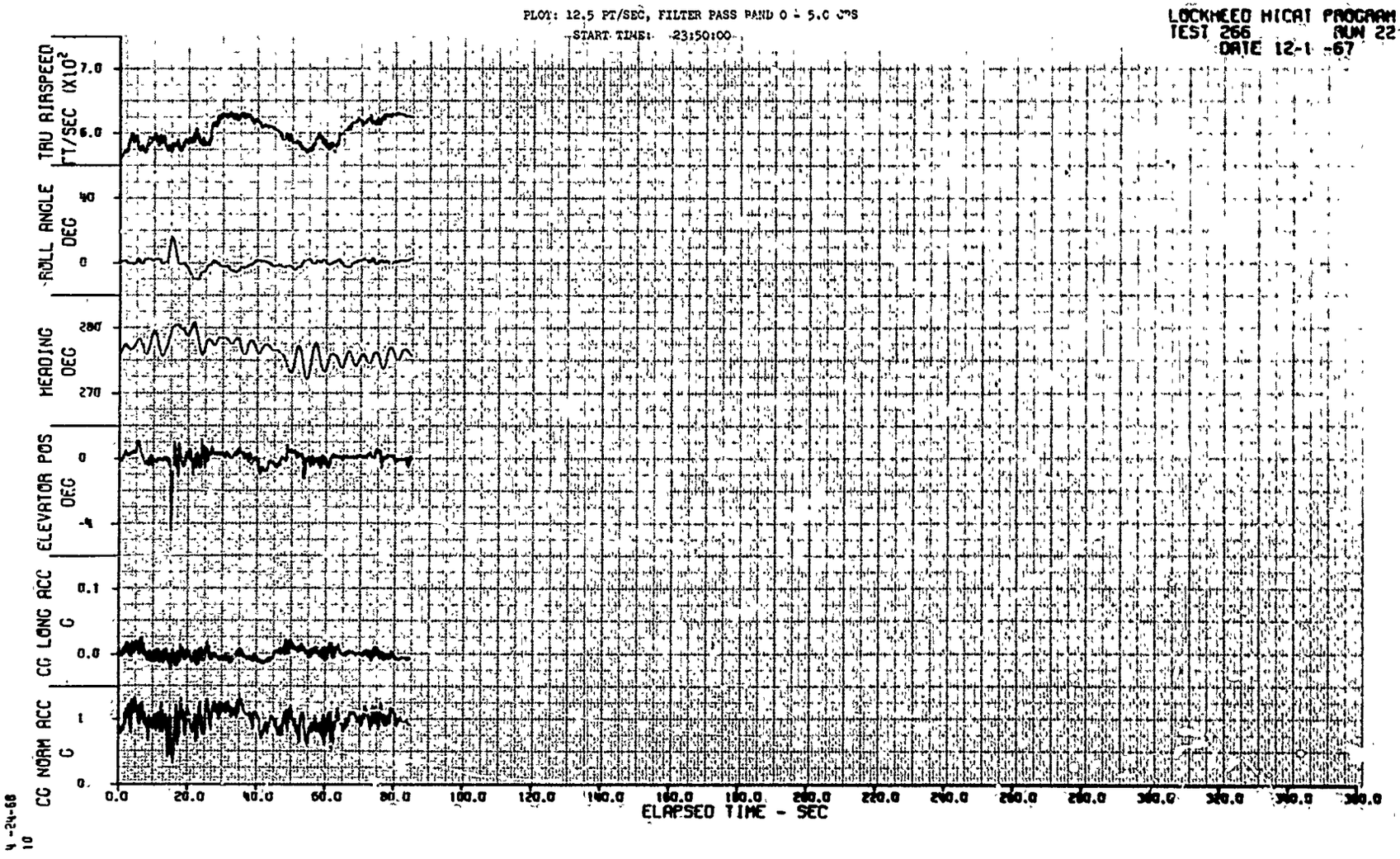


Figure 44B Flight Parameter Time Histories of Test 266, Run 22

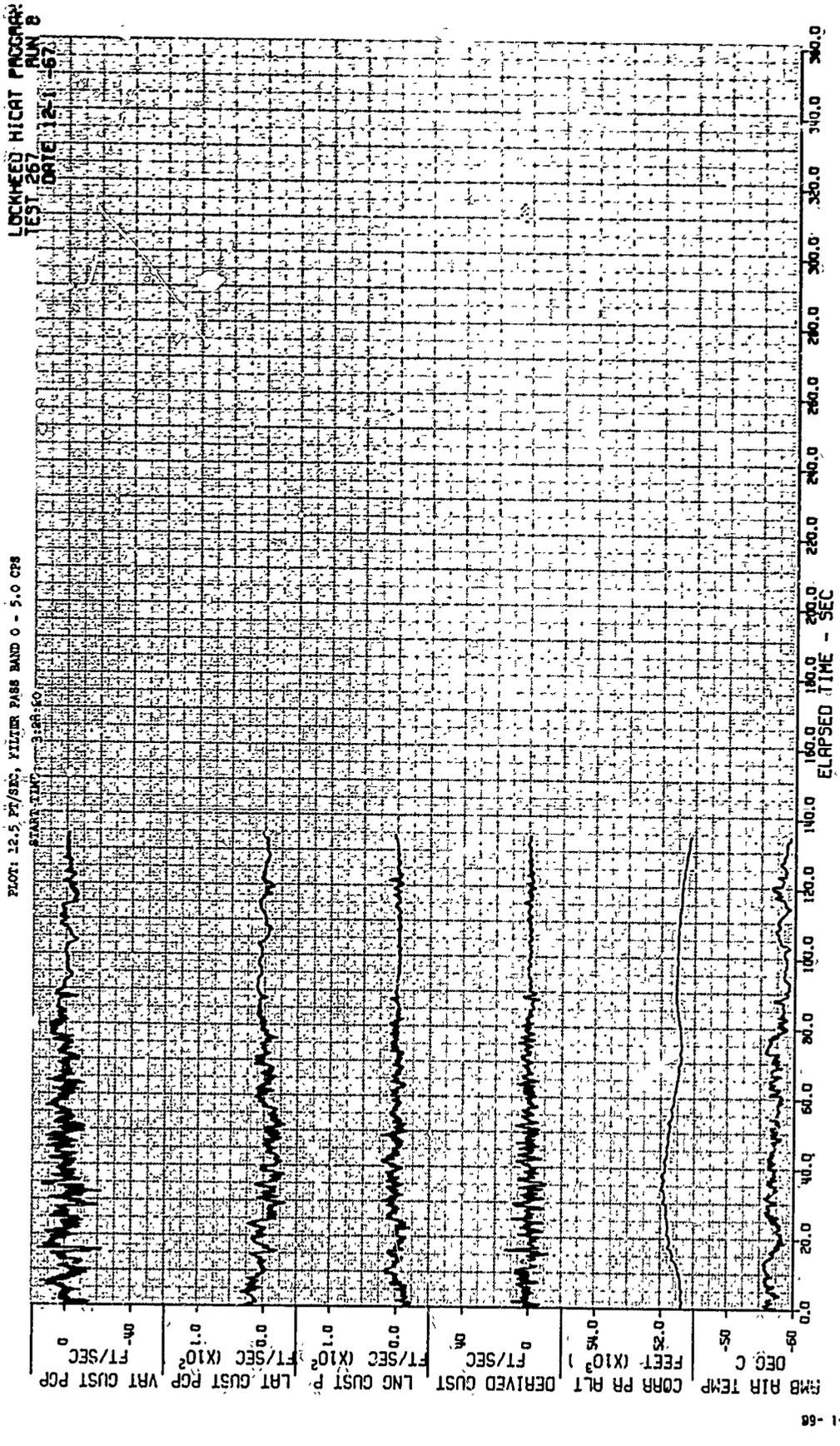


Figure 45A Gust Velocity Time Histories of Test 267, Run 8 - Edwards AFB, California, 2 Dec 67

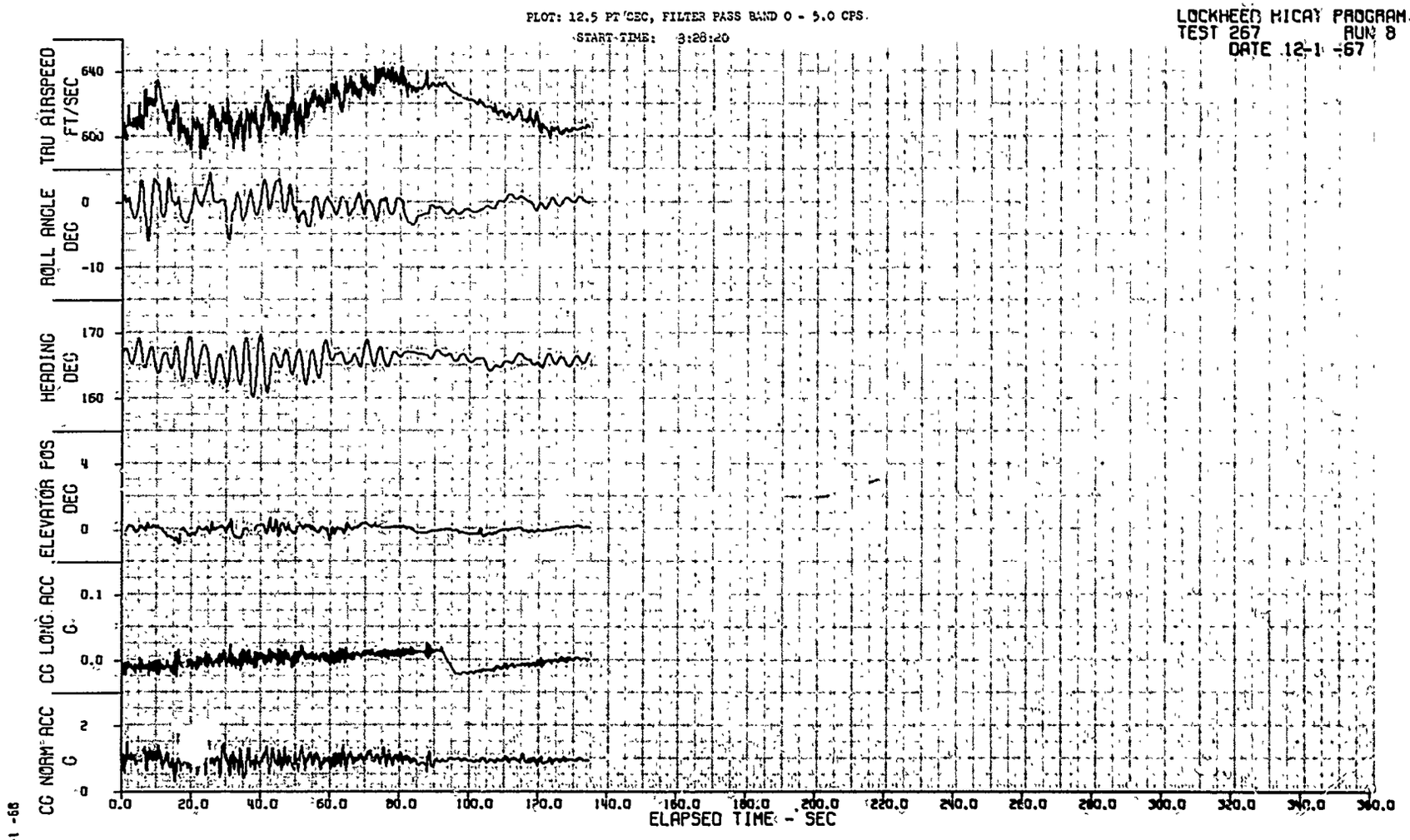


Figure 45B Flight Parameter Time Histories of Test 267, Run 8

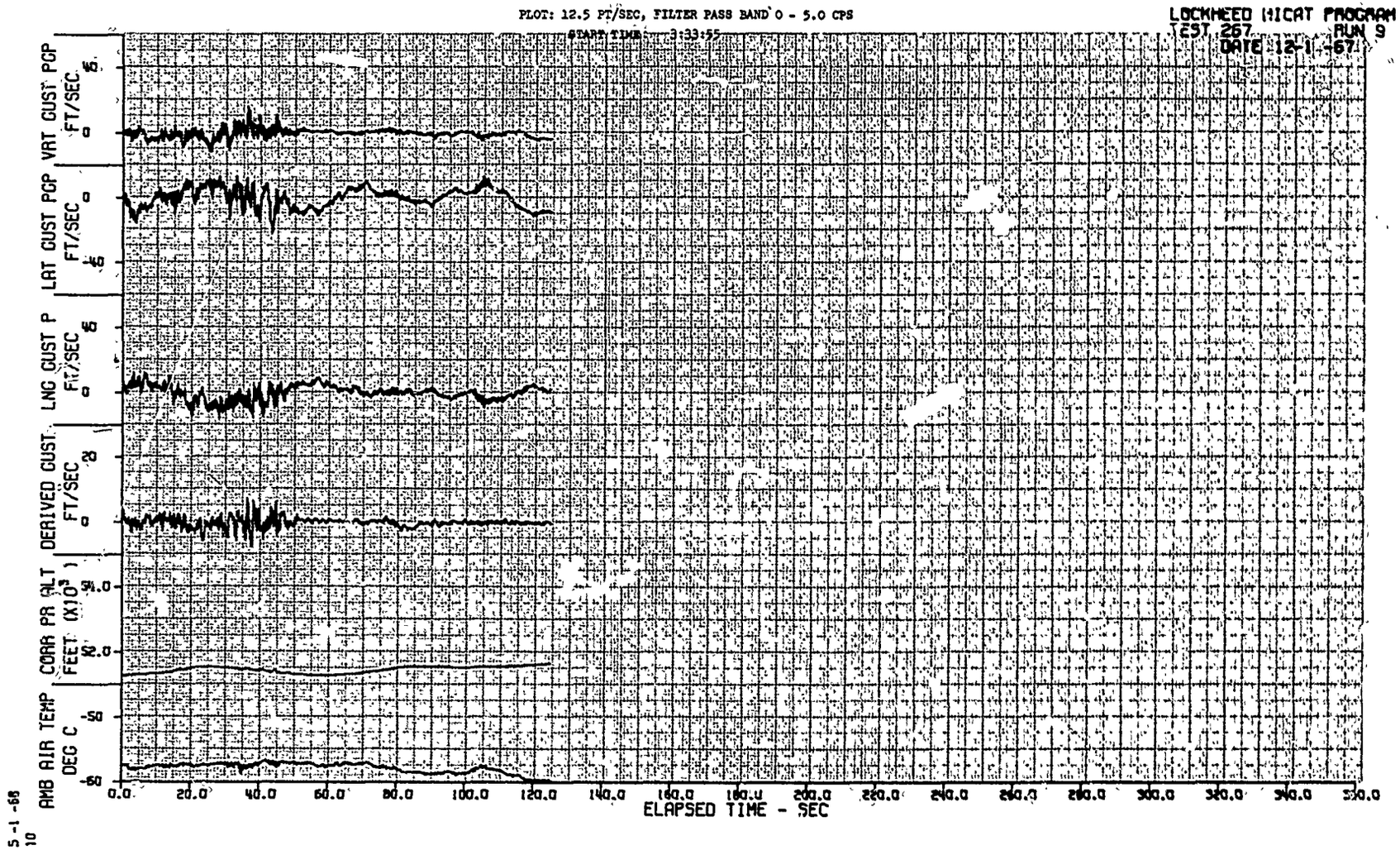


Figure 46A Gust Velocity Time Histories of Test 267, Run 9 - Edwards AFB, California, 2 Dec 67

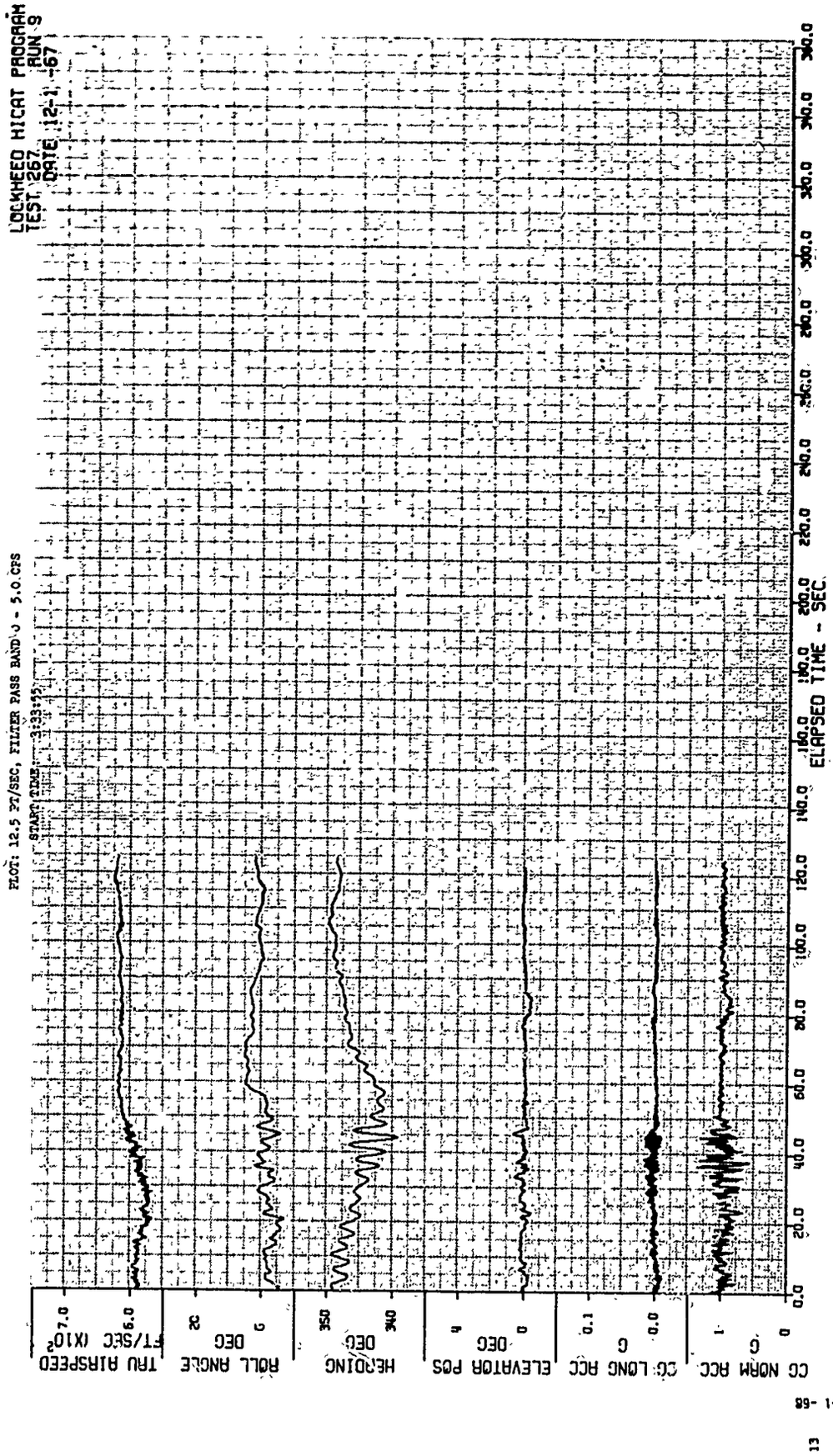


Figure 46B Flight Parameter Time Histories of Test 267, Run 9

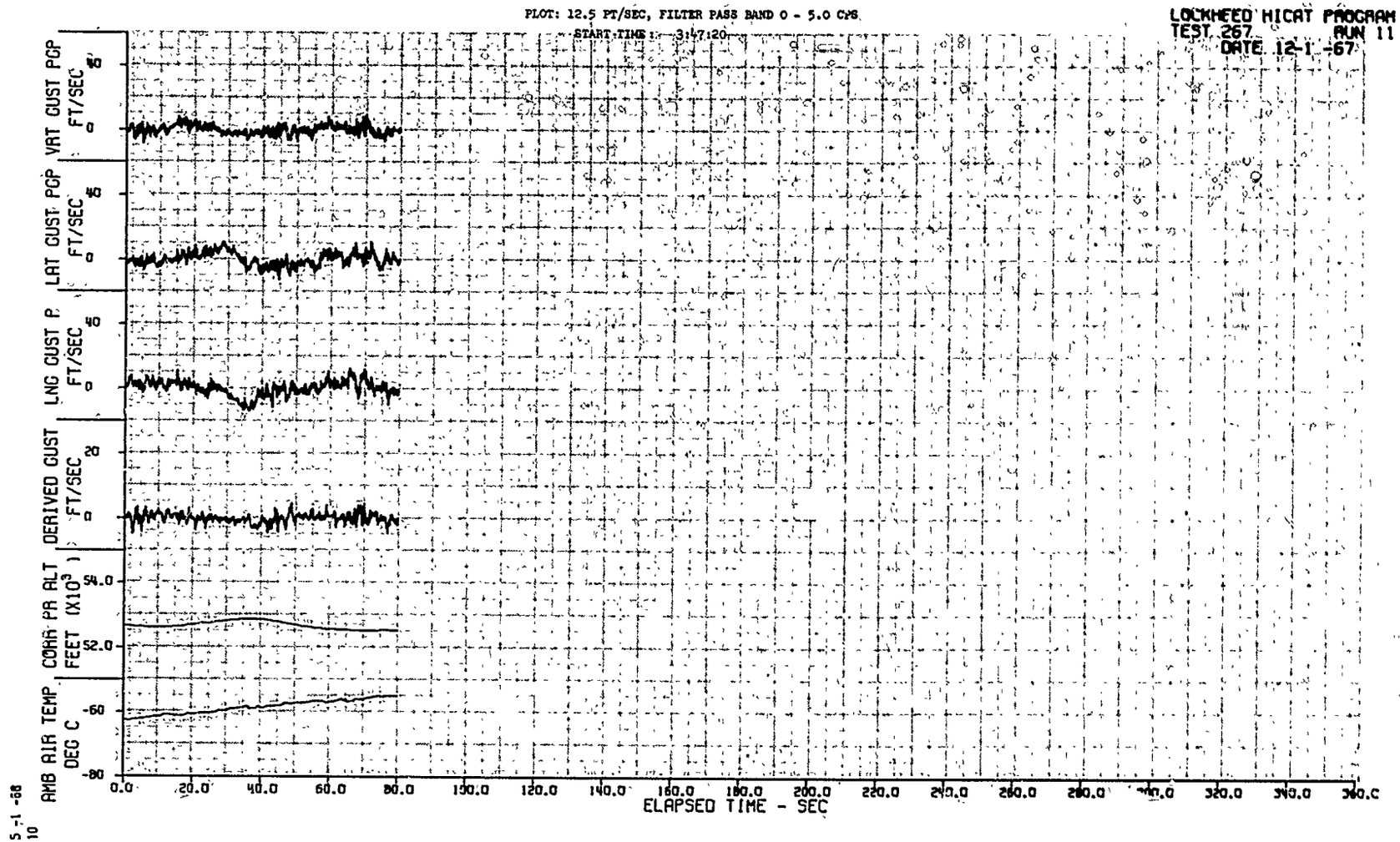


Figure 47A Gust Velocity Time Histories of Test 267, Run 11 - Edwards AFB, California, 2 Dec 67

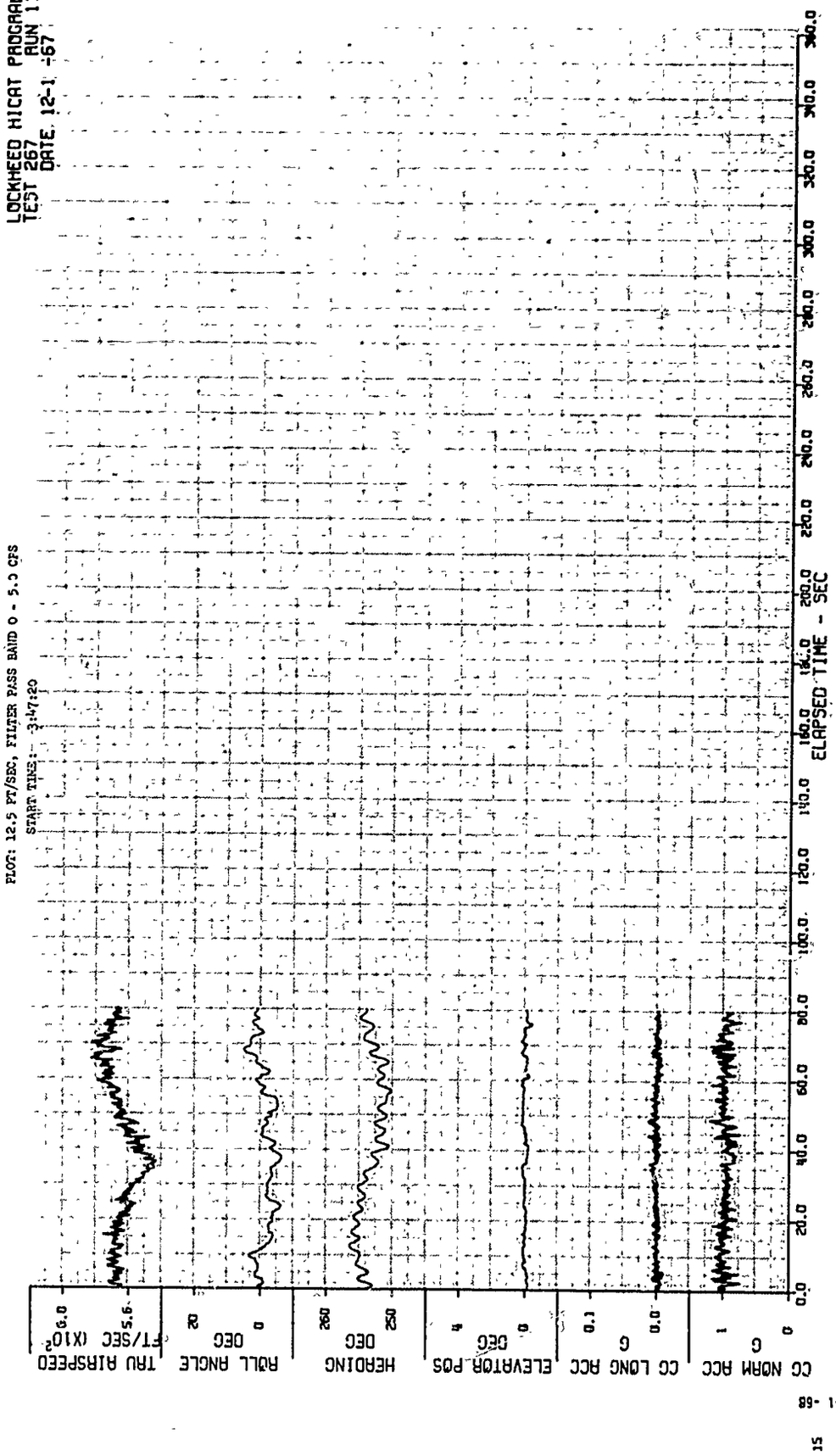


Figure 47B Flight Parameter Time Histories of Test 267, Run 11

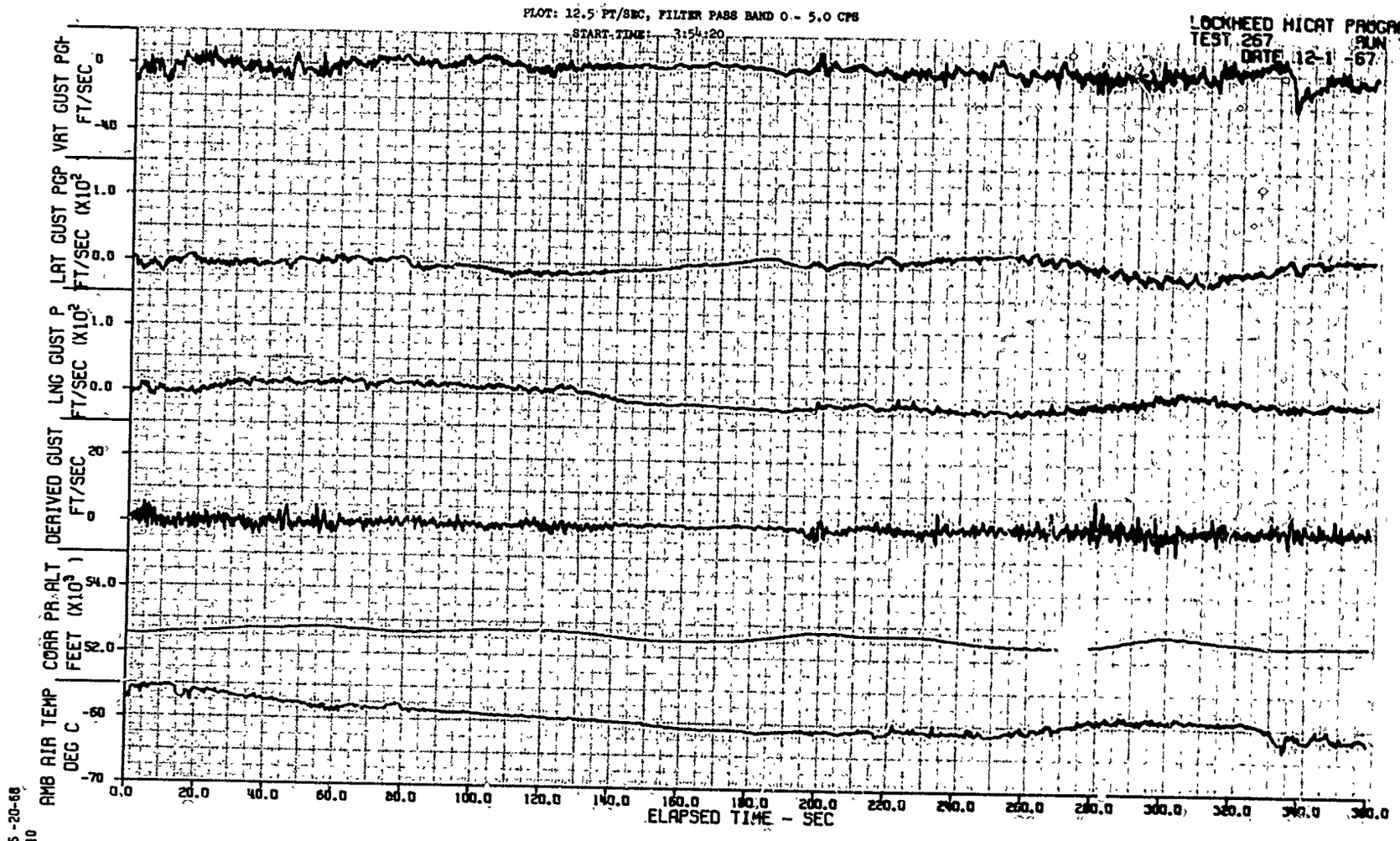


Fig 48A (Sht 1) P 120

Figure 48A Gust Velocity Time Histories of Test 267, Run 14 - Edwards AFB, California, 2 Dec 67 (Sheet 1 of 2)

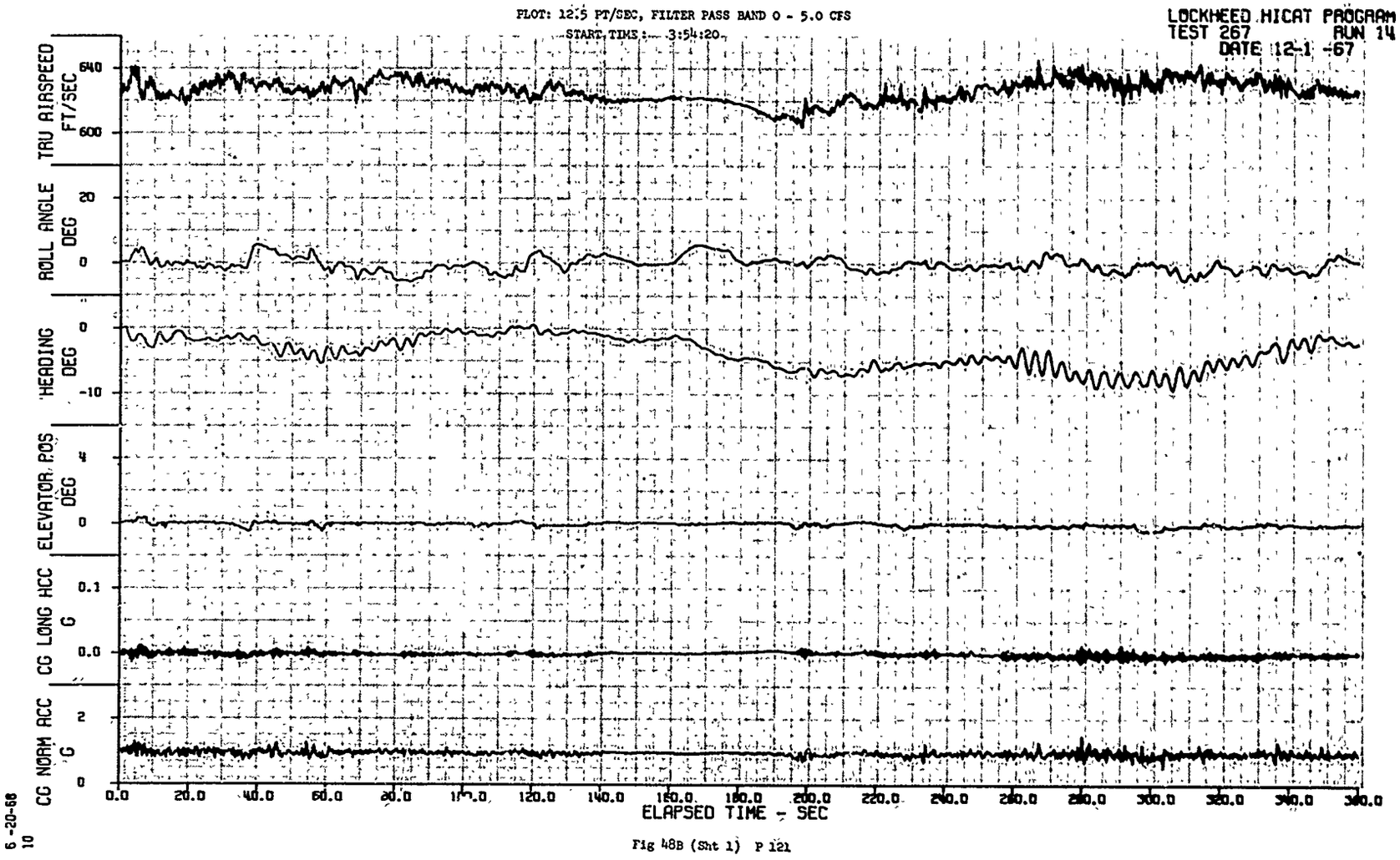


Fig 48B (Sht 1) P 121

Figure 48B Flight Parameter Time Histories of Test 267, Run 14 (Sheet 1 of 2)

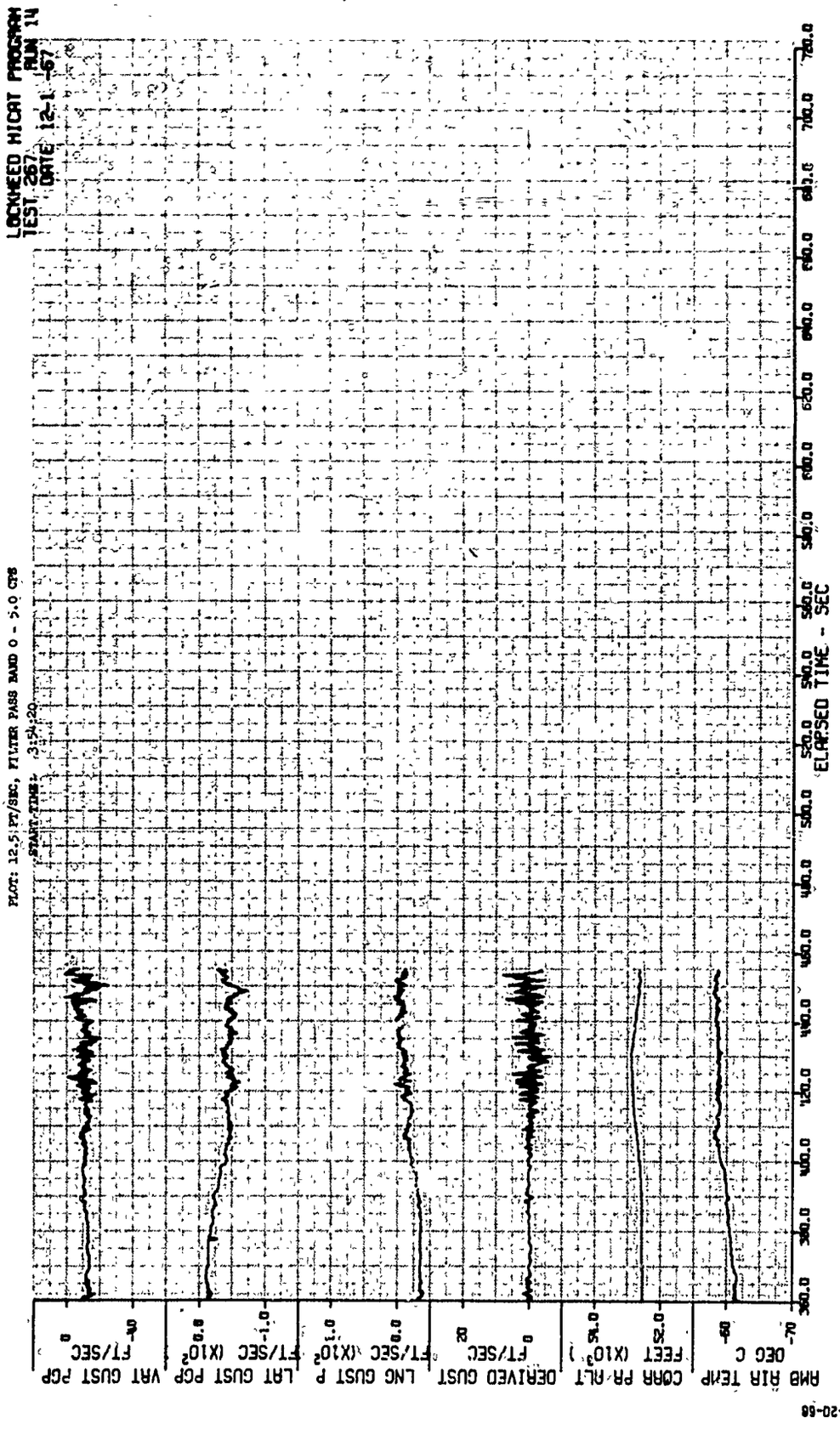


Fig 48A (Sht 2) P.122

Figure 48A Gust Velocity Time Histories of Test 267, Run 14 - Edwards AFB, California, 2 Dec 67 (Sheet 2 of 2)

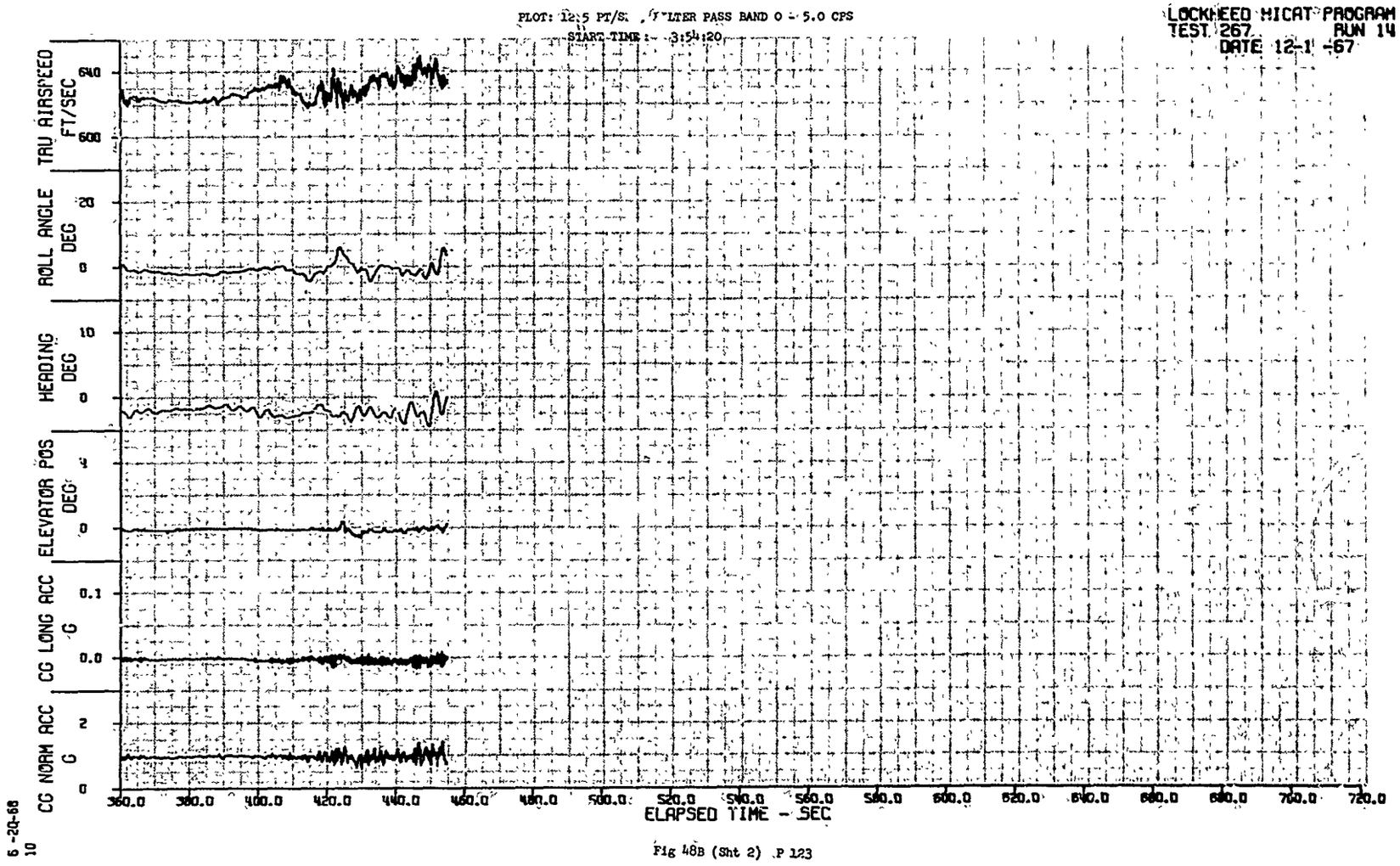


Fig 48B (Sht 2) P 123

Figure 48B Flight Parameter Time Histories of Test 267, Run 14 (Sheet 2 of 2)

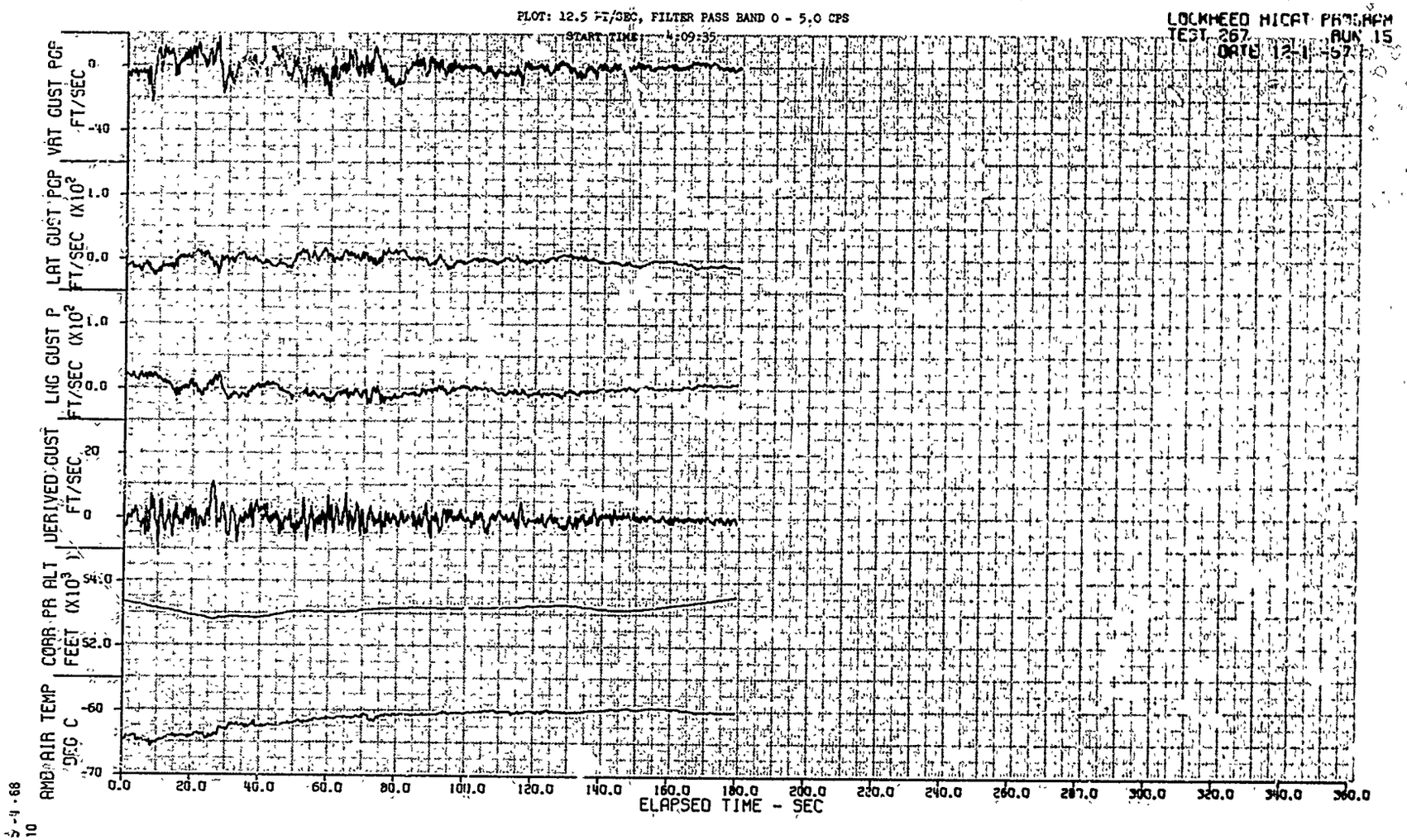


Figure 49A Gust Velocity Time Histories of Test 267, Run 15 - Edwards AFB, California, 2 Dec 67

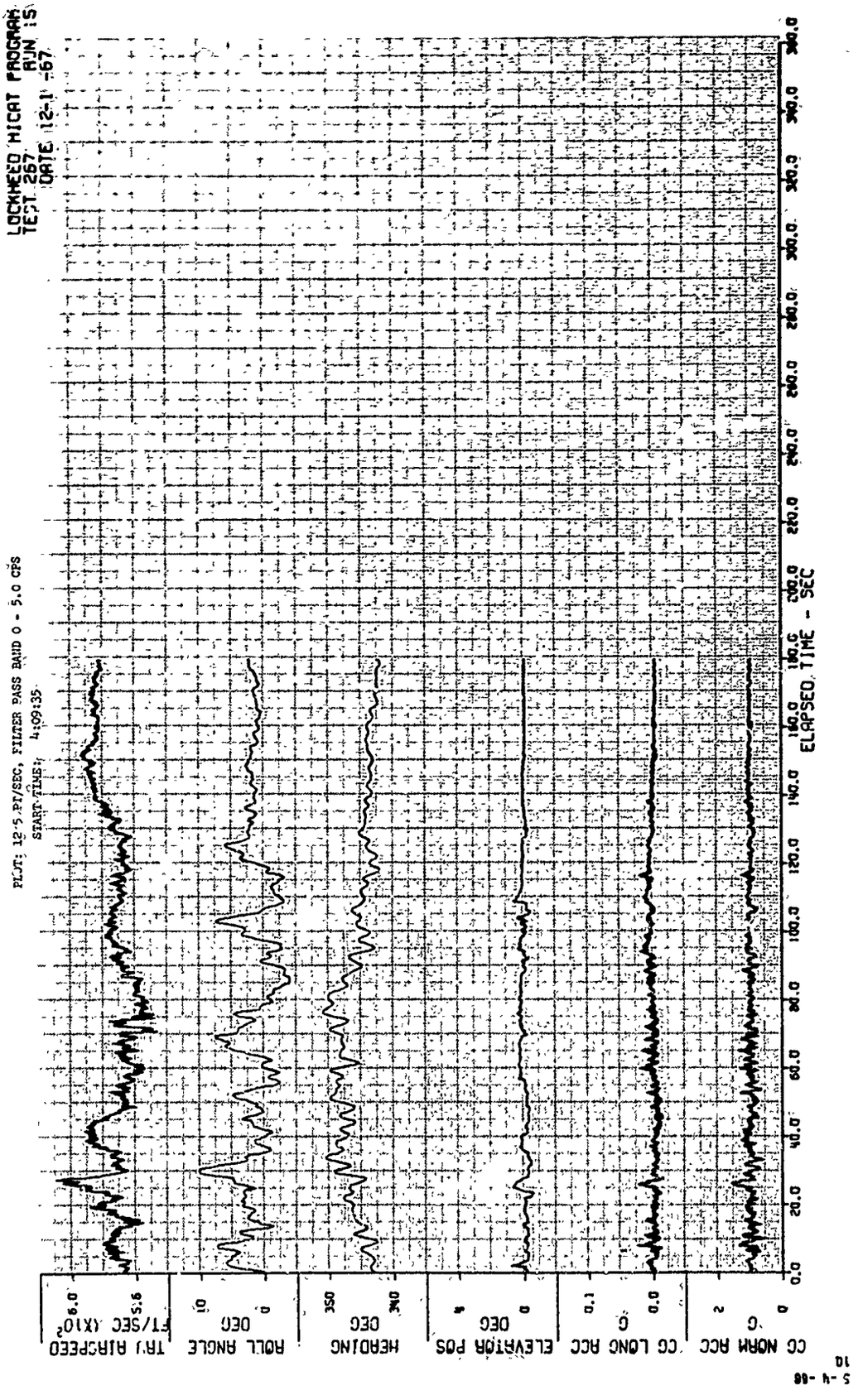


Figure 49B Flight Parameter Time Histories of Test 267, Run 15

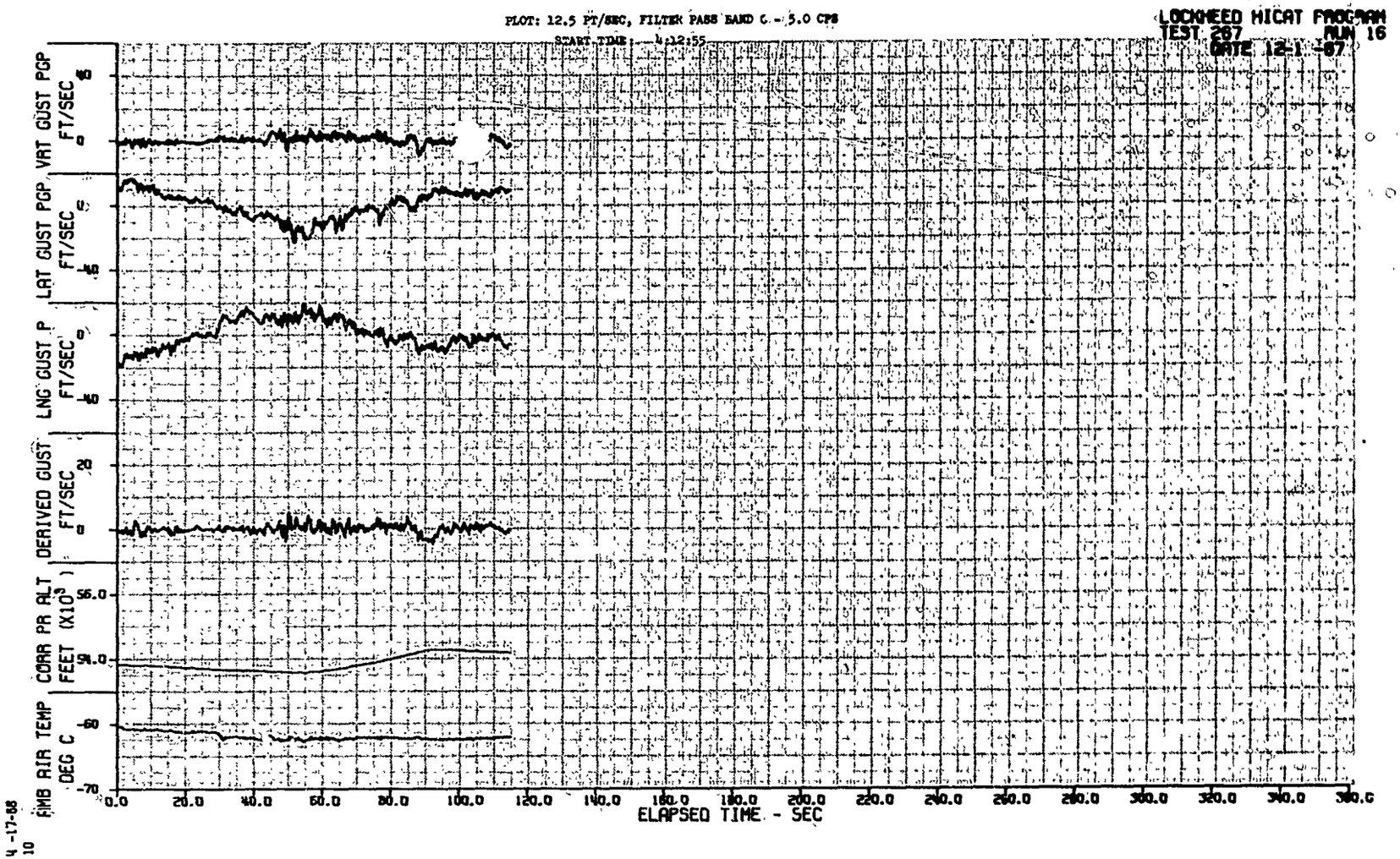


Figure 50A Gust Velocity Time Histories of Test 267, Run 16 - Edwards AFB, California, 2 Dec 67

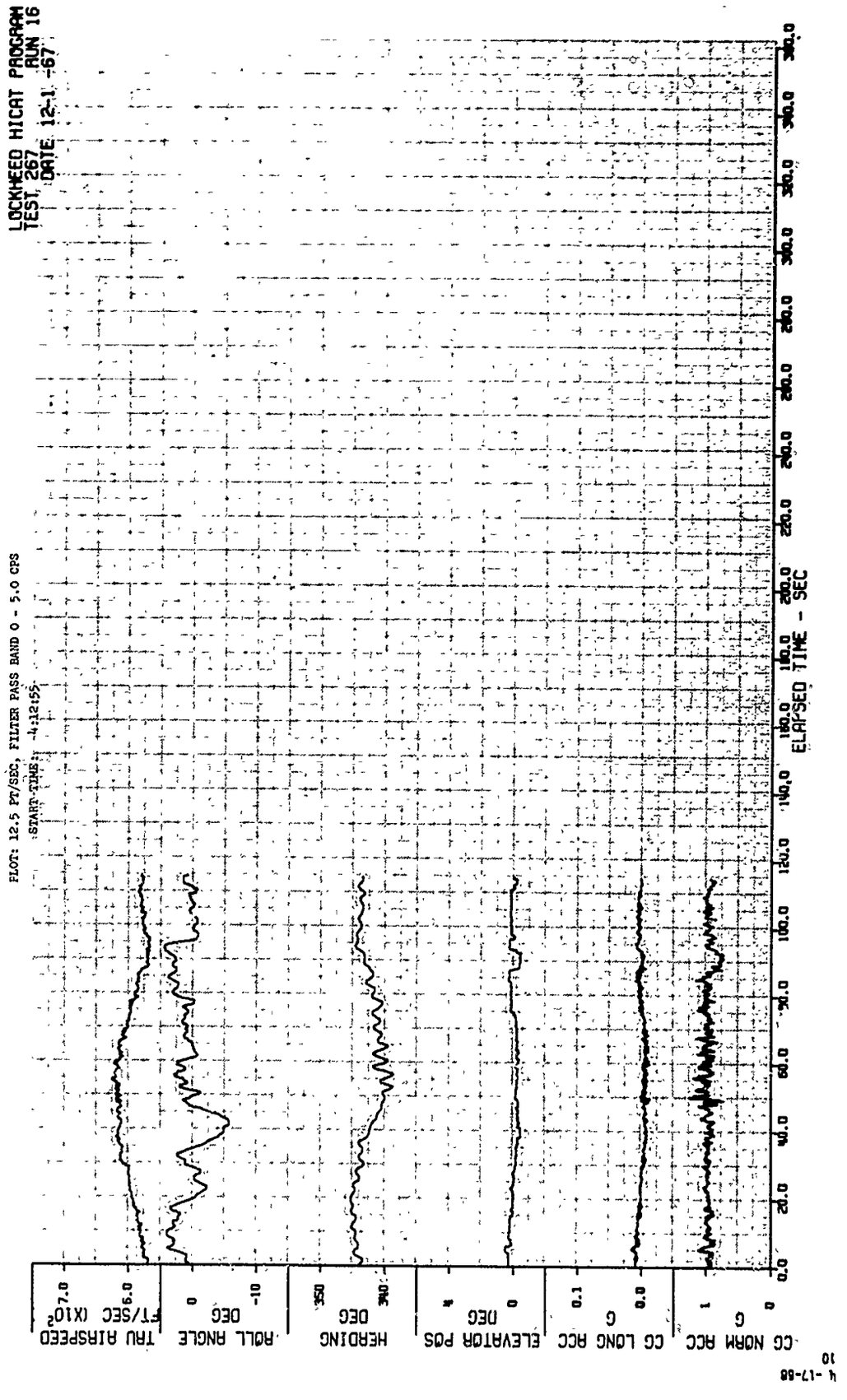


Figure 50B Flight Parameter Time Histories of Test 267, Run 16

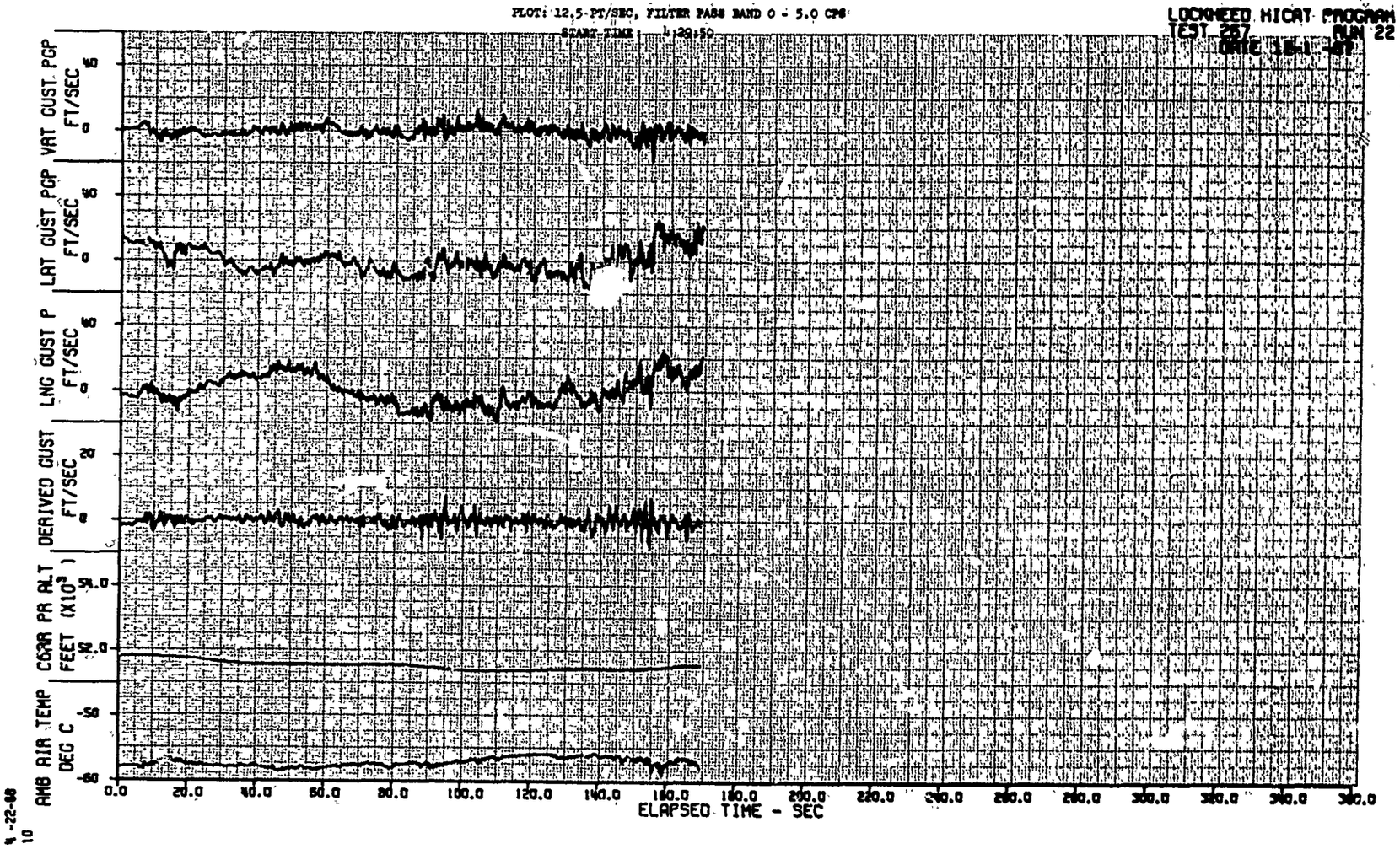


Figure 51A Gust Velocity Time Histories of Test 267, Run 22 - Edwards AFB, California, 2 Dec 67

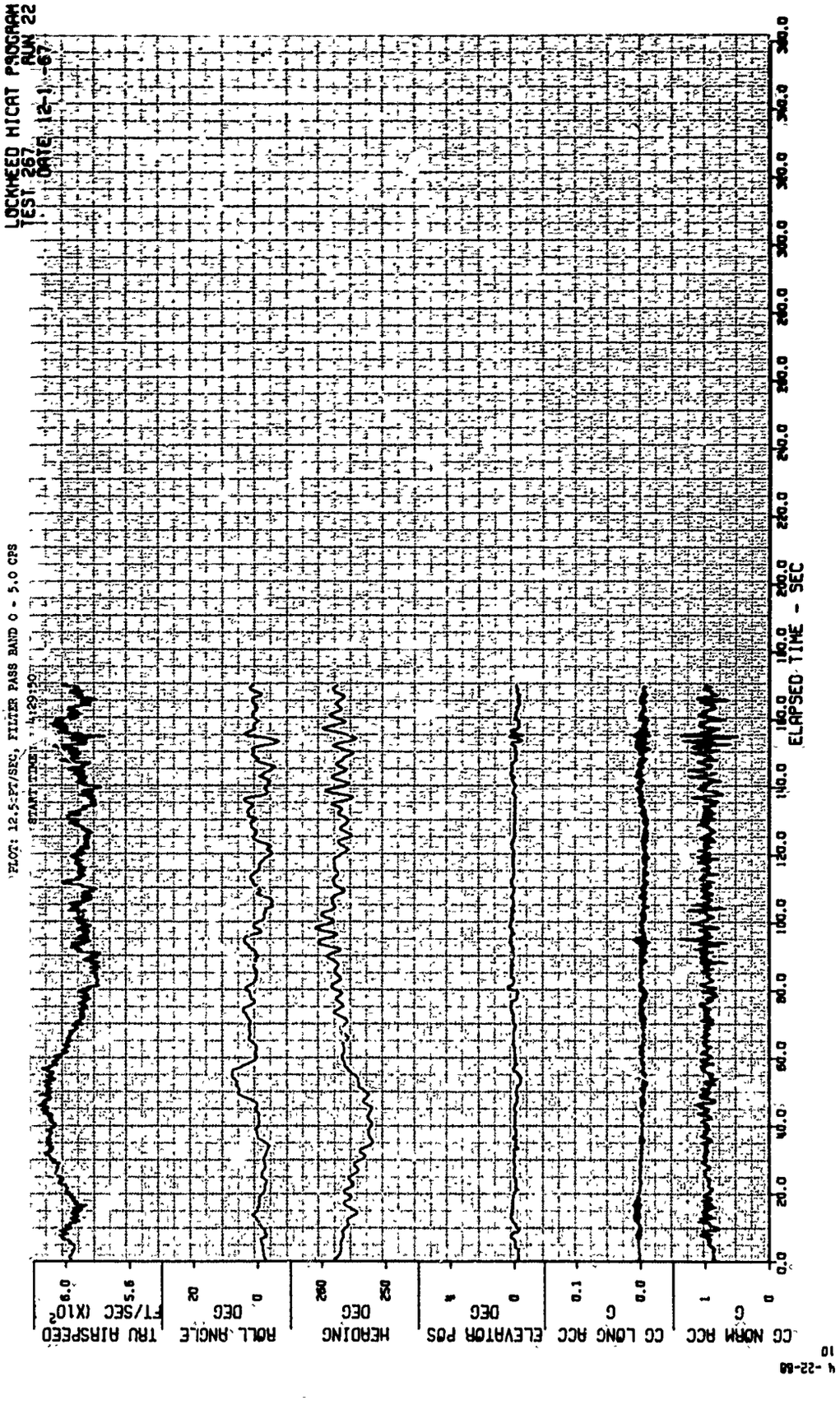


Figure 51B Flight Parameter Time Histories of Test 267, Run 22

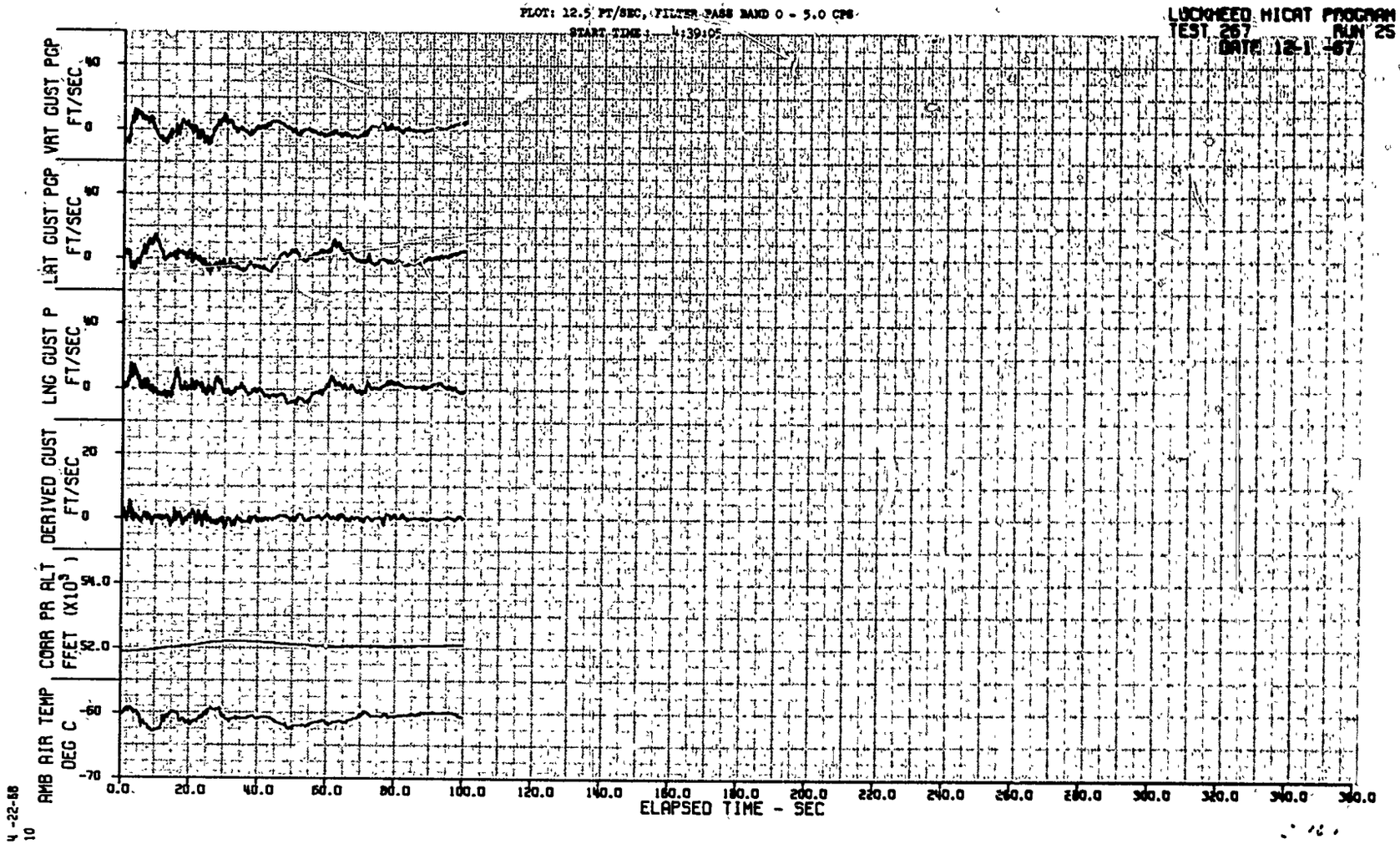


Figure 52A Gust Velocity Time Histories of Test 267, Run 25 - Edwards AFB, California, 2 Dec 67

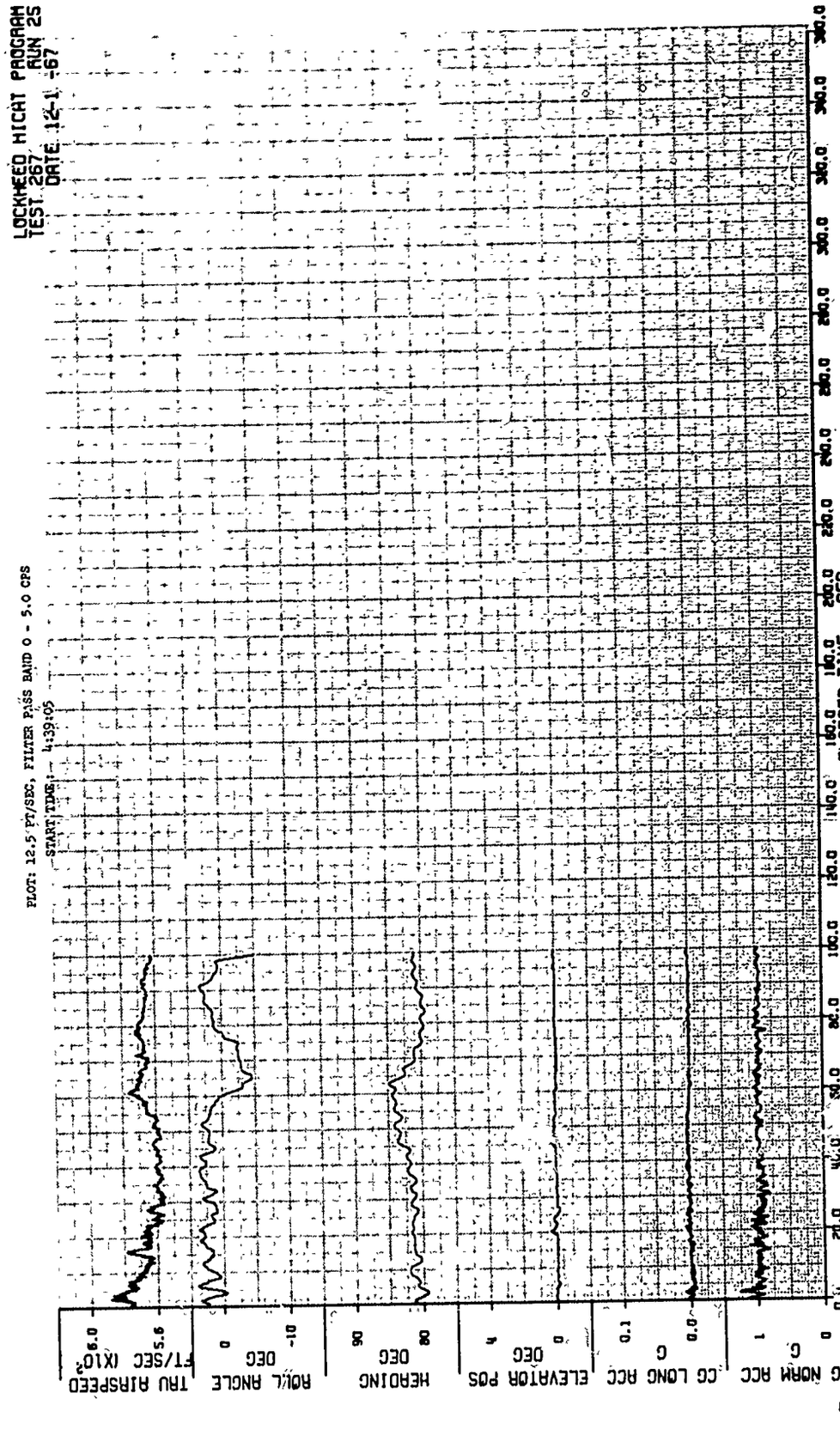


Figure 52B Flight Parameter Time Histories of Test 267, Run 25

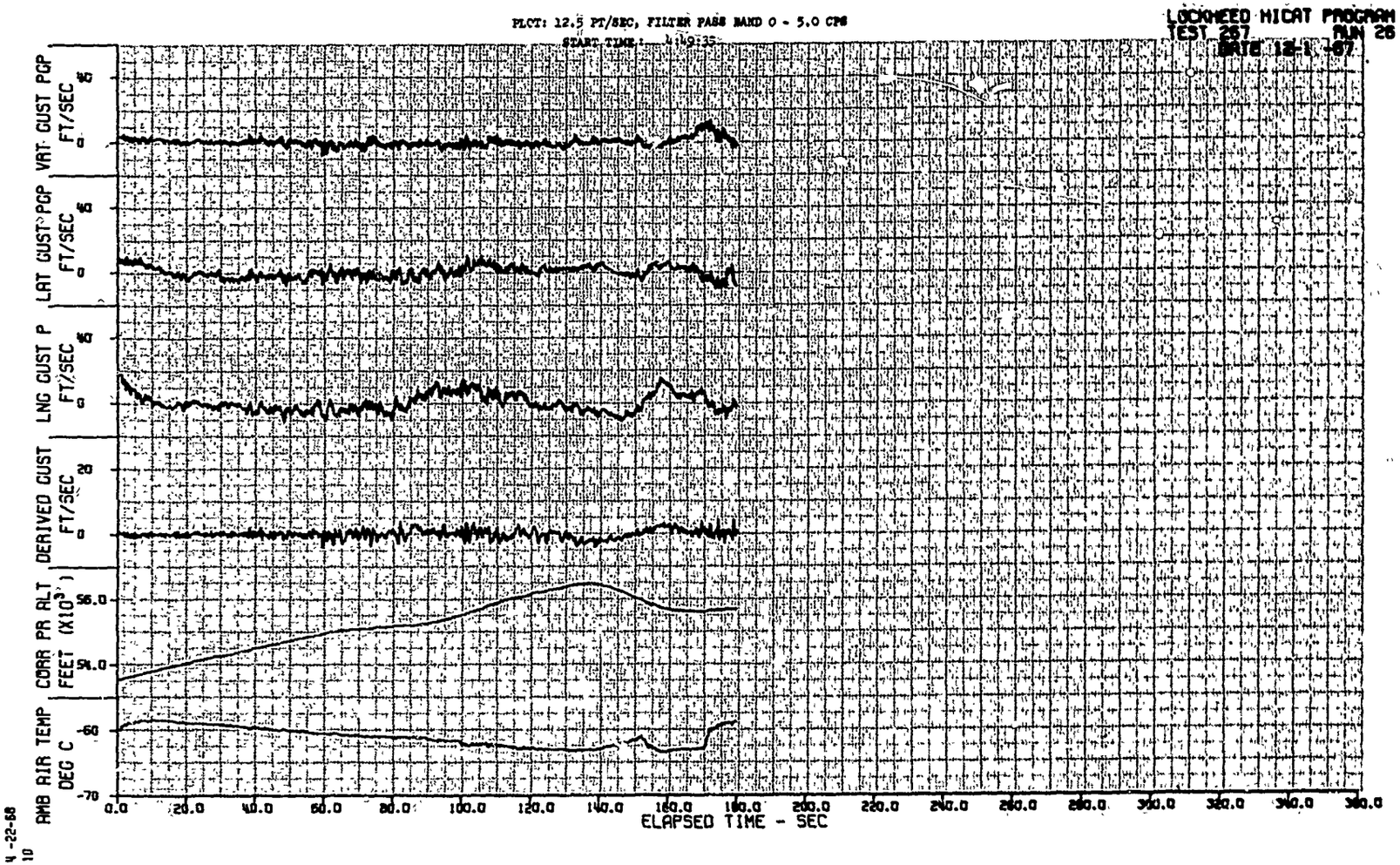


Figure 53A Gust Velocity Time Histories of Test 267, Run 26 - Edwards AFB, California, 2 Dec 67

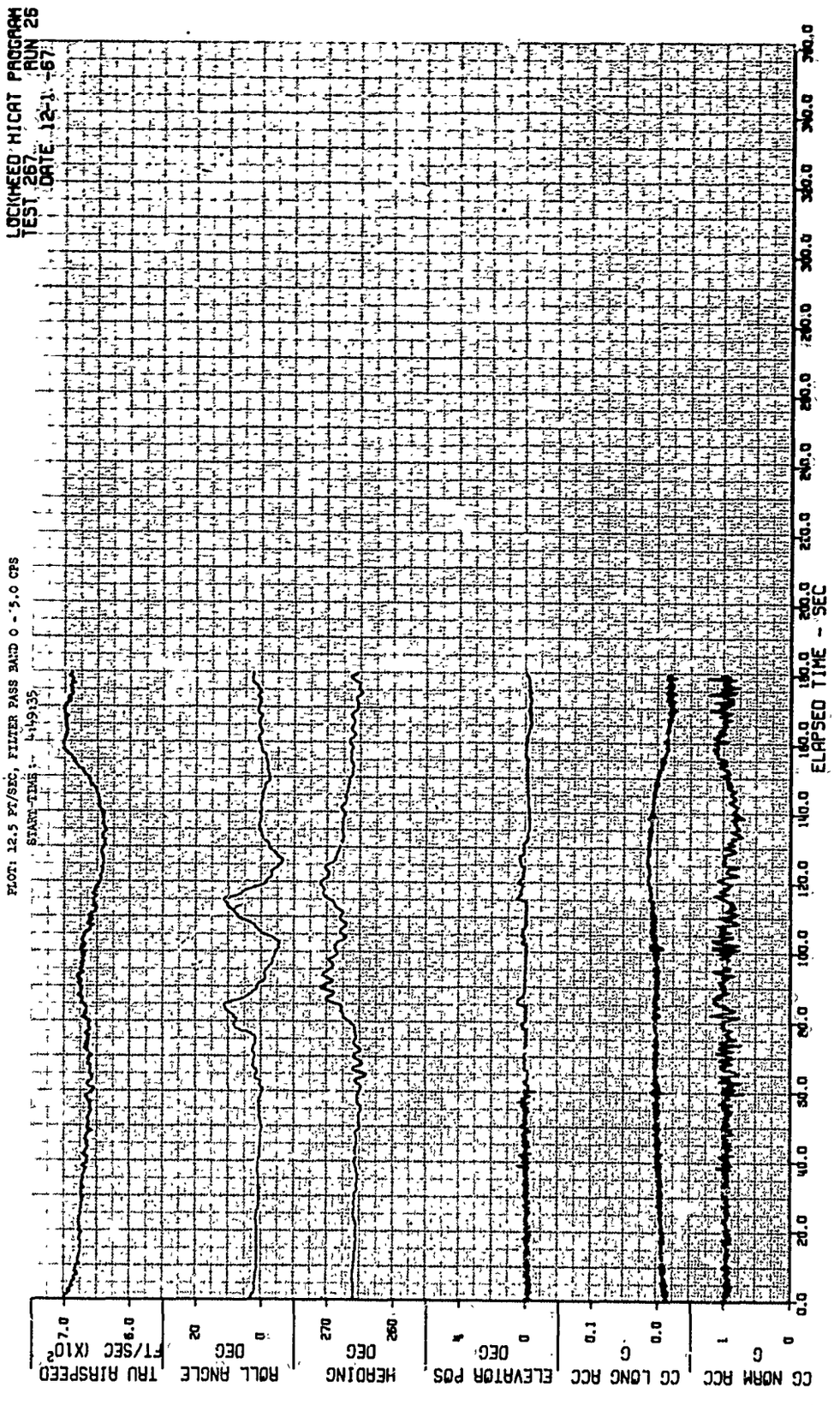


Figure 53B Flight Parameter Time Histories of Test 267, Run 26

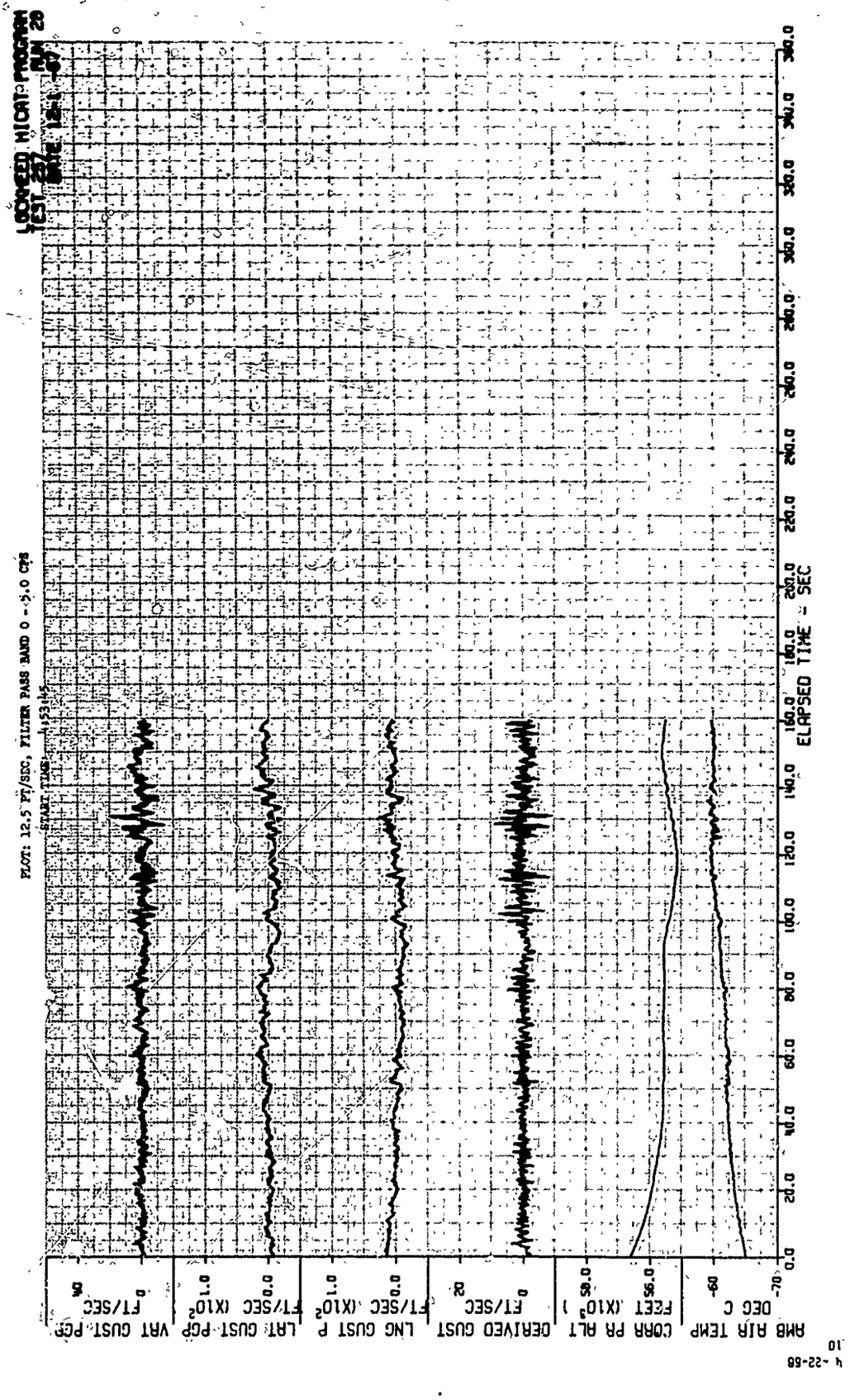


Figure 54A Gust Velocity Time Histories of Test 267, Run 28 - Edwards AFB, California, 2 Dec 67

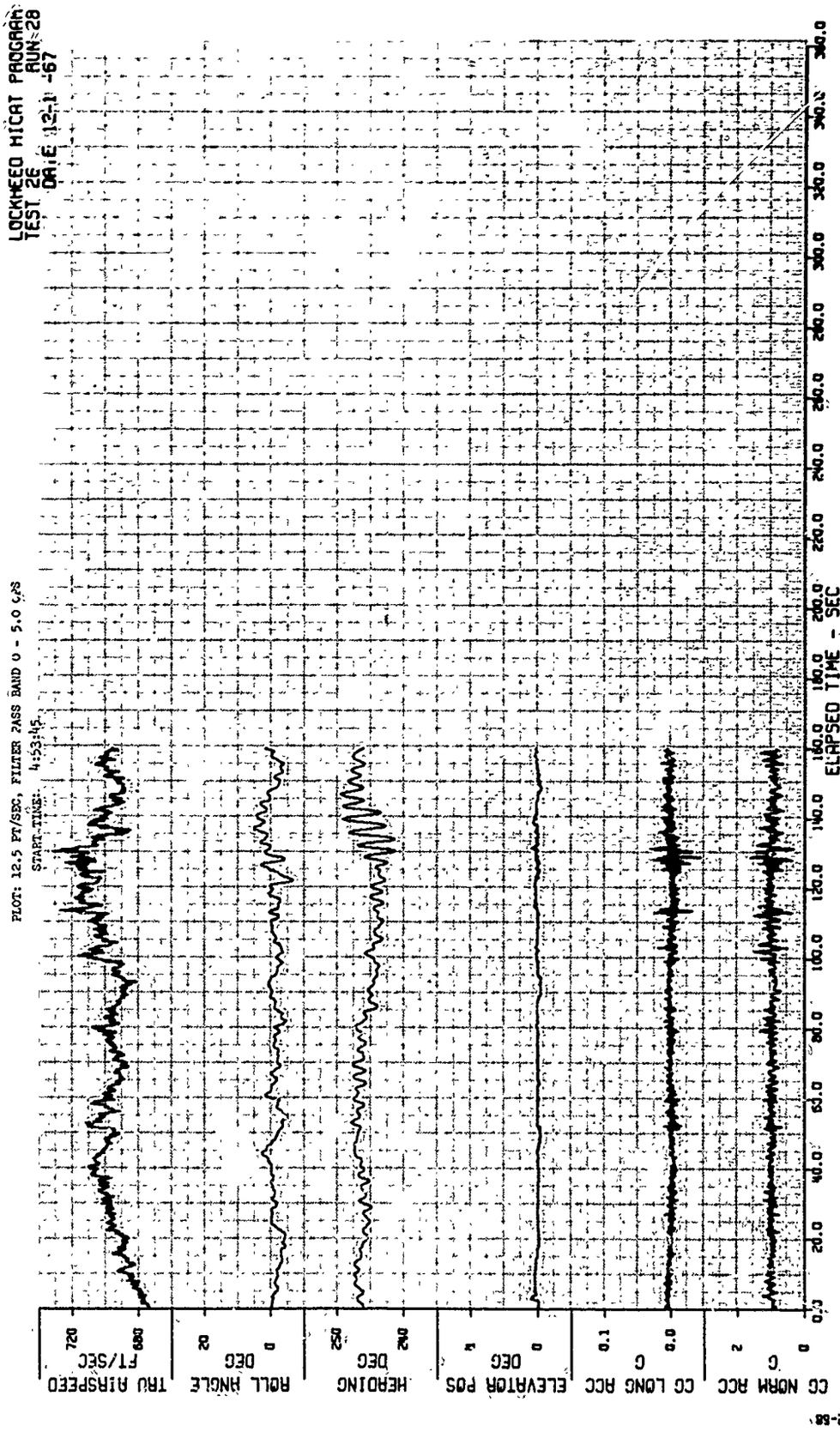


Figure 54B Flight Parameter Time Histories of Test 267, Run 28

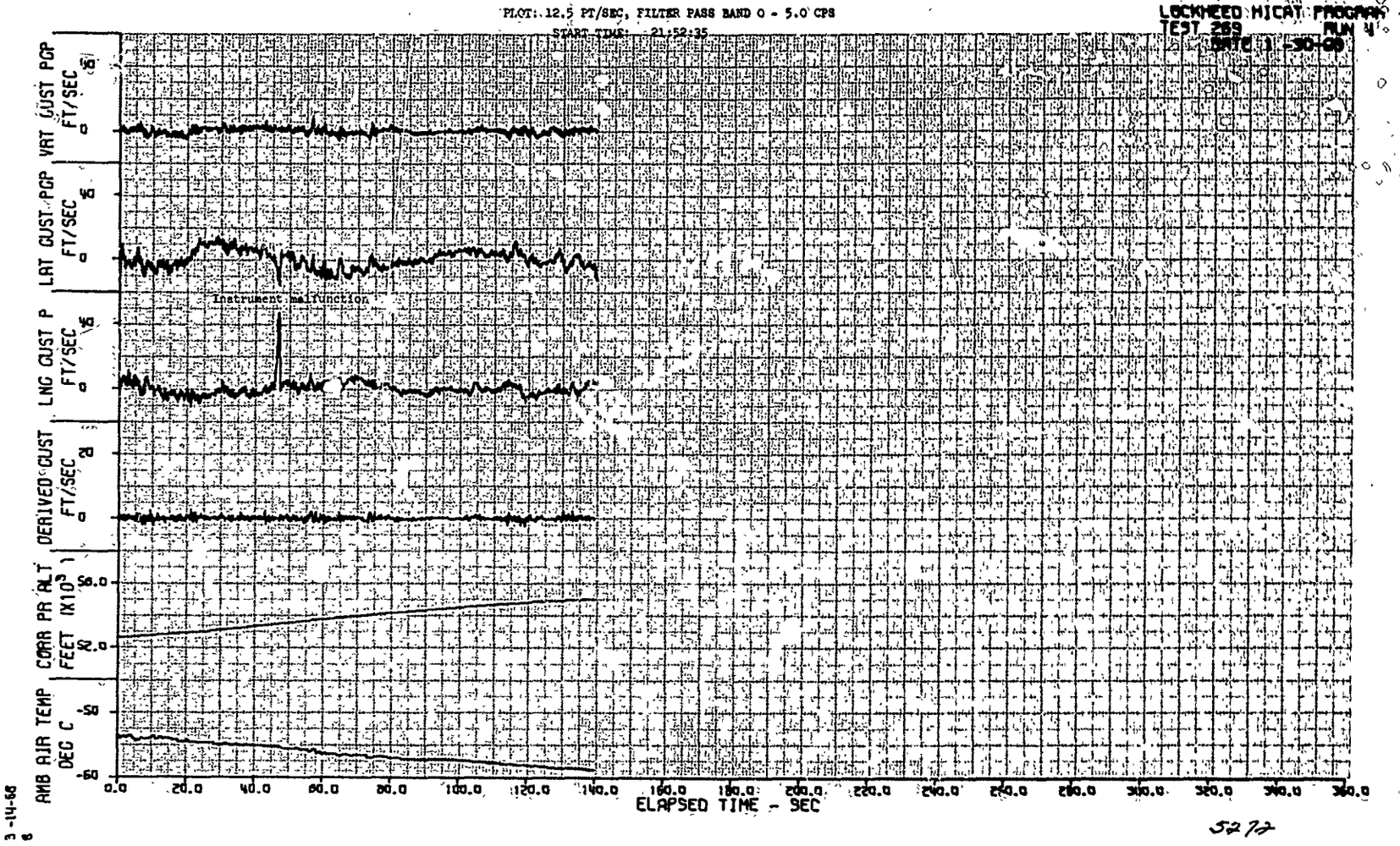


Figure 55A Gust Velocity Time Histories of Test 269, Run 4 - Edwards AFB, California, 1 Jan 68

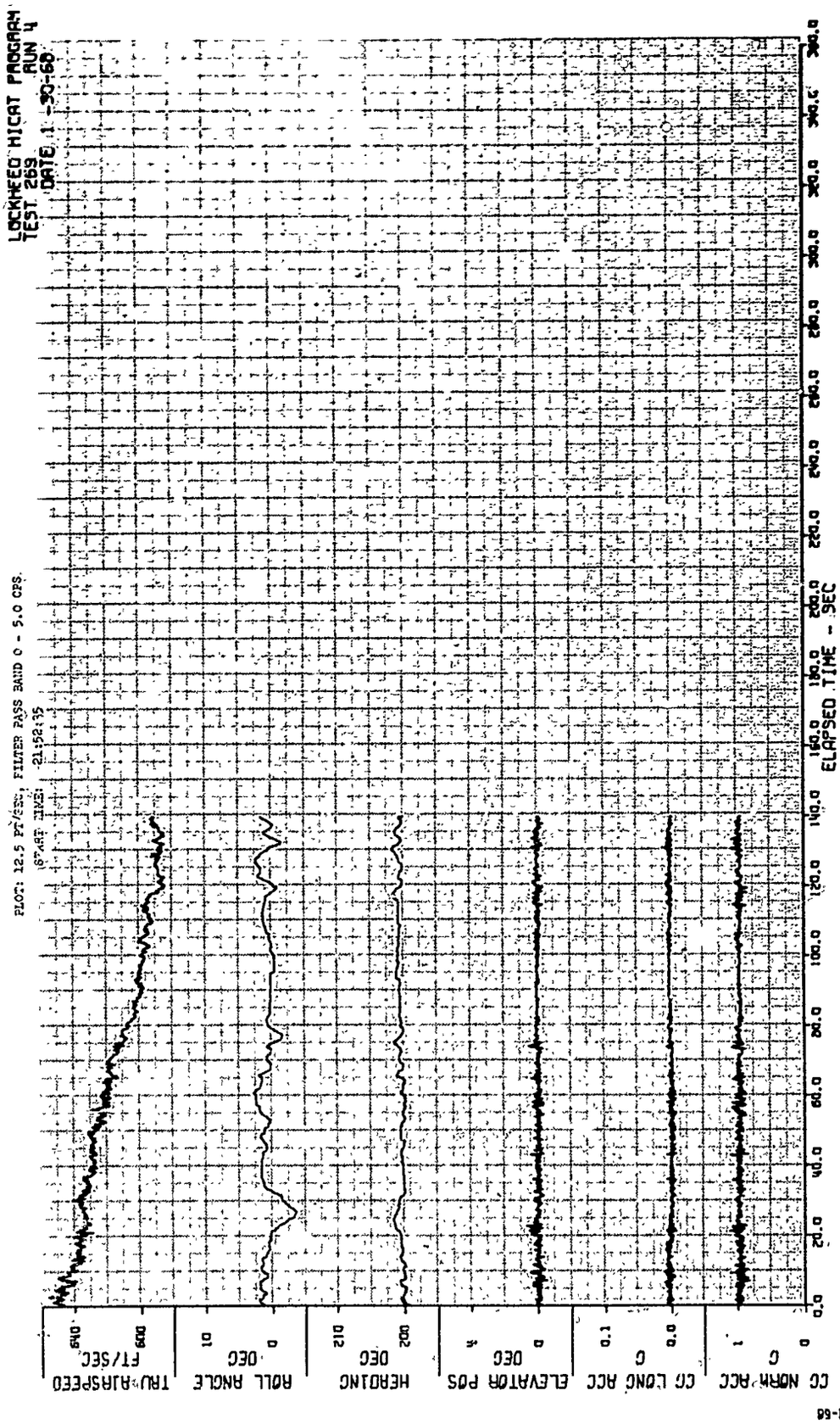


Figure 55B Flight Parameter Time Histories of Test 269, Run 4

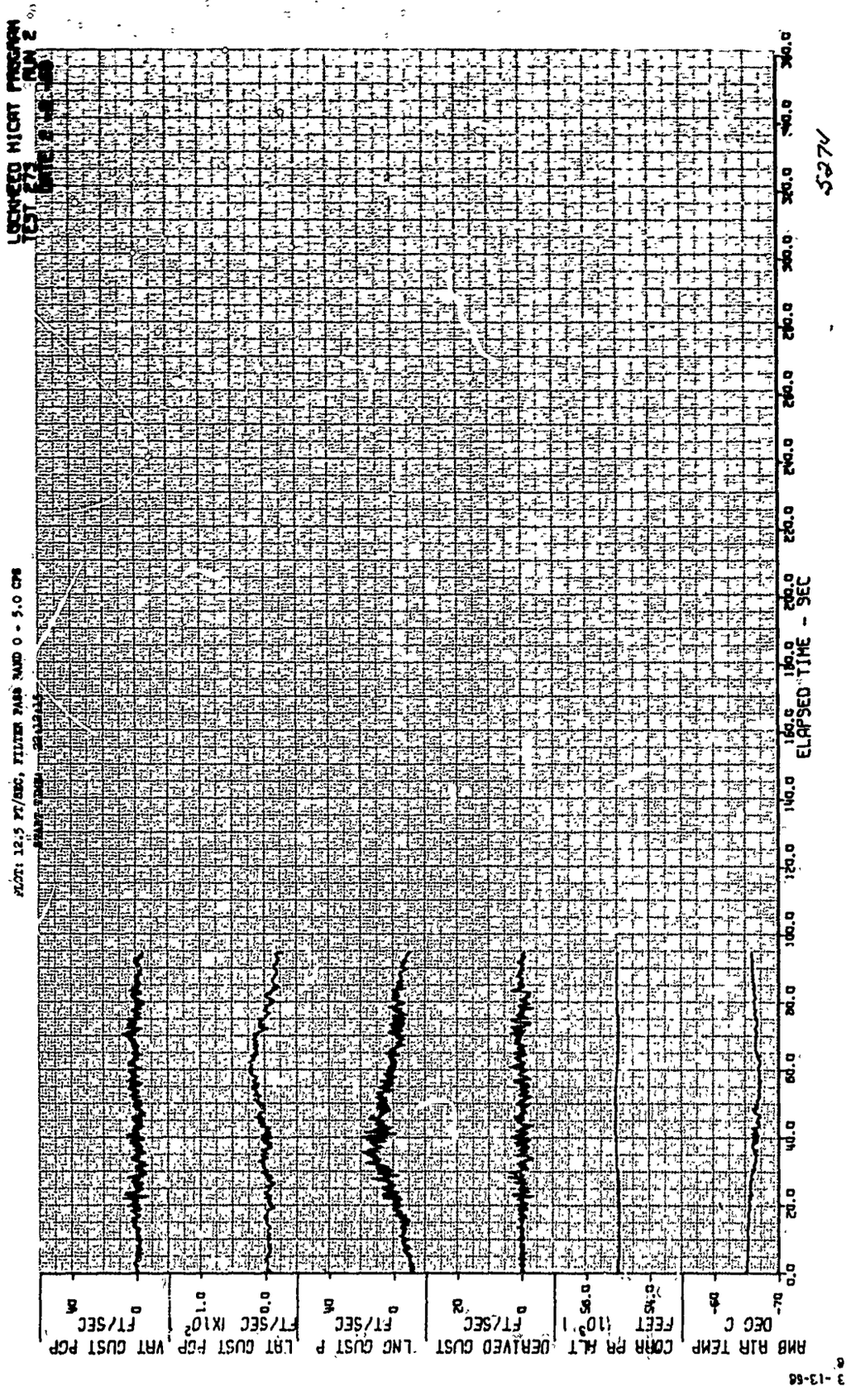


Figure 56A Gust Velocity Time Histories of Test 273, Run 2 - Edwards AFB, California, 2 Feb 68

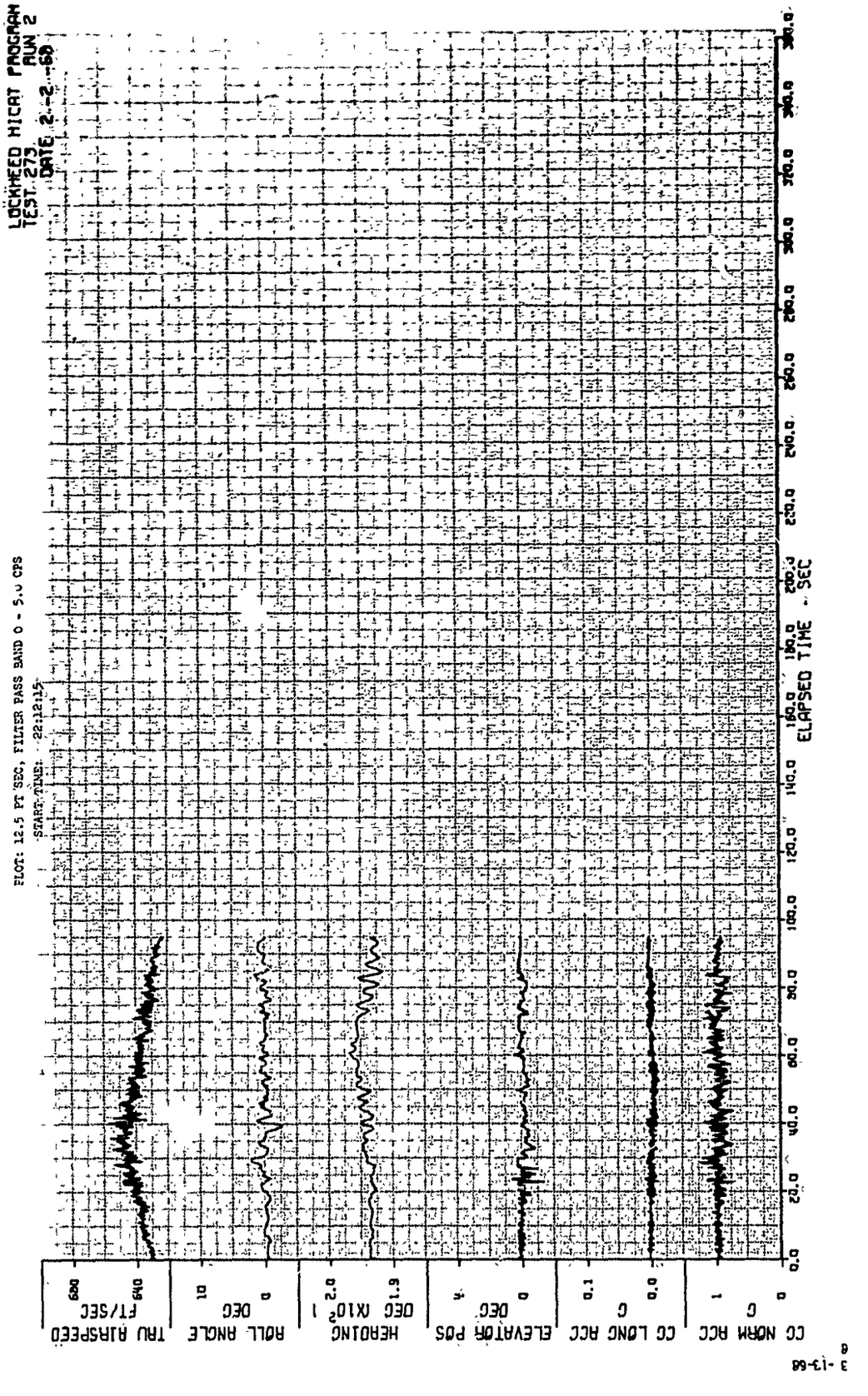


Figure 56B Flight Parameter Time Histories of Test 273, Run 2

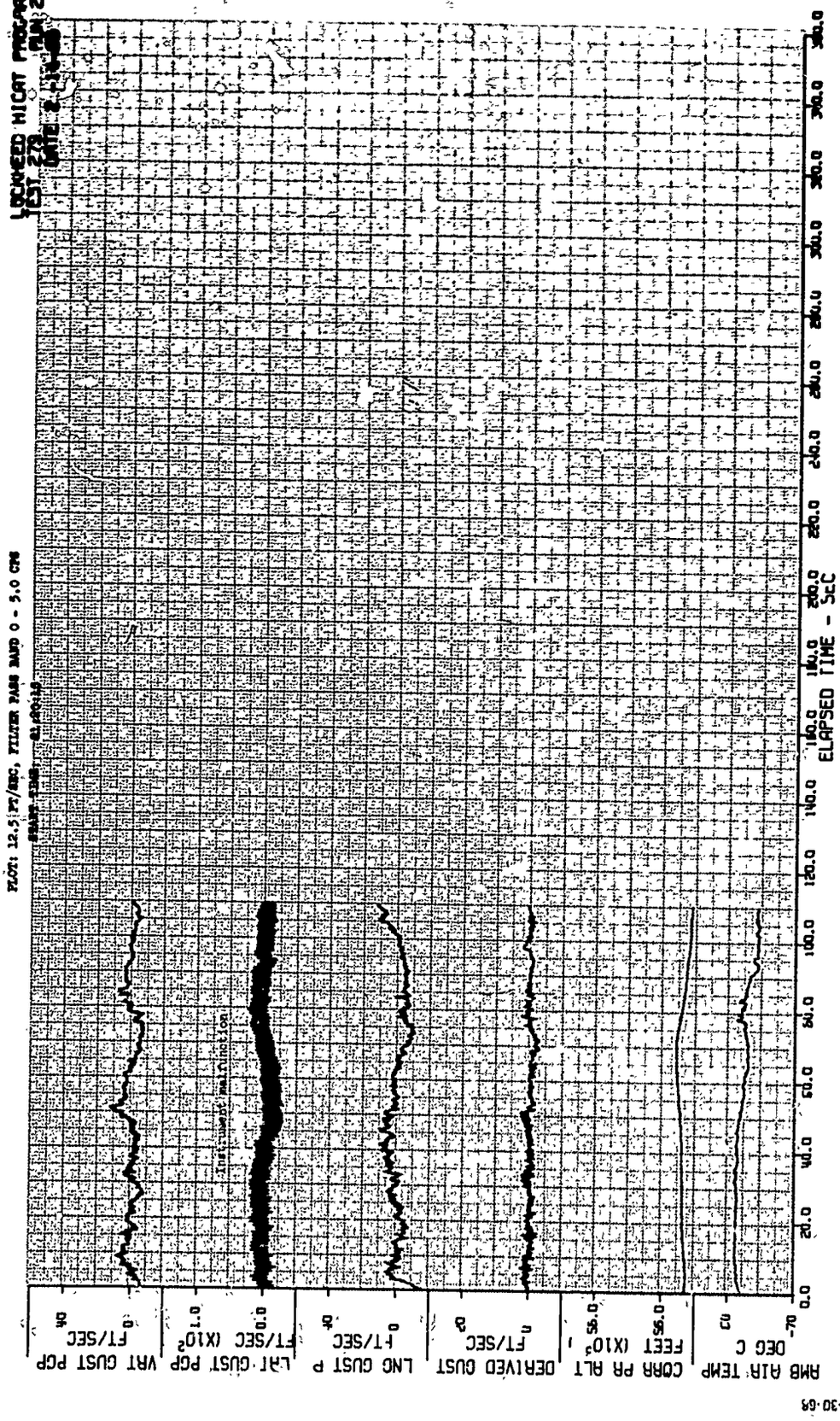


Figure 57A Gust Velocity Time Histories of Test 279, Run 2 - Edwards AFB, California, 14 Feb 68

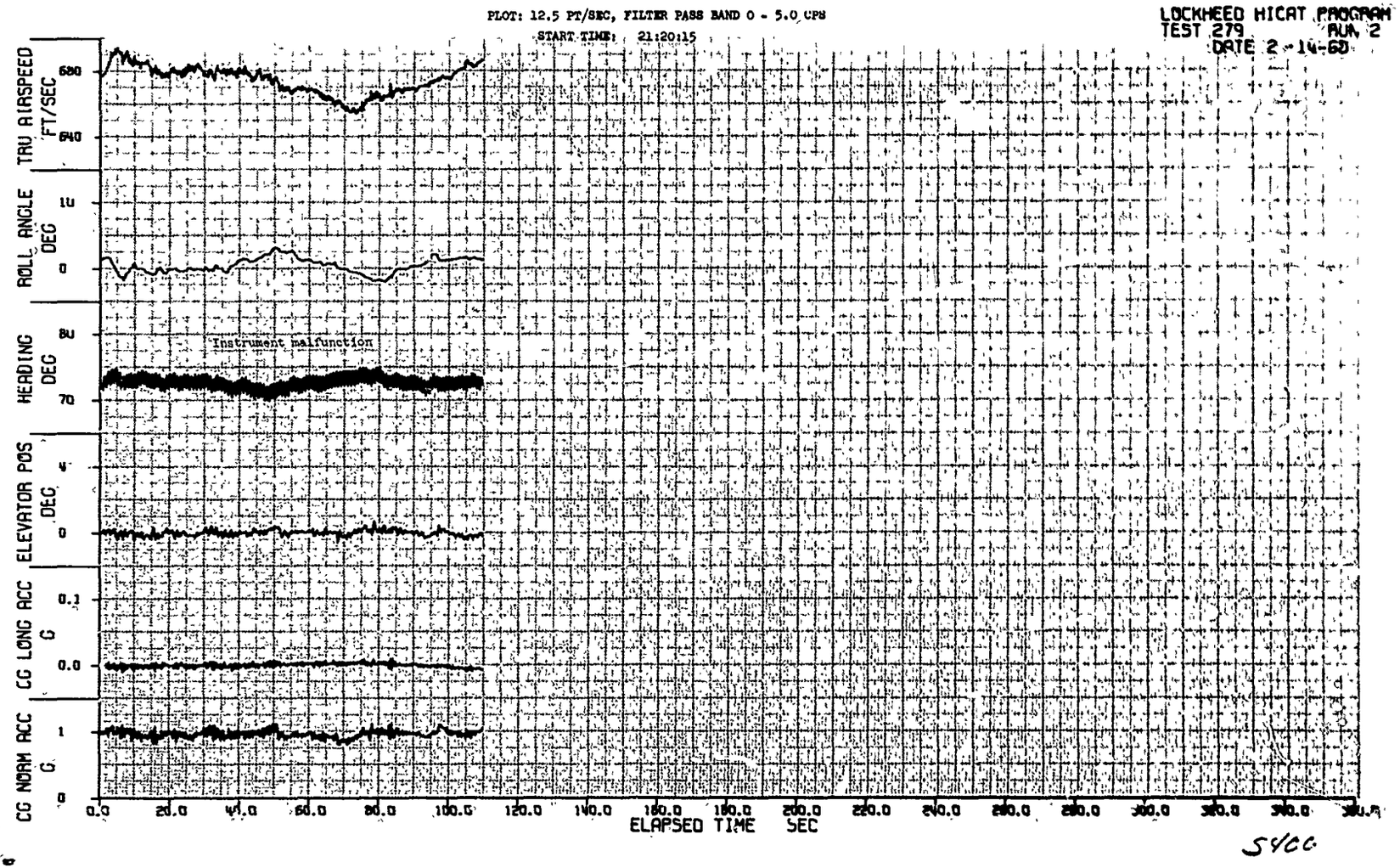


Figure 57B Flight Parameter Time Histories of Test 279, Run 2

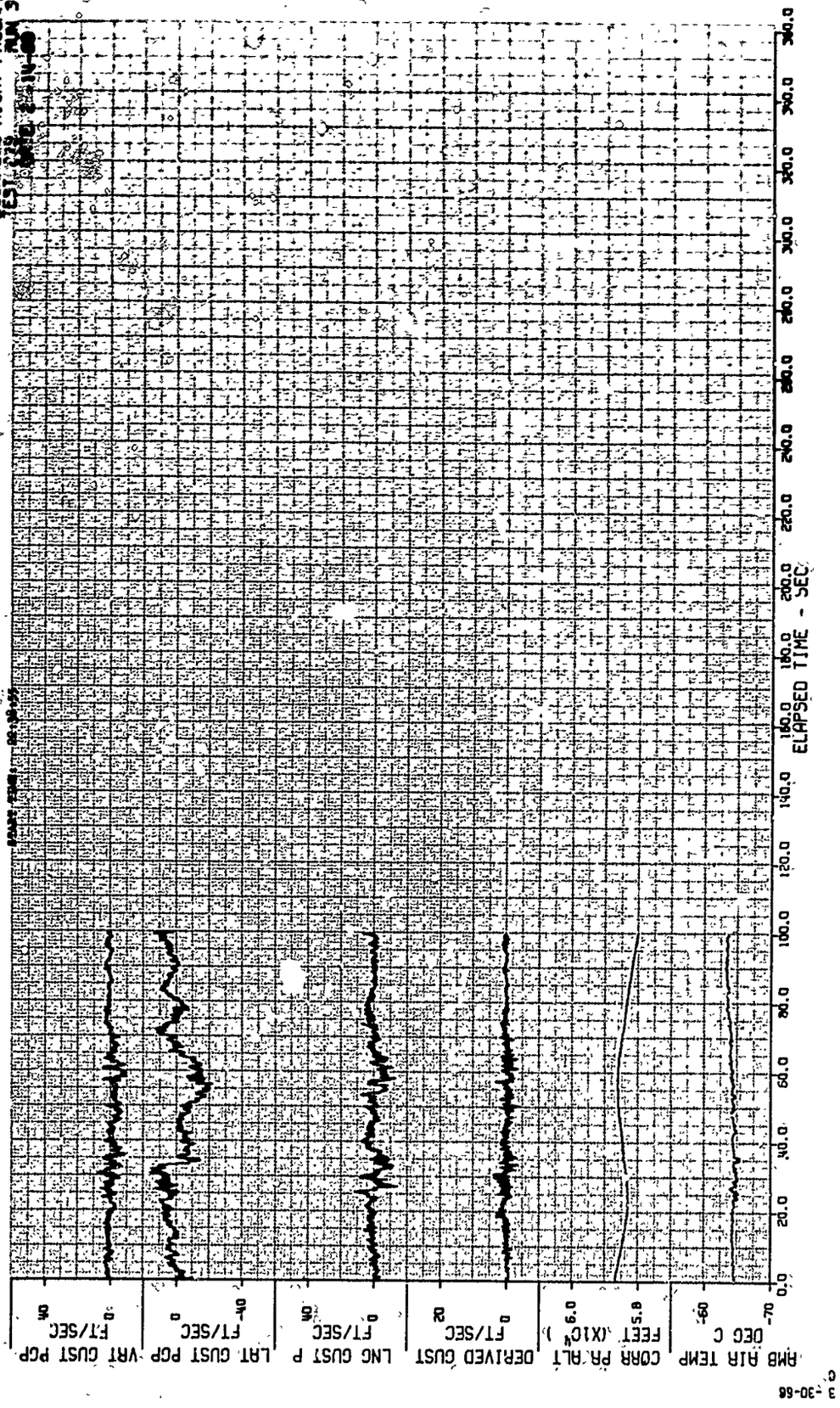


Figure 58A Gust Velocity Time Histories of Test 279, Run 3 - Edwards AFB, California, 14 Feb 68

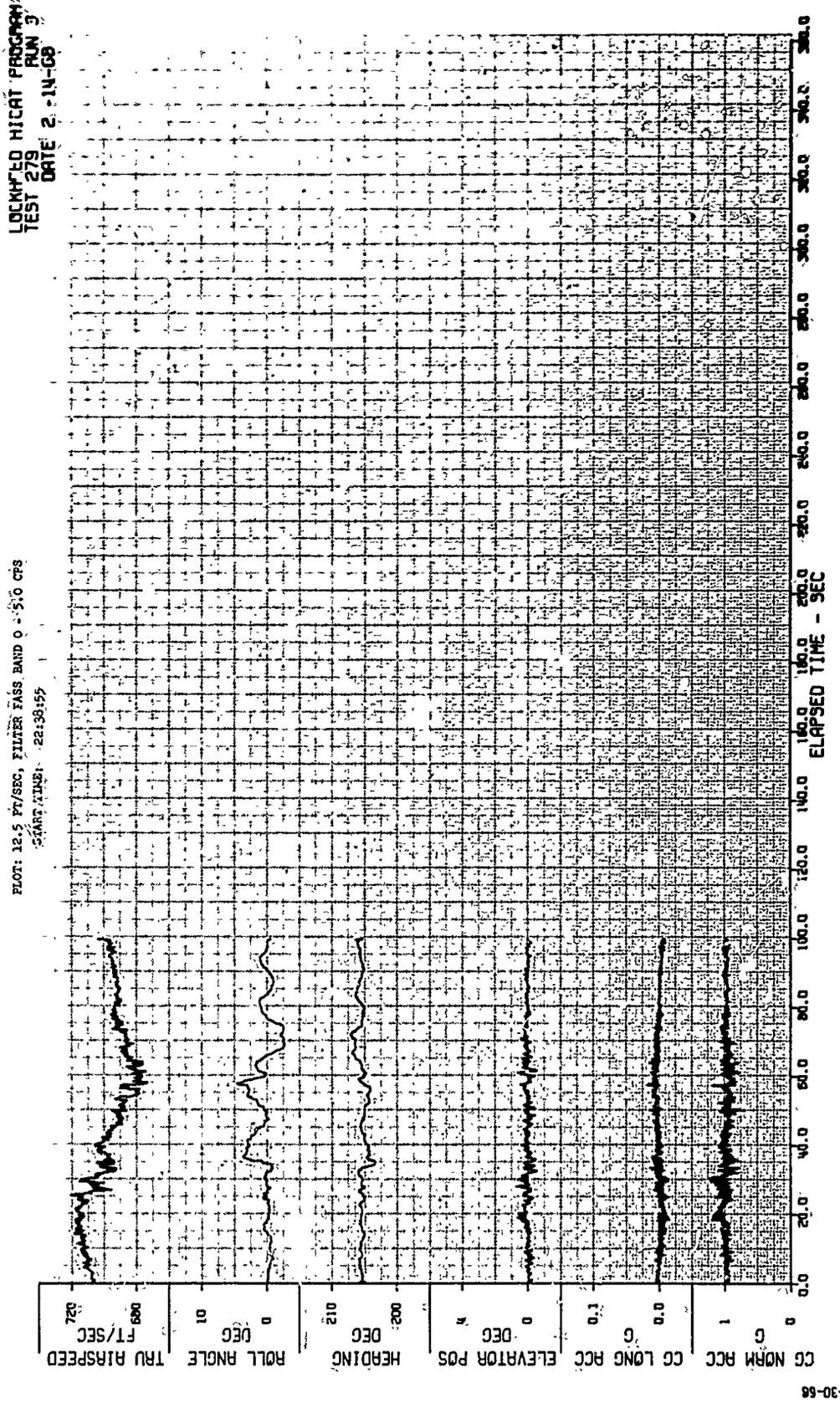


Figure 58B Flight Parameter Time Histories of Test 279, Run 3

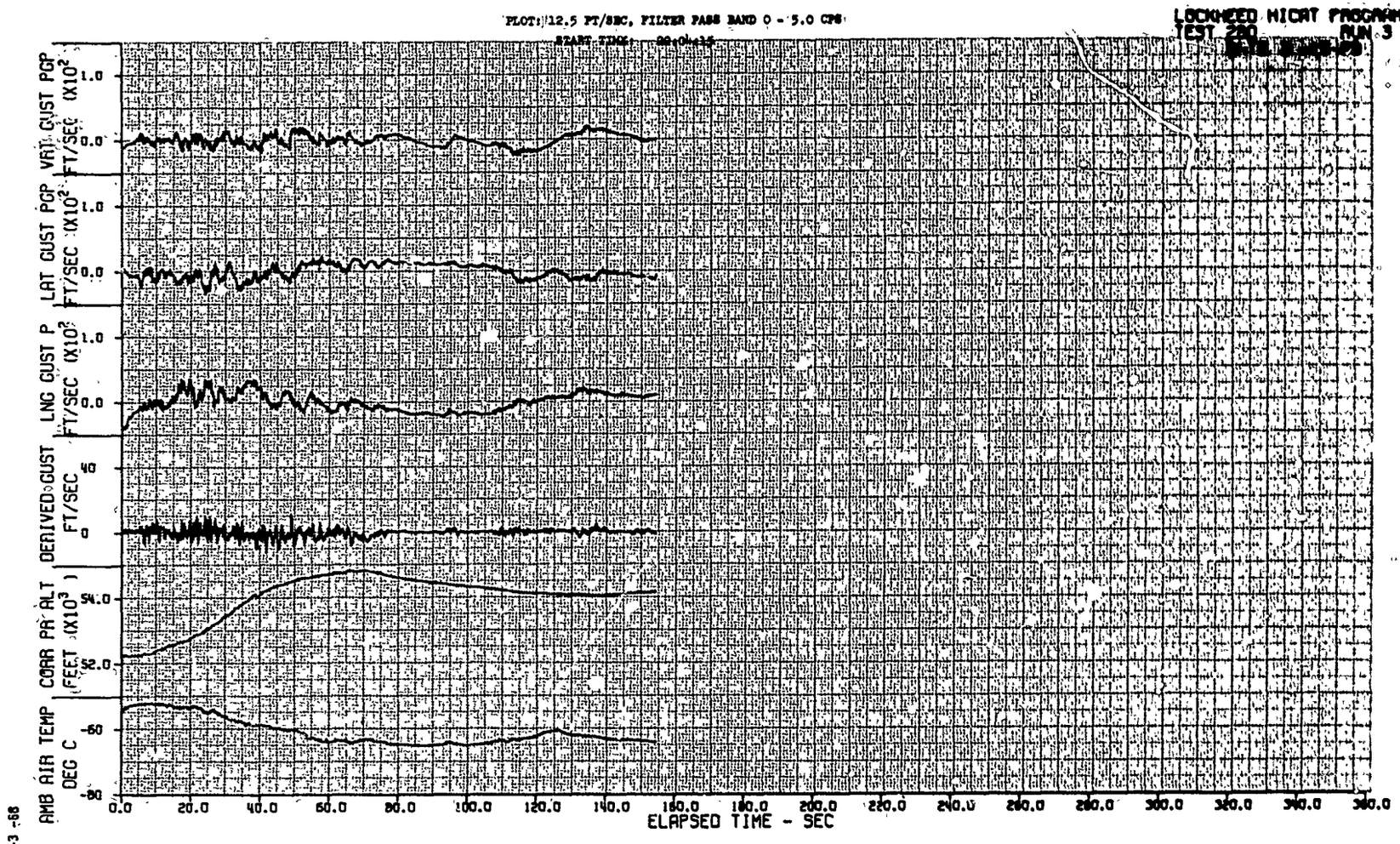


Figure 59A Gust Velocity Time Histories of Test 280, Run 3 - Edwards AFB, California, 15 Feb 68

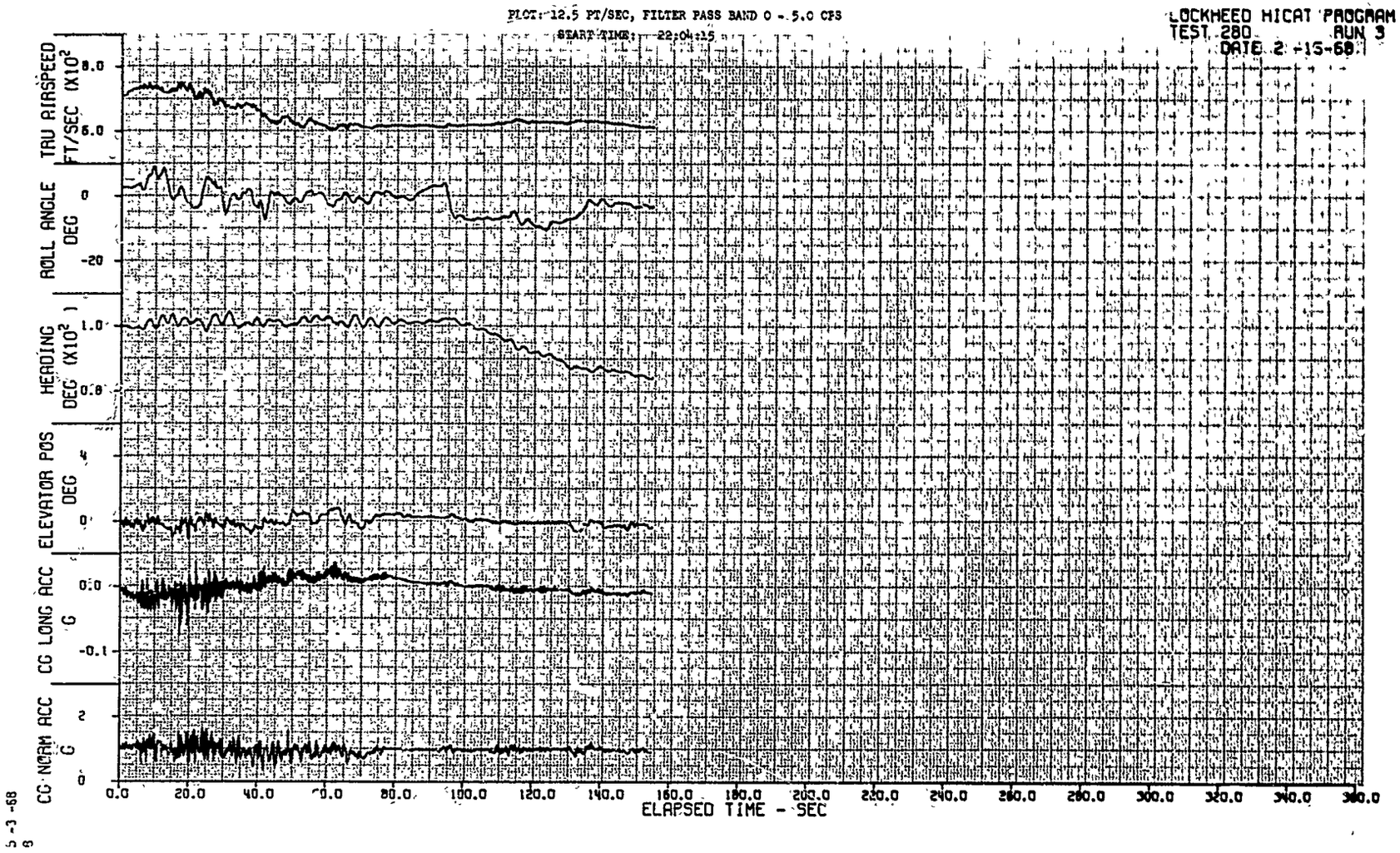


Figure 59B Flight Parameter Time Histories of Test 280, Run 3

APPENDIX IV

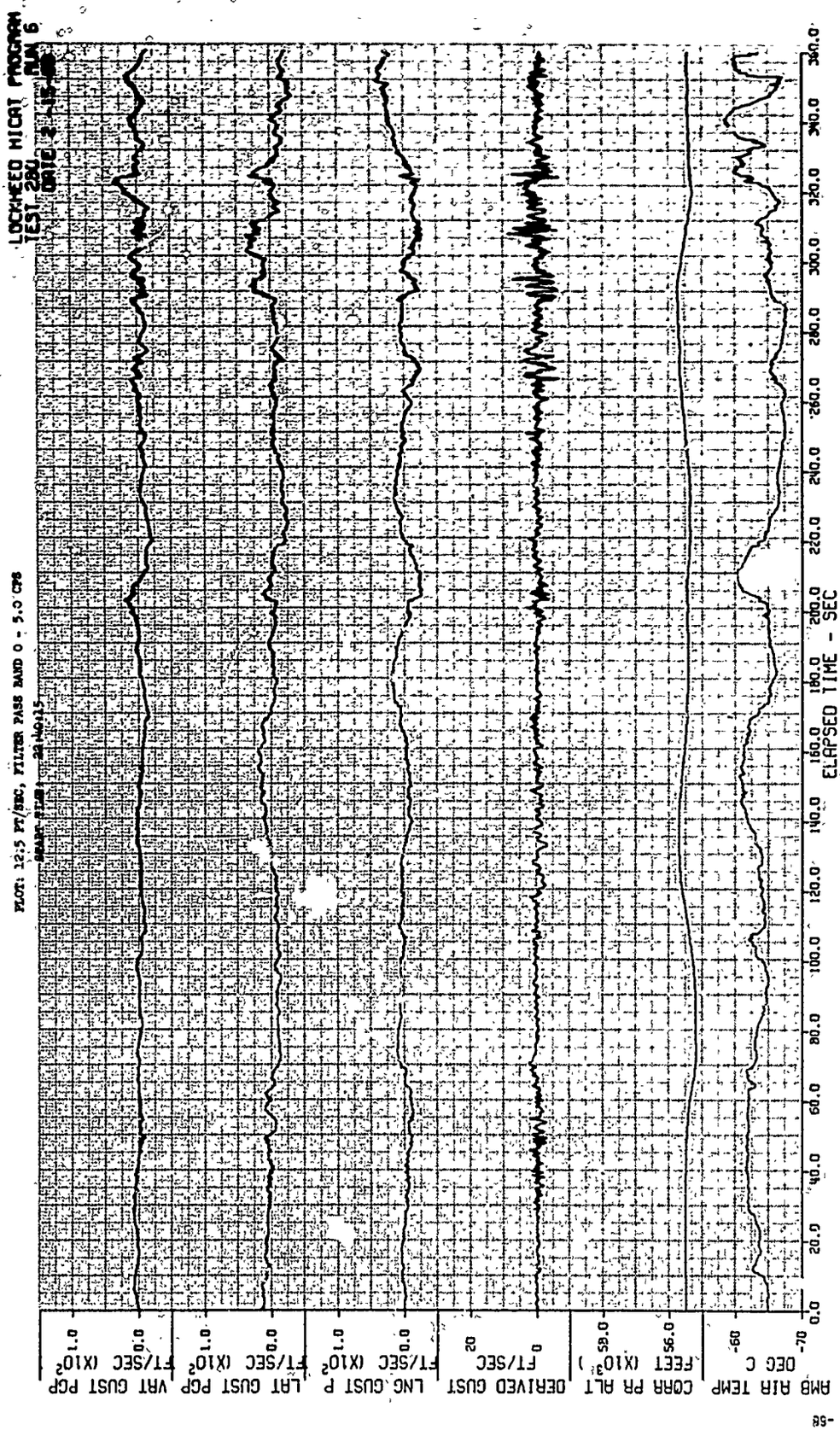


Figure 60A Gust Velocity Time Histories of Test 280, Run 6 - Edwards AFB, California; 15 Feb 68 (Sheet 1 of 2)

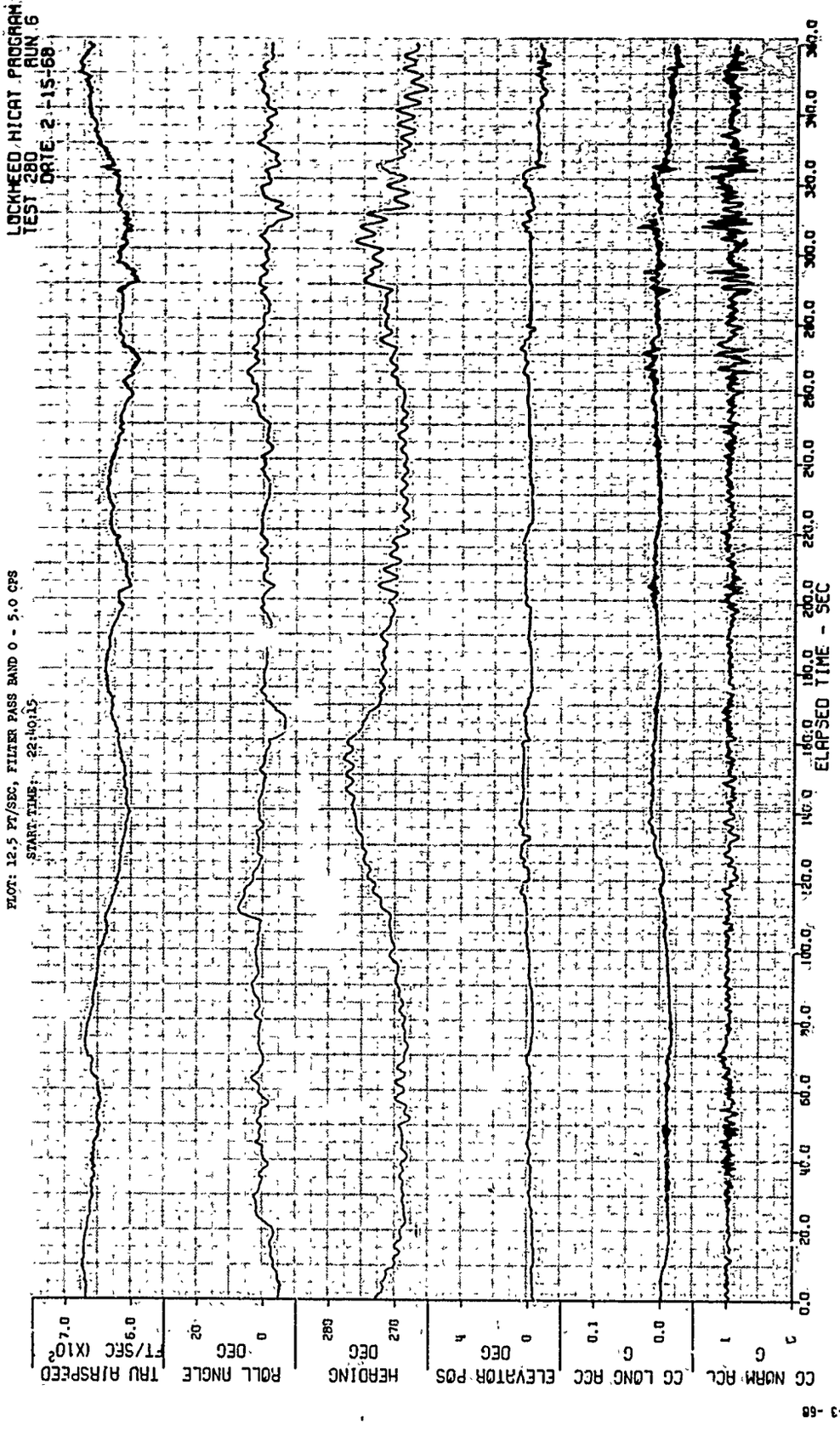


Figure 60B Flight Parameter Time Histories of Test 280, Run 6 (Sheet 1 of 2)

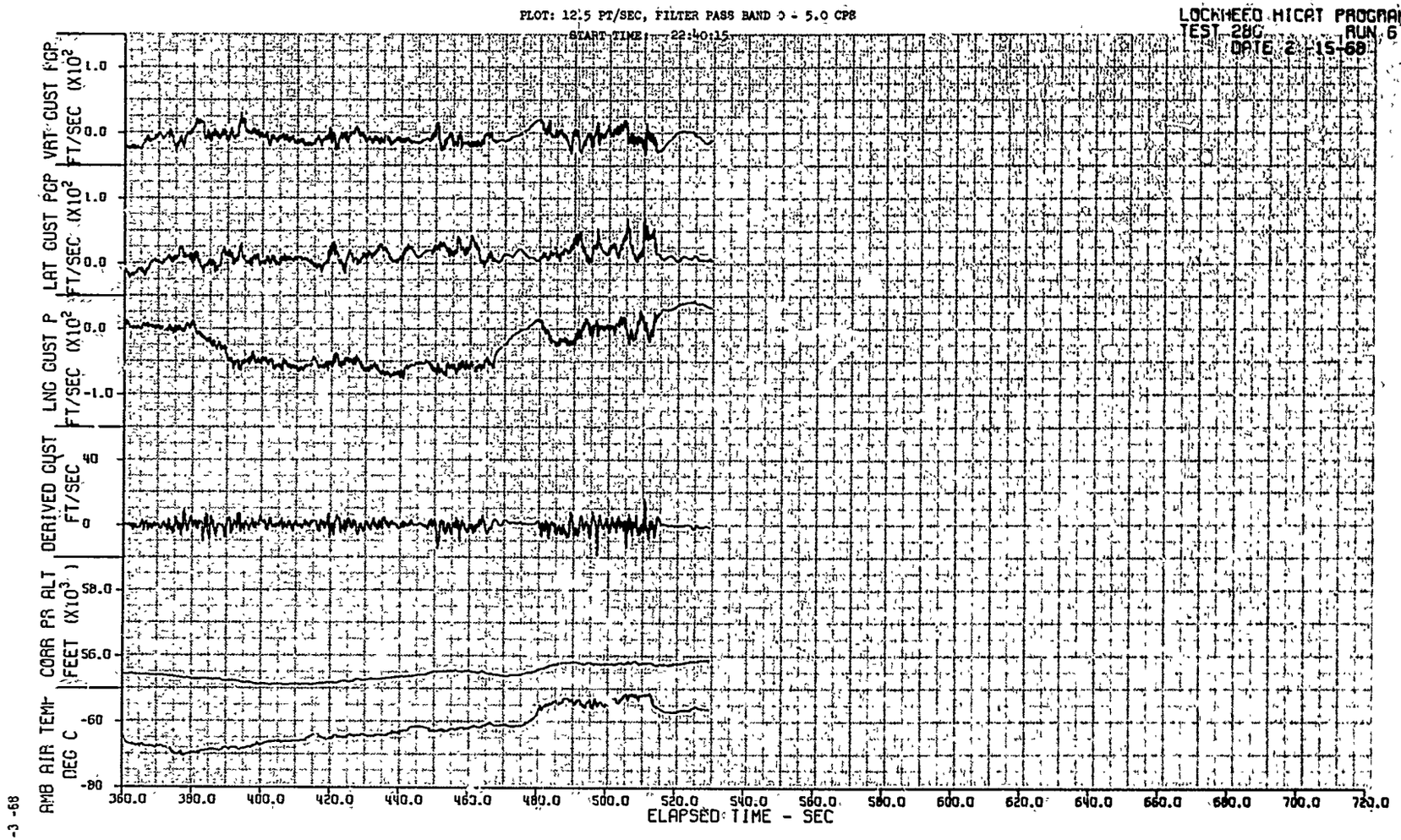


Figure 60A Gust Velocity Time Histories of Test 280, Run 6 - Edwards AFB, California, 15 Feb 68 (Sheet 2 of 2)

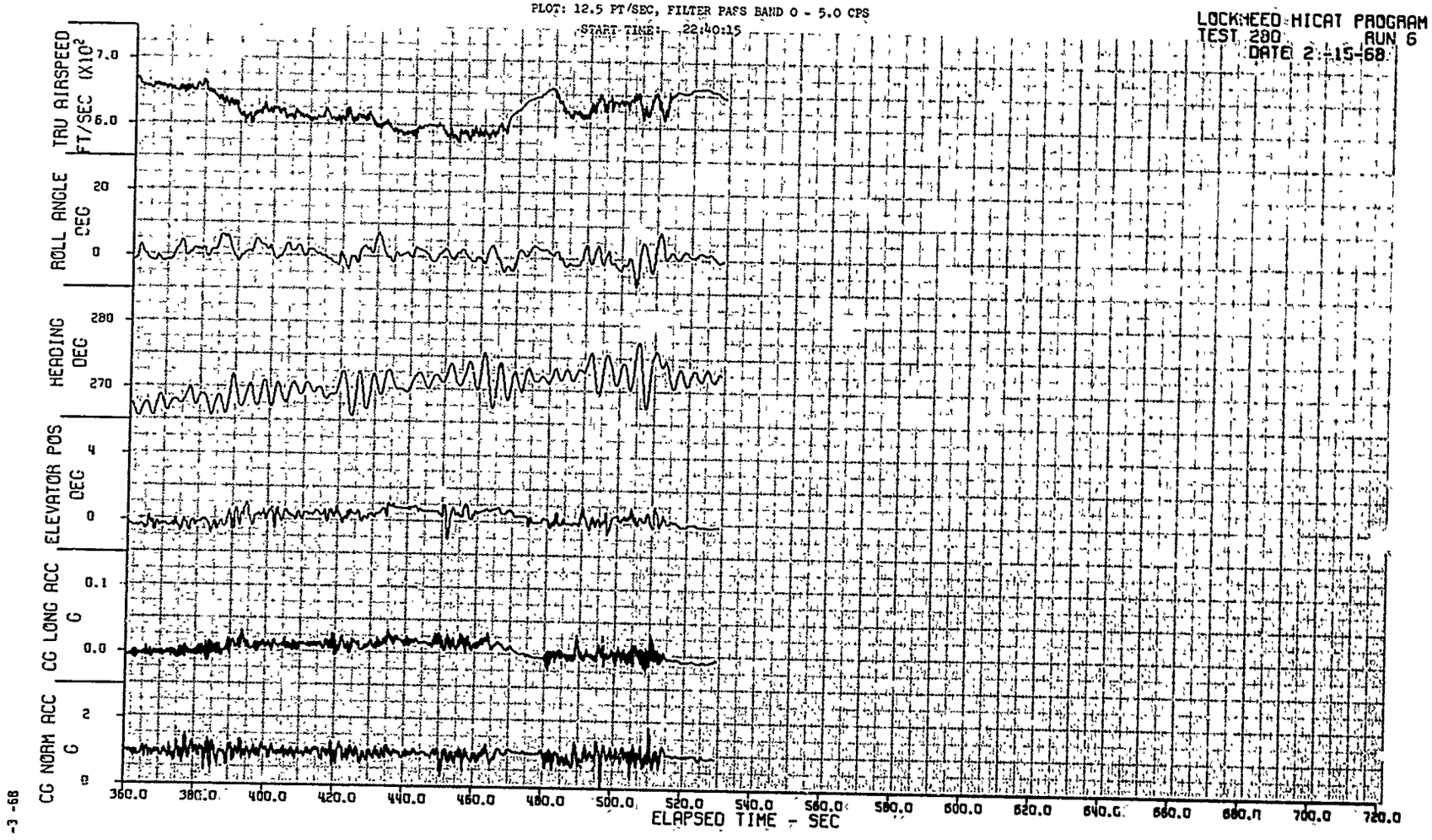


Figure 60B Flight Parameter Time Histories of Test 280, Run 6 (Sheet 2 of 2)

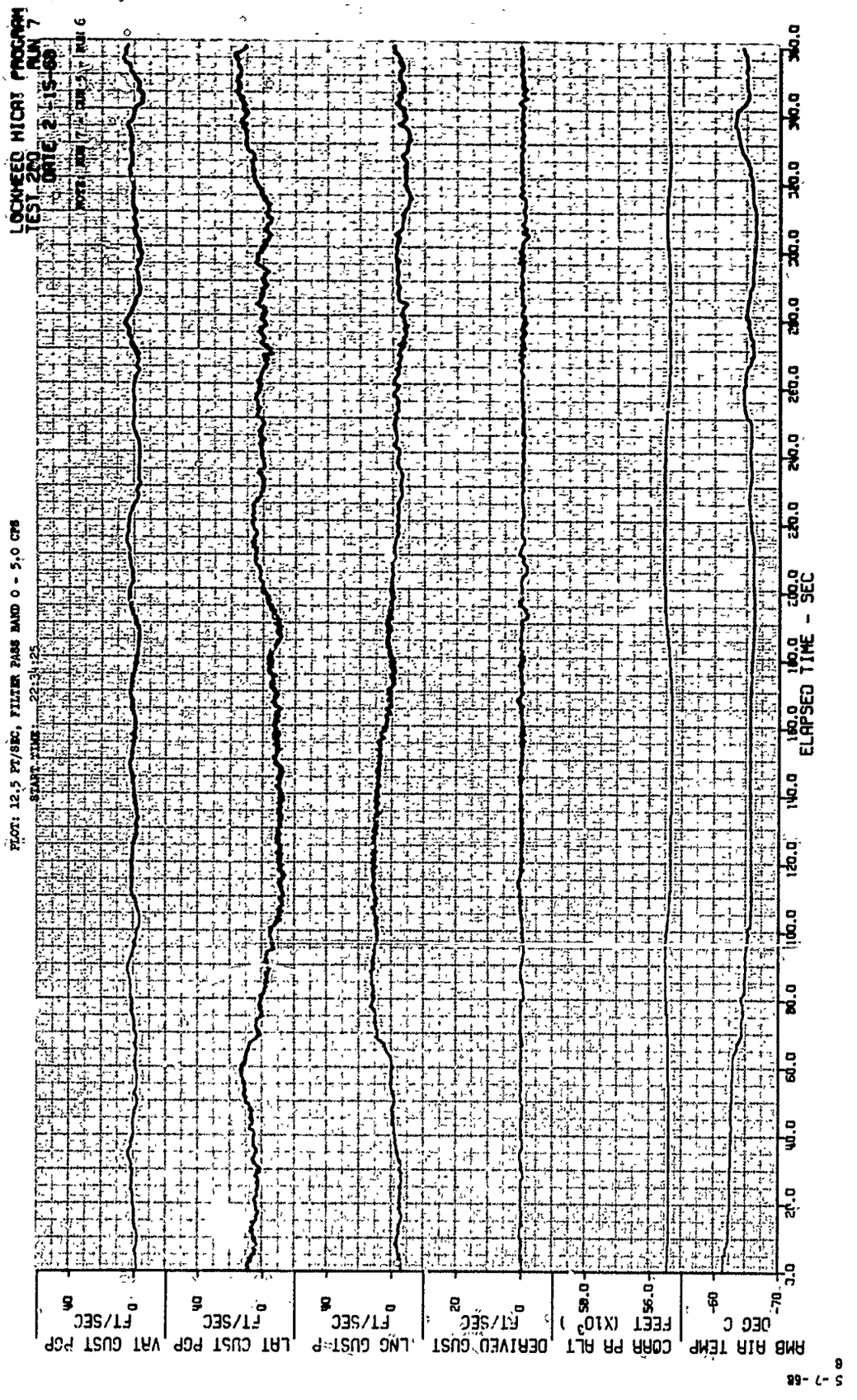


Figure 61A Gust Velocity Time Histories of Test 280, Run 7 - Edwards AFB, California, 15 Feb 68 (Sheet 1 of 3)

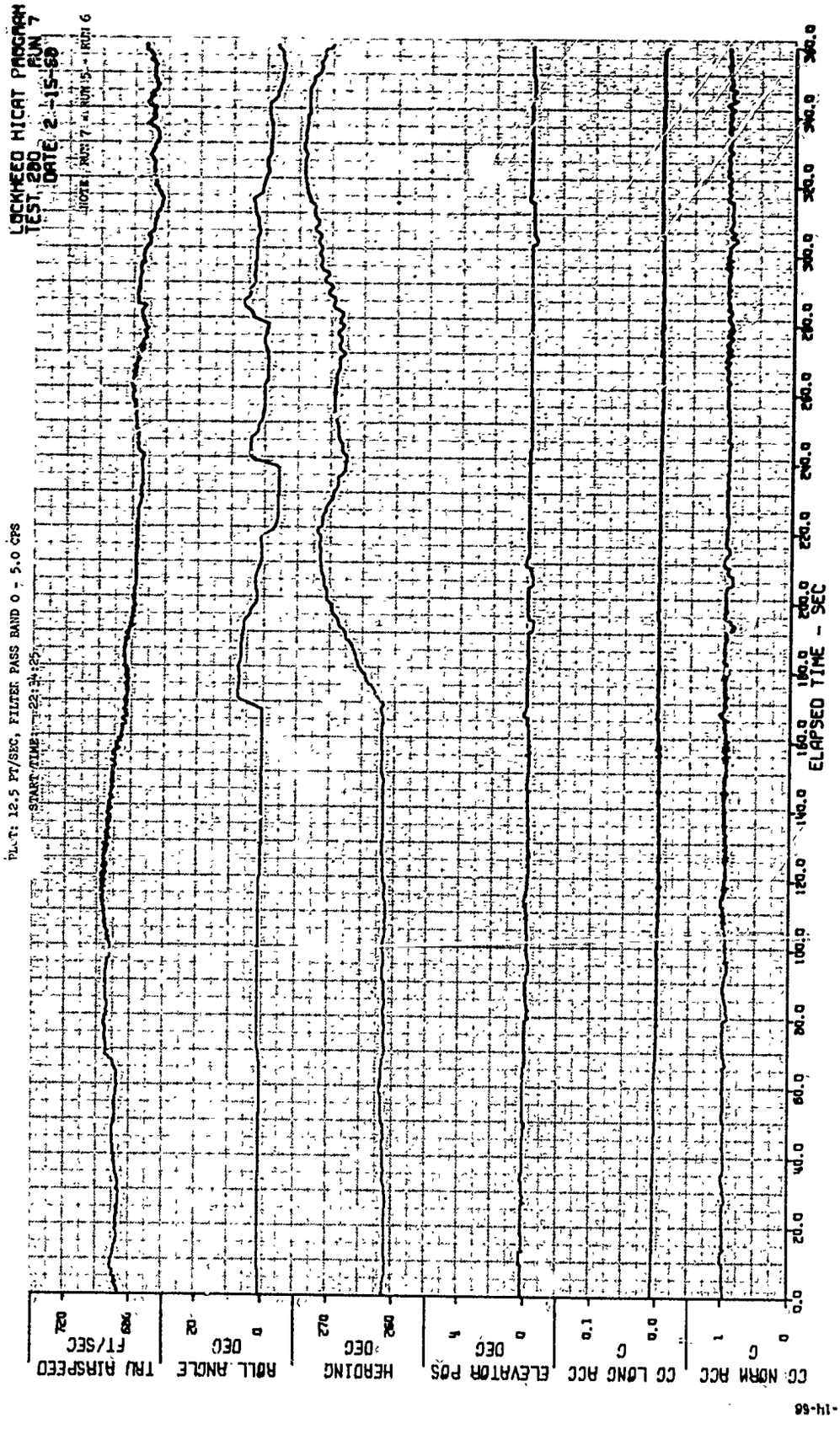


Figure 61B Flight Parameter Time Histories of Test 280, Run 7 (Sheet 1 of 3)

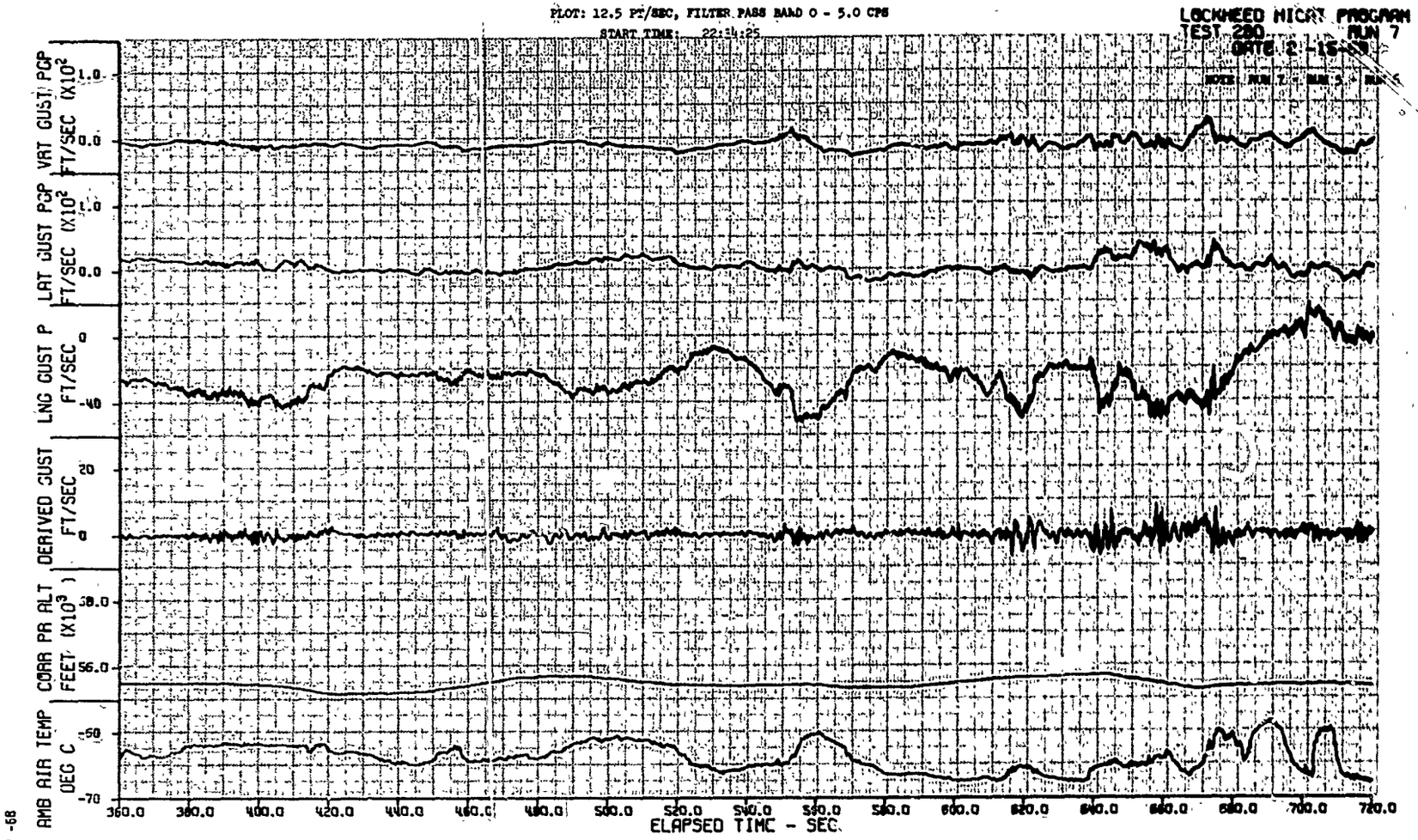


Figure 61A Gust Velocity Time Histories of Test 280, Run 7 - Edwards AFB, California, 15 Feb 68 (Sheet 2 of 3)

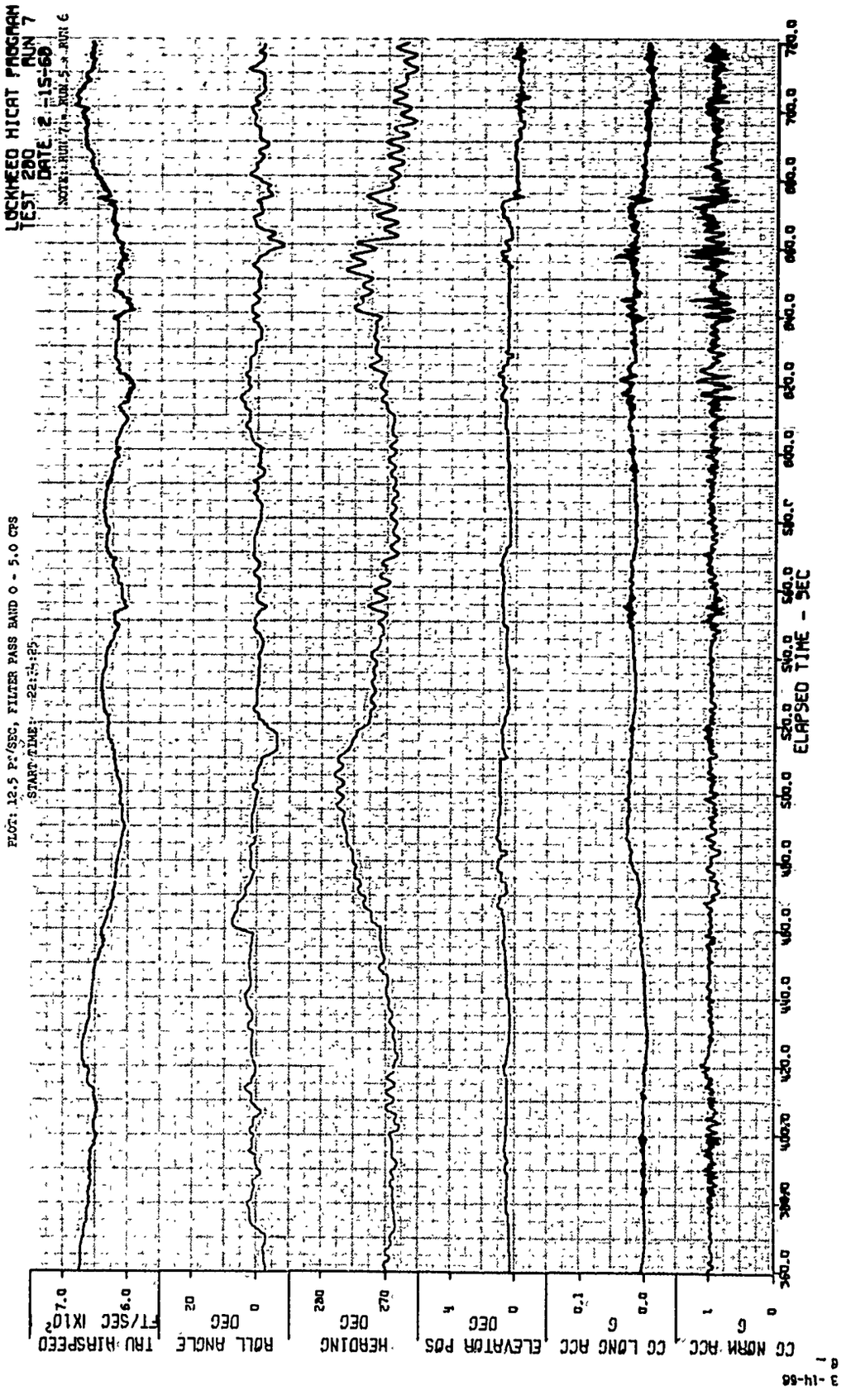


Figure 61B Flight Parameter Time Histories of Test 280, Run 7 (Sheet 2 of 3)

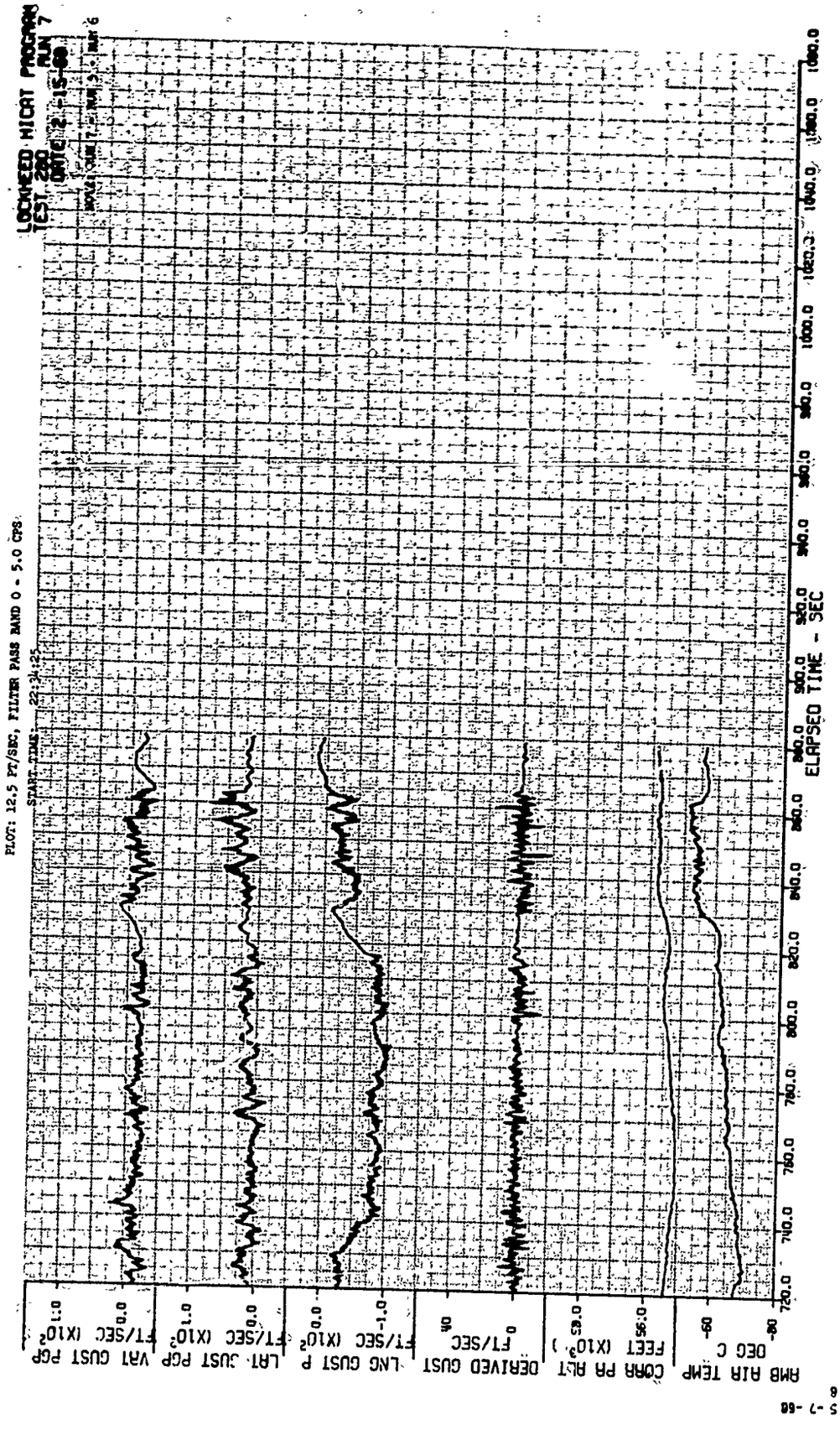


Figure 61A. Gust Velocity Time Histories of Test 280, Run 7 - Edwards AFB, California, 15 Feb 68 (Sheet 3 of 3)

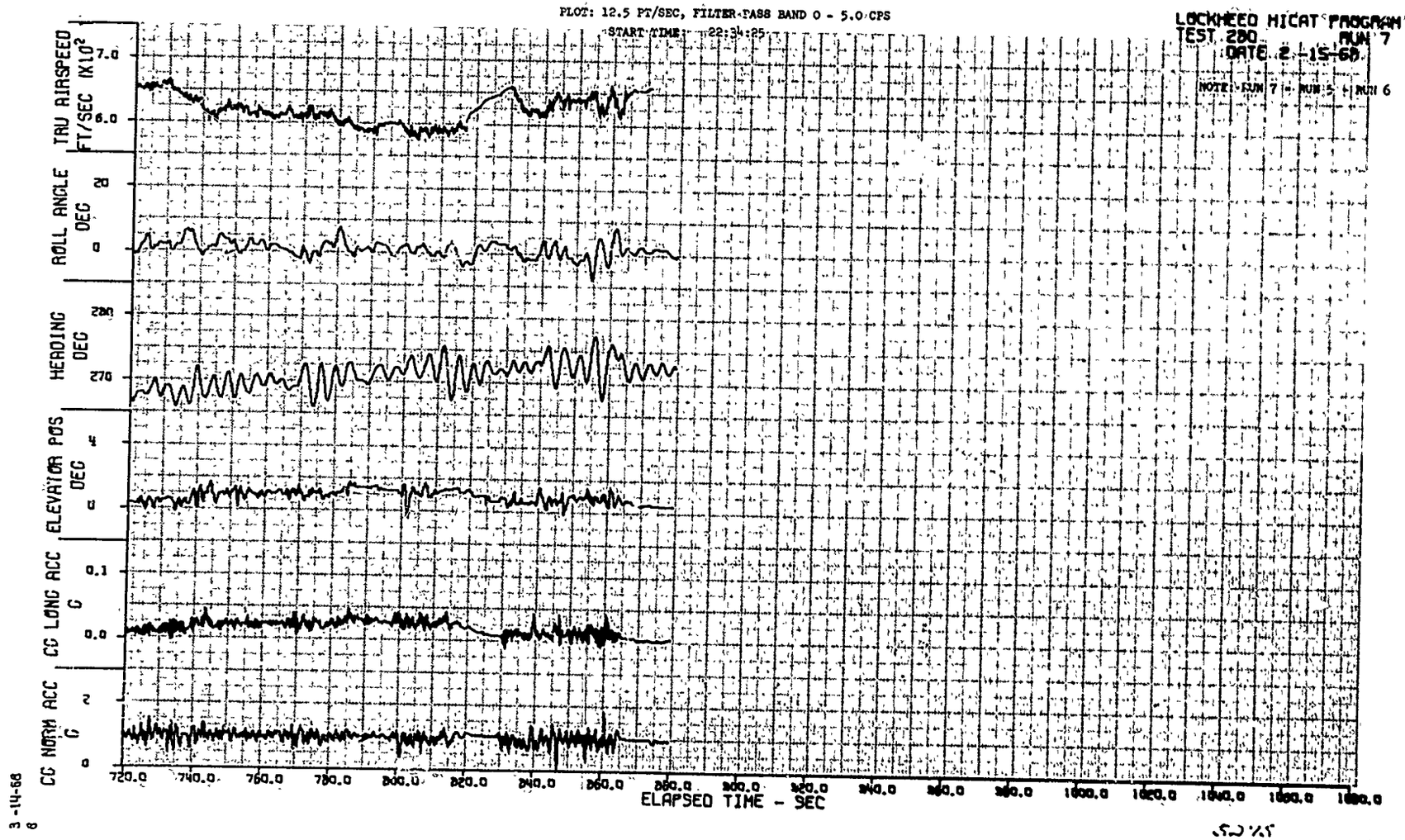


Figure 61B Flight Parameter Time Histories of Test 280, Run 7 (Sheet 3 of 3)

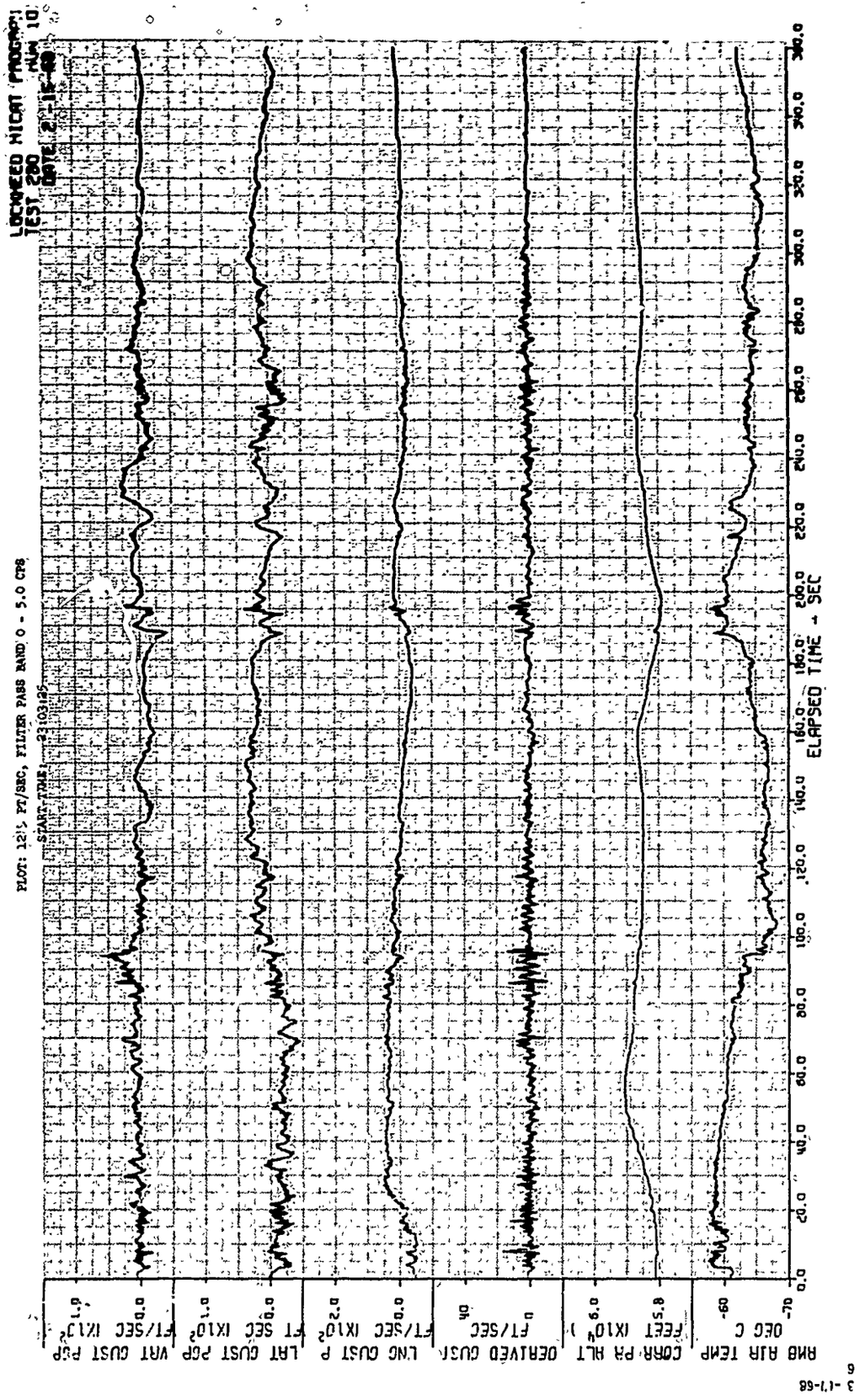


Figure 62A Gust Velocity Time Histories of Test 280, Run 10 - Edwards AFB, California, 15 Feb 68 (Sheet 1 of 2)

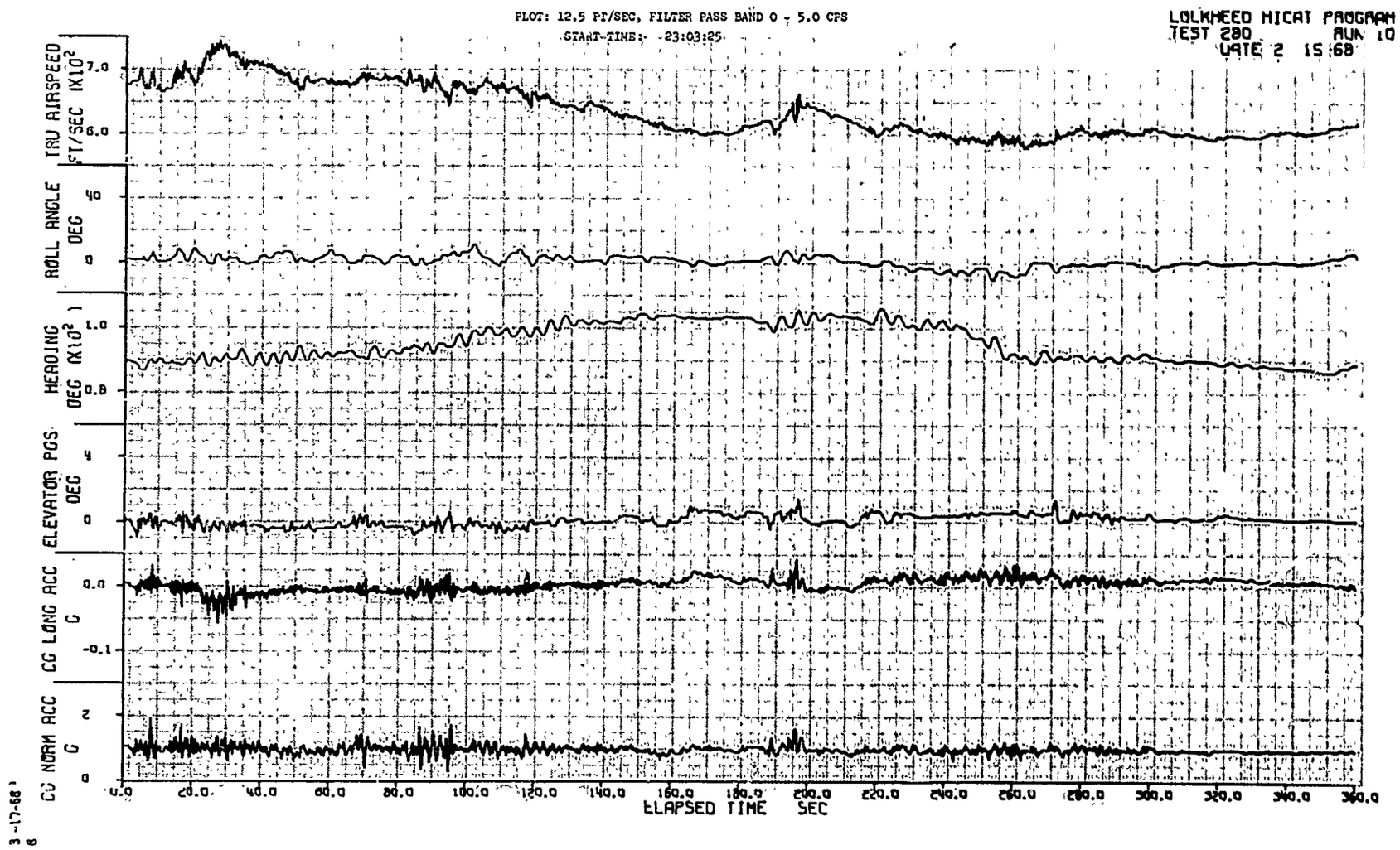


Figure 62B Flight Parameter Time Histories of Test 280, Run 10 (Sheet 1 of 2)

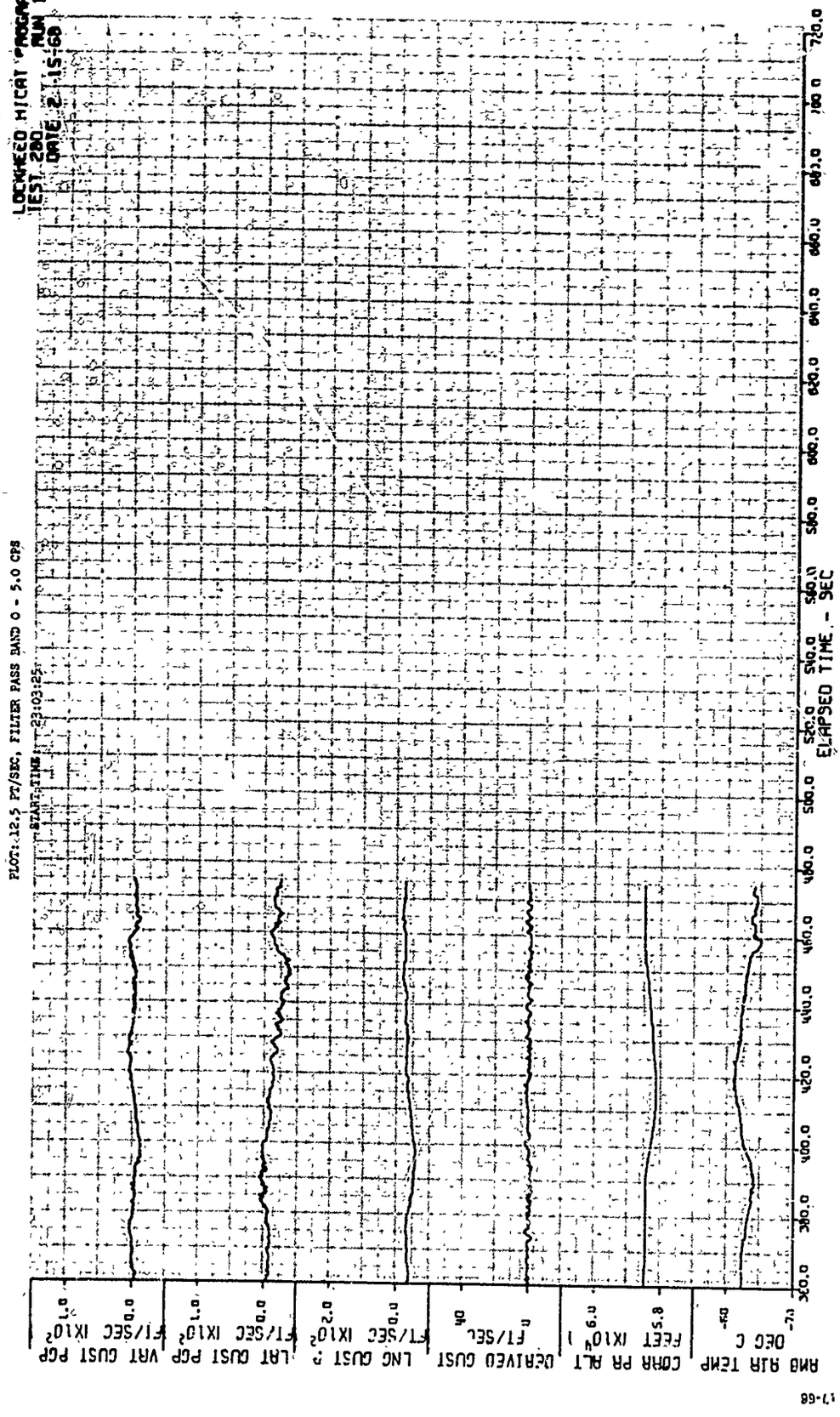


Figure 62A Gust Velocity Time Histories of Test 280, Run 10 - Edwards AFB, California, 15 Feb 68 (Sheet 2 of 2)

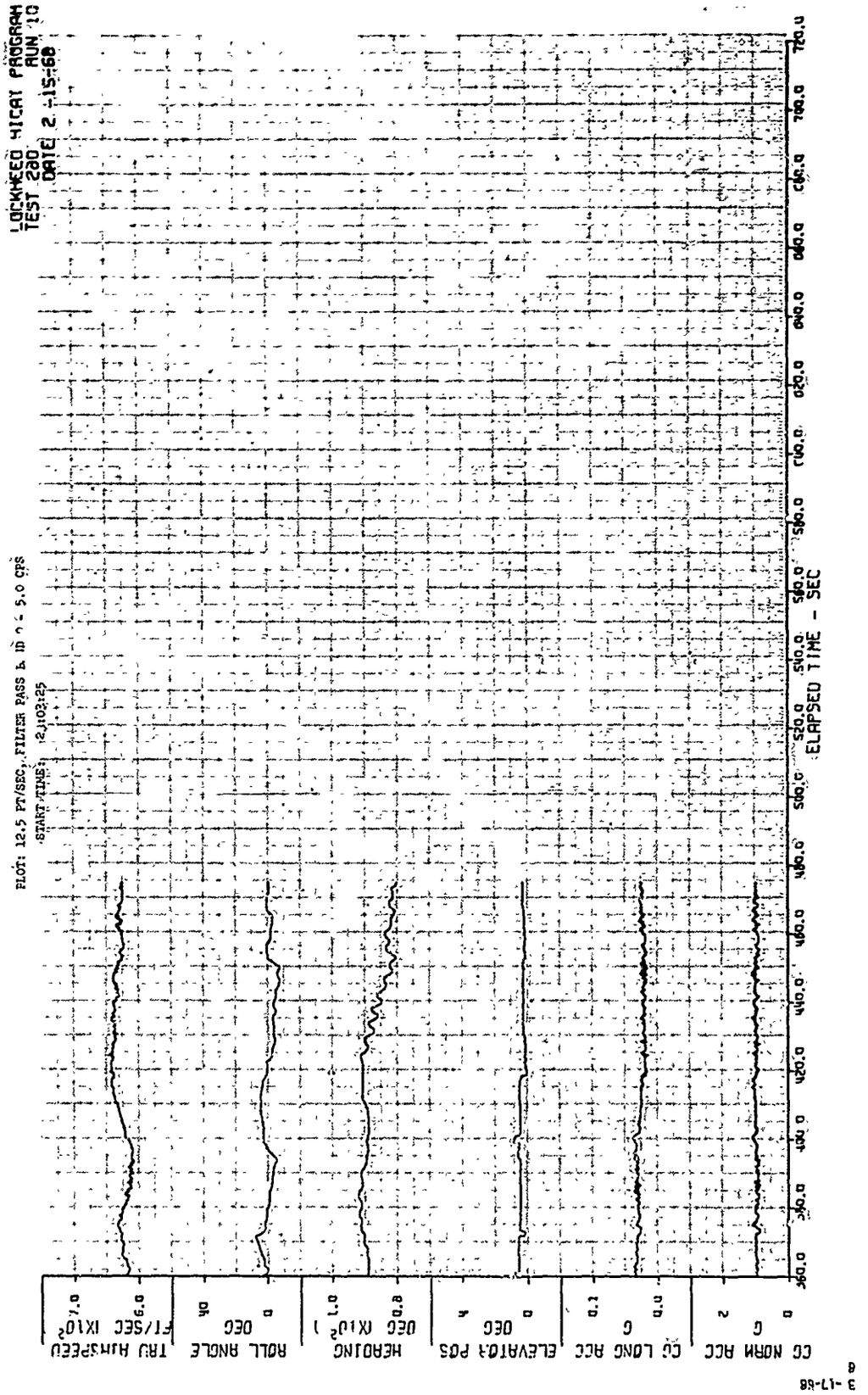


Figure 62B Flight Parameter Time Histories of Test 280, Run 10 (Sheet 2 of 2)

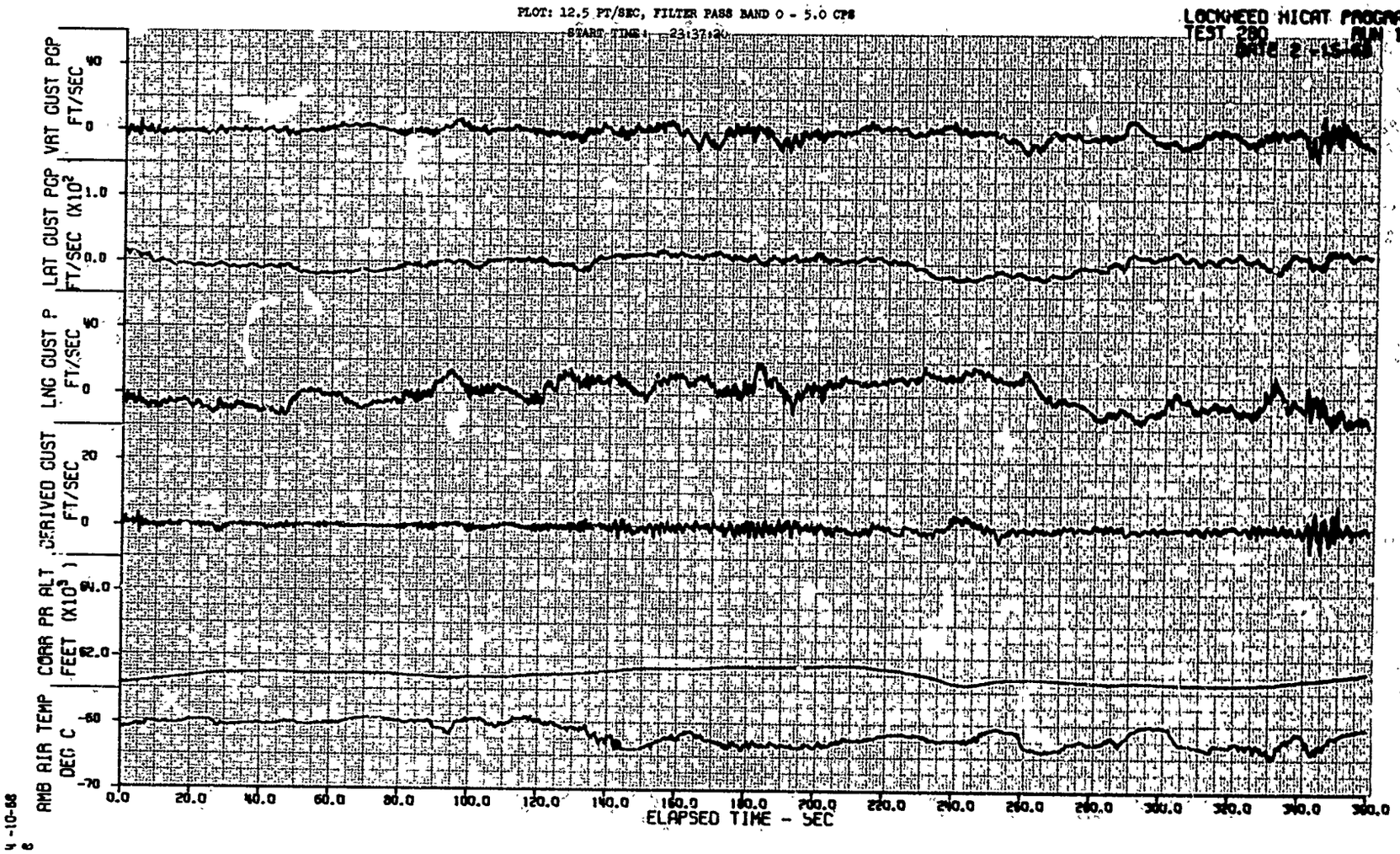


Figure 63A Gust Velocity Time Histories of Test 280, Run 11 - Edwards AFB, California, 15 Feb 68 (Sheet 1 of 2)

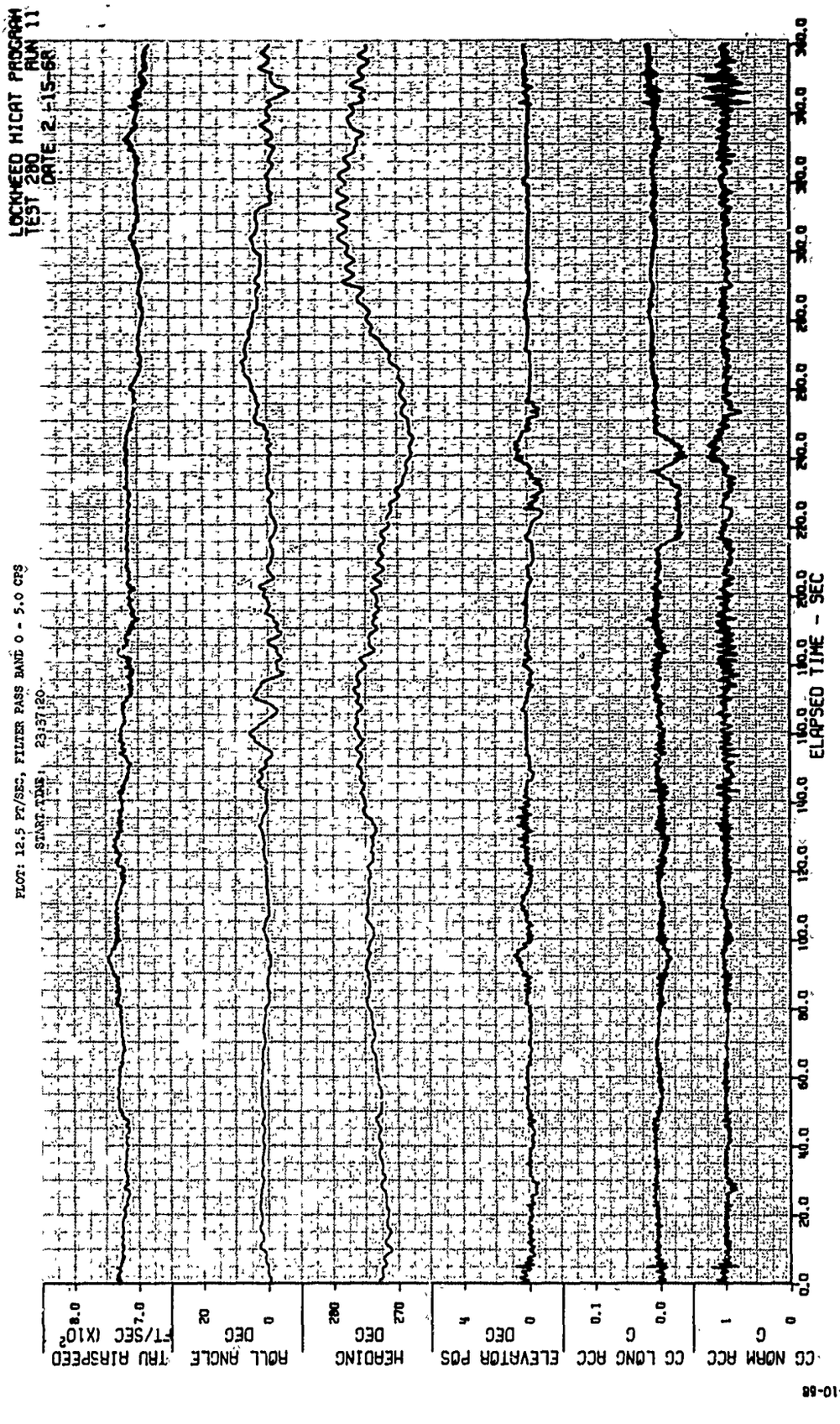


Figure 63B Flight Parameter Time Histories of Test 280, Run 11 (Sheet 1 of 2)

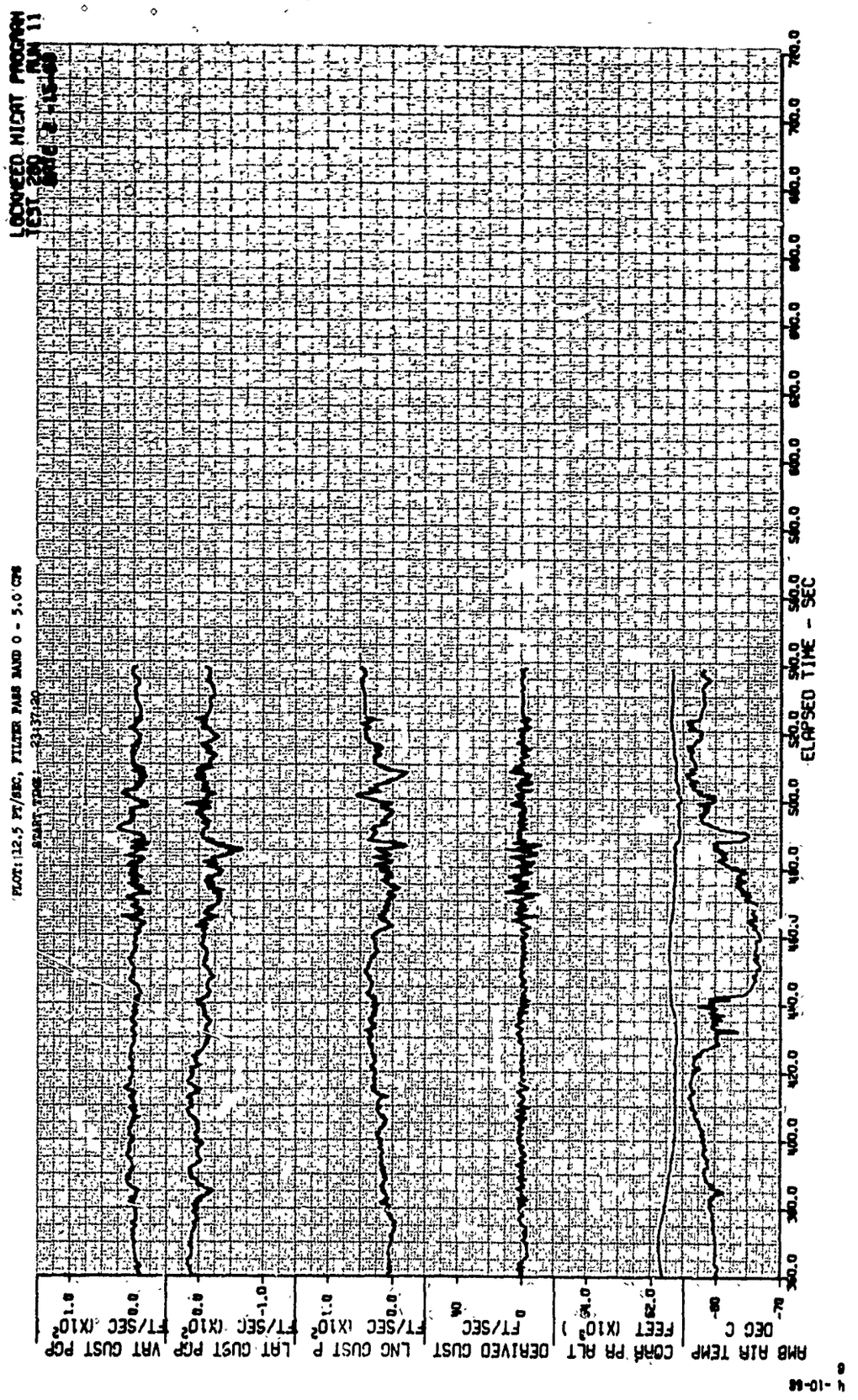


Figure 63A Gust Velocity Time Histories of Test 280, Run 11 - Edwards AFB, California, 15 Feb 68 (Sheet 2 of 2)

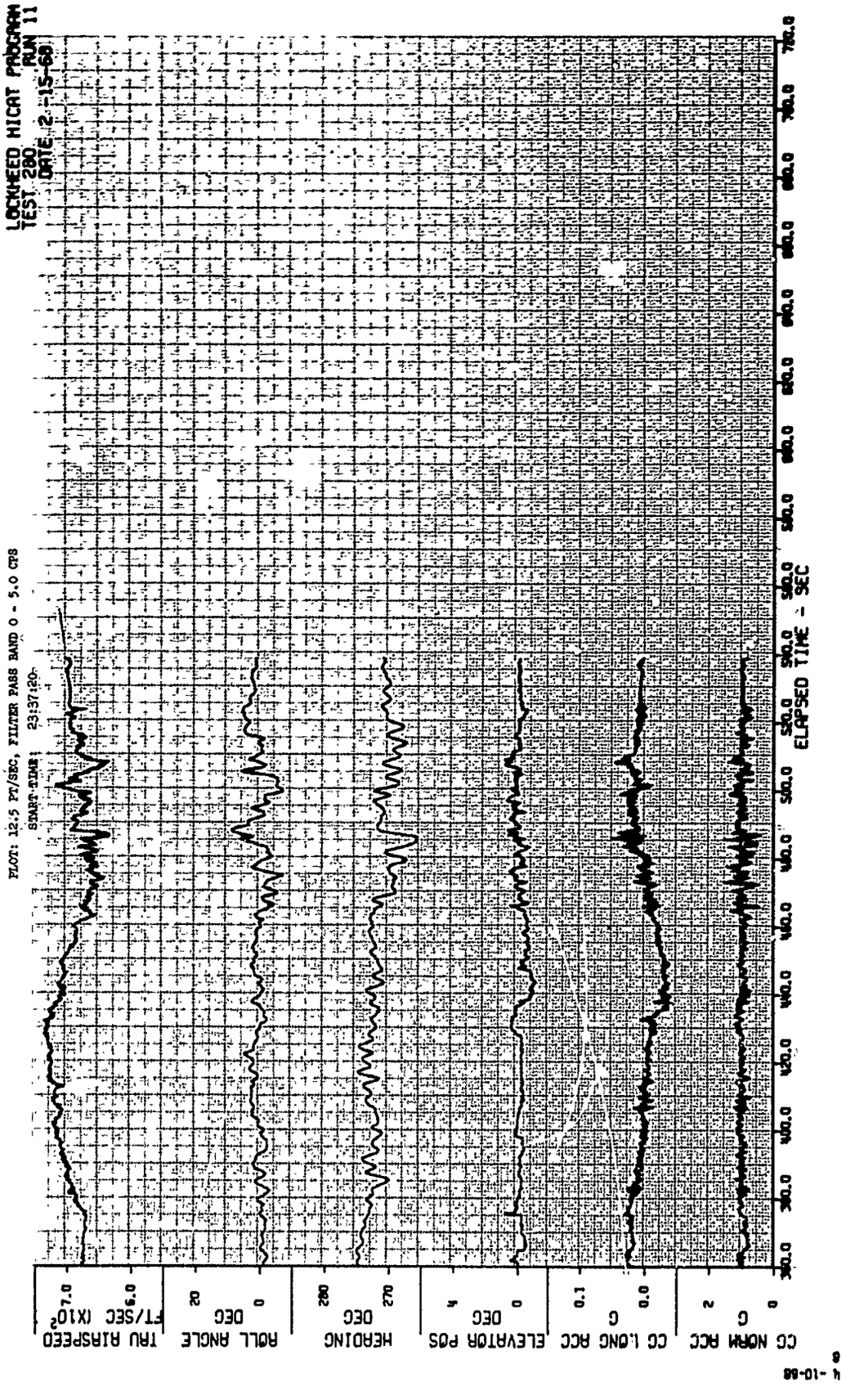


Figure 63B Flight Parameter Time Histories of Test 280, Run 11 (Sheet 2 of 2)

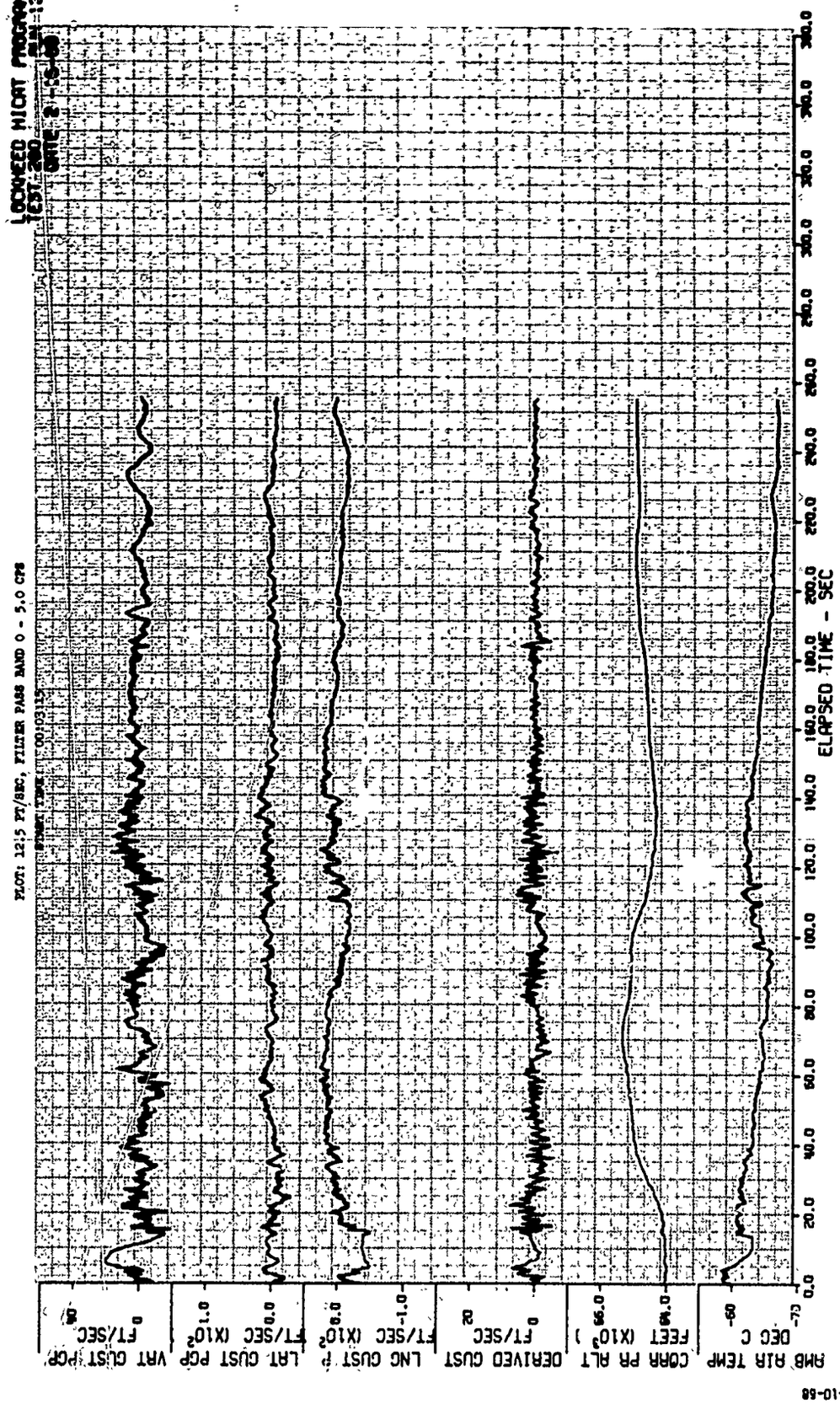


Figure 64A Gust Velocity Time Histories of Test 280, Run 12 - Edwards AFB, California, 15 Feb 68

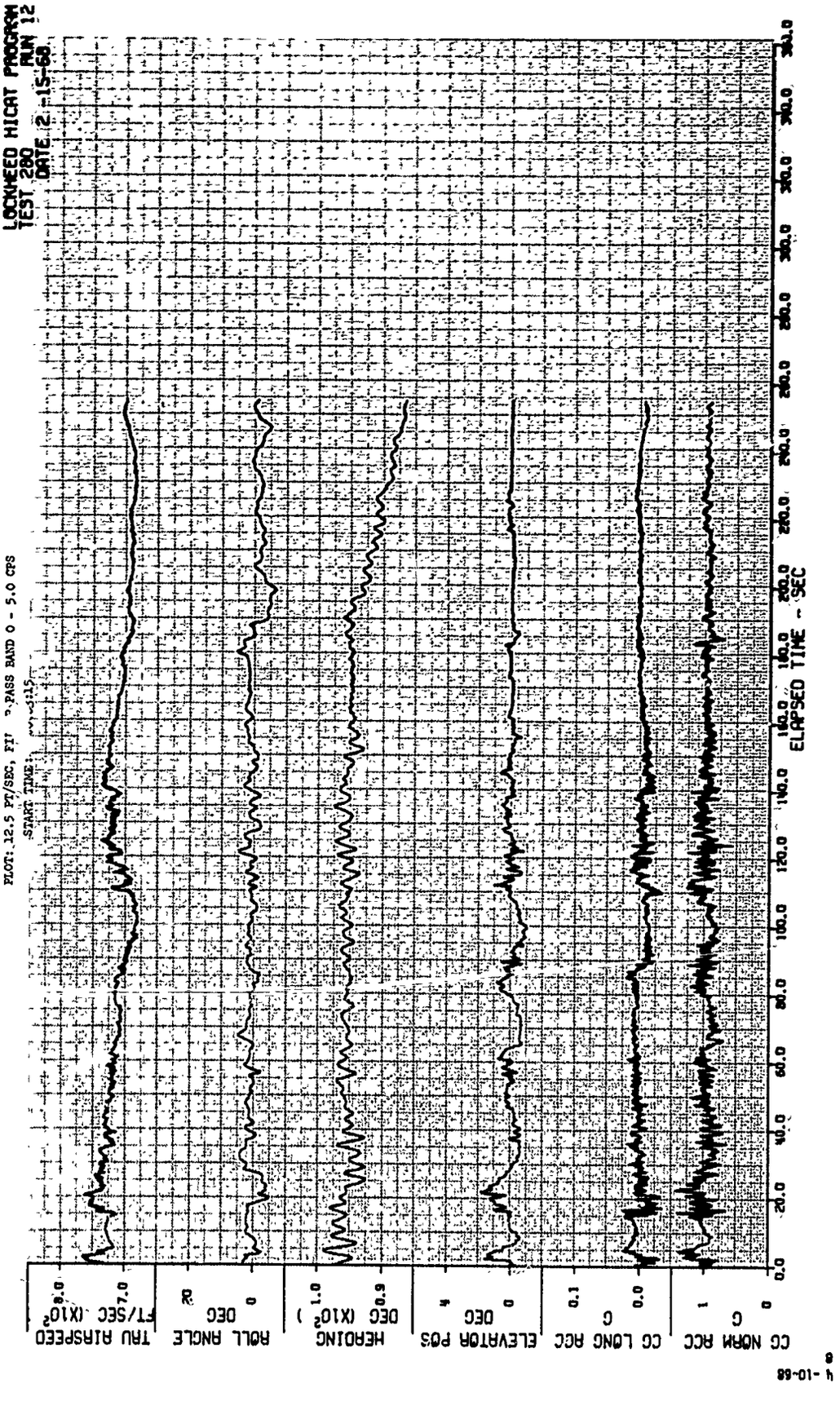


Figure 64B Flight Parameter Time Histories of Test 280, Run 12

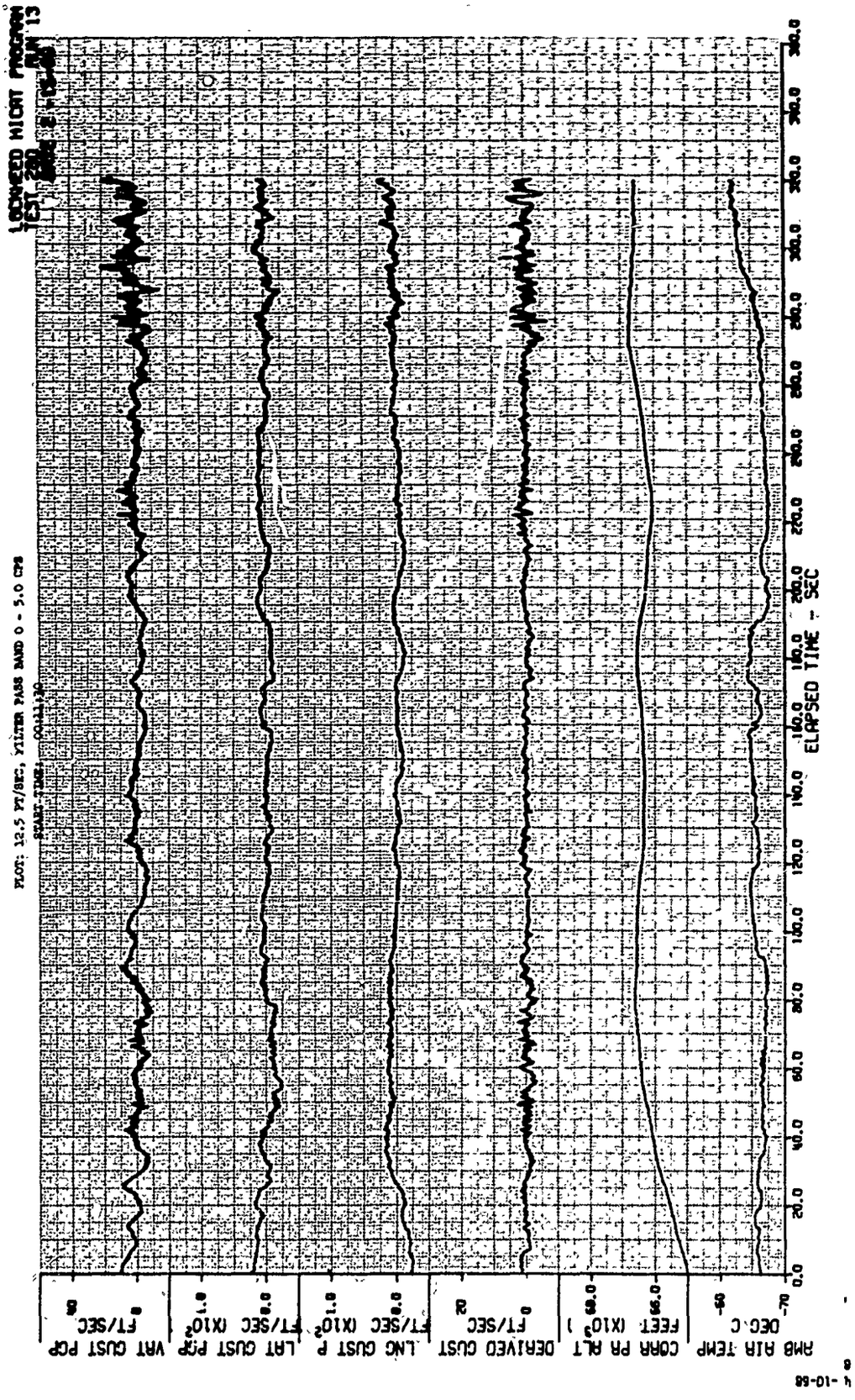


Figure 65A Gust Velocity Time Histories of Test 280. Run 13 - Edwards AFB. California, 15 Feb 68

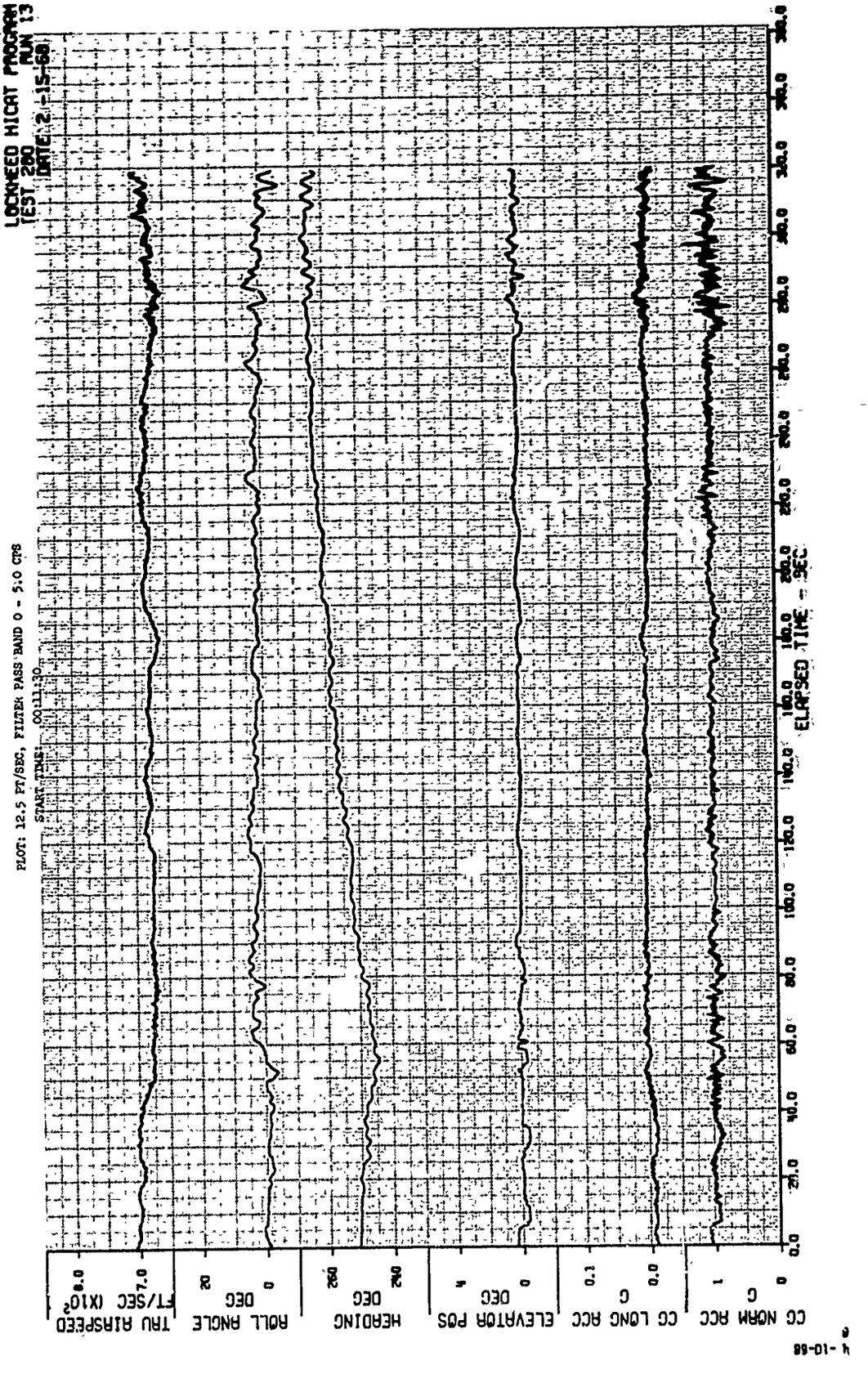


Figure 65B Flight Parameter Time Histories of Test 280, Run 13

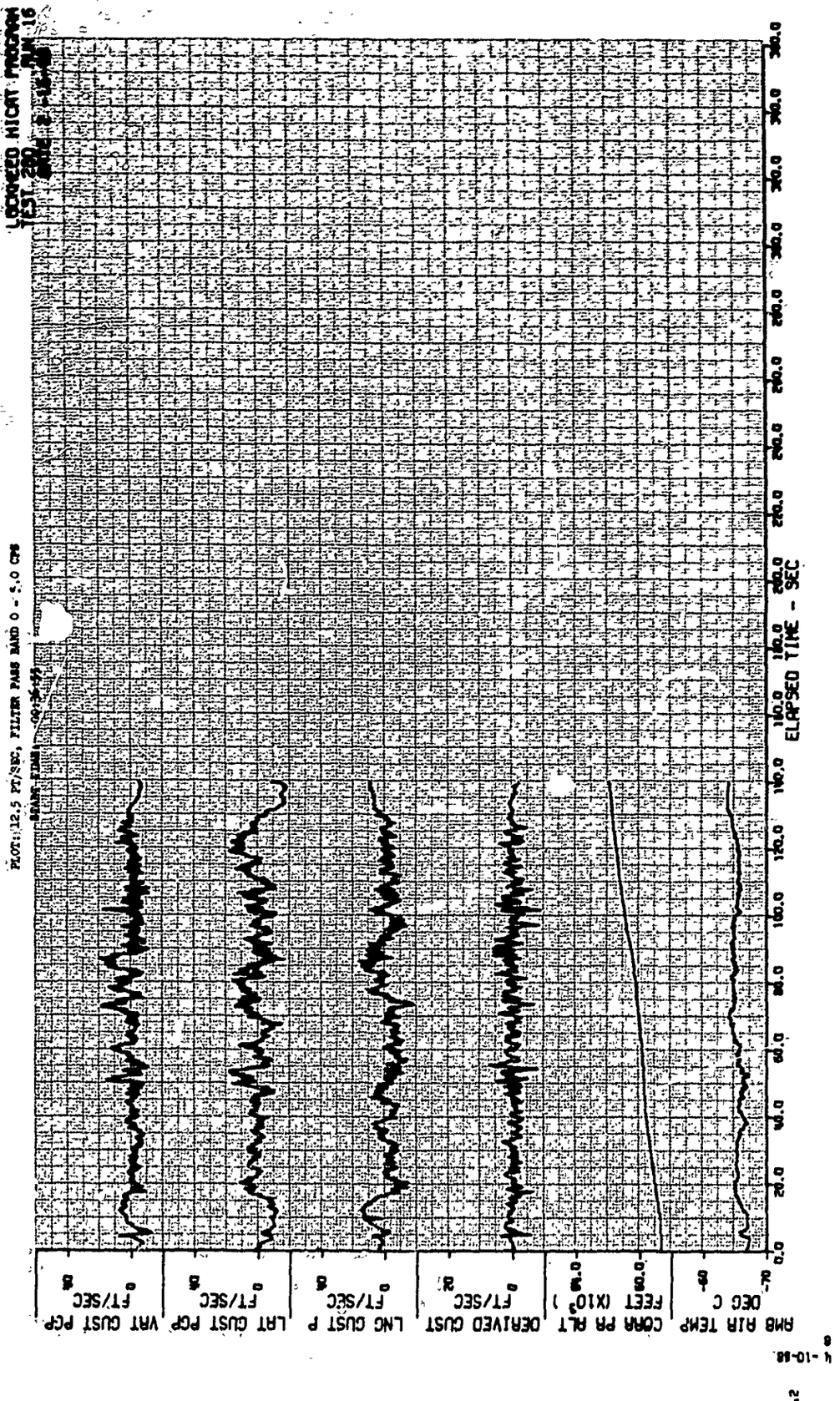


Figure 66A Gust Velocity Time Histories of Test 280, Run 16 - Edwards AFB, California, 15 Feb 68

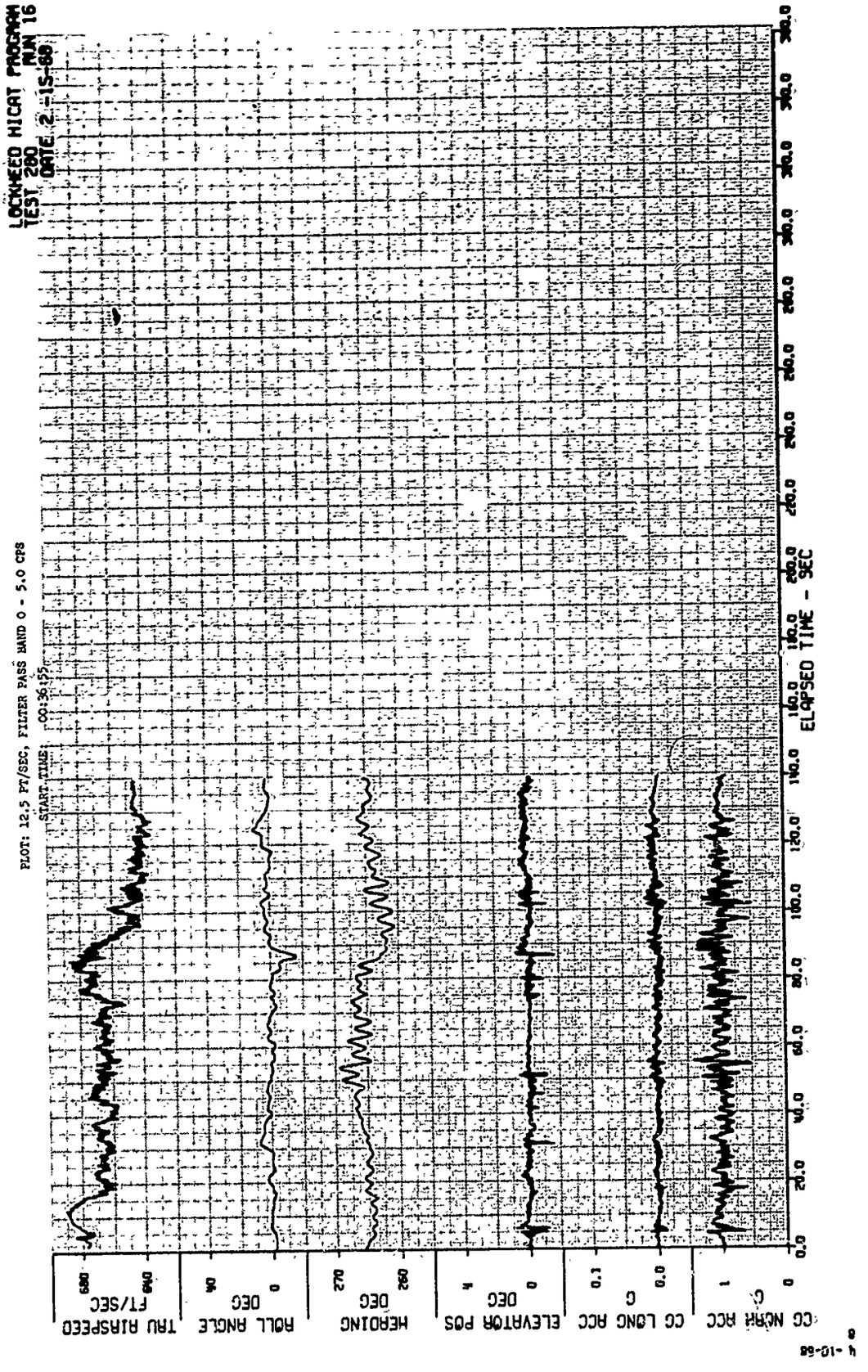


Figure 66B Flight Parameter Time Histories of Test 280, Run 16

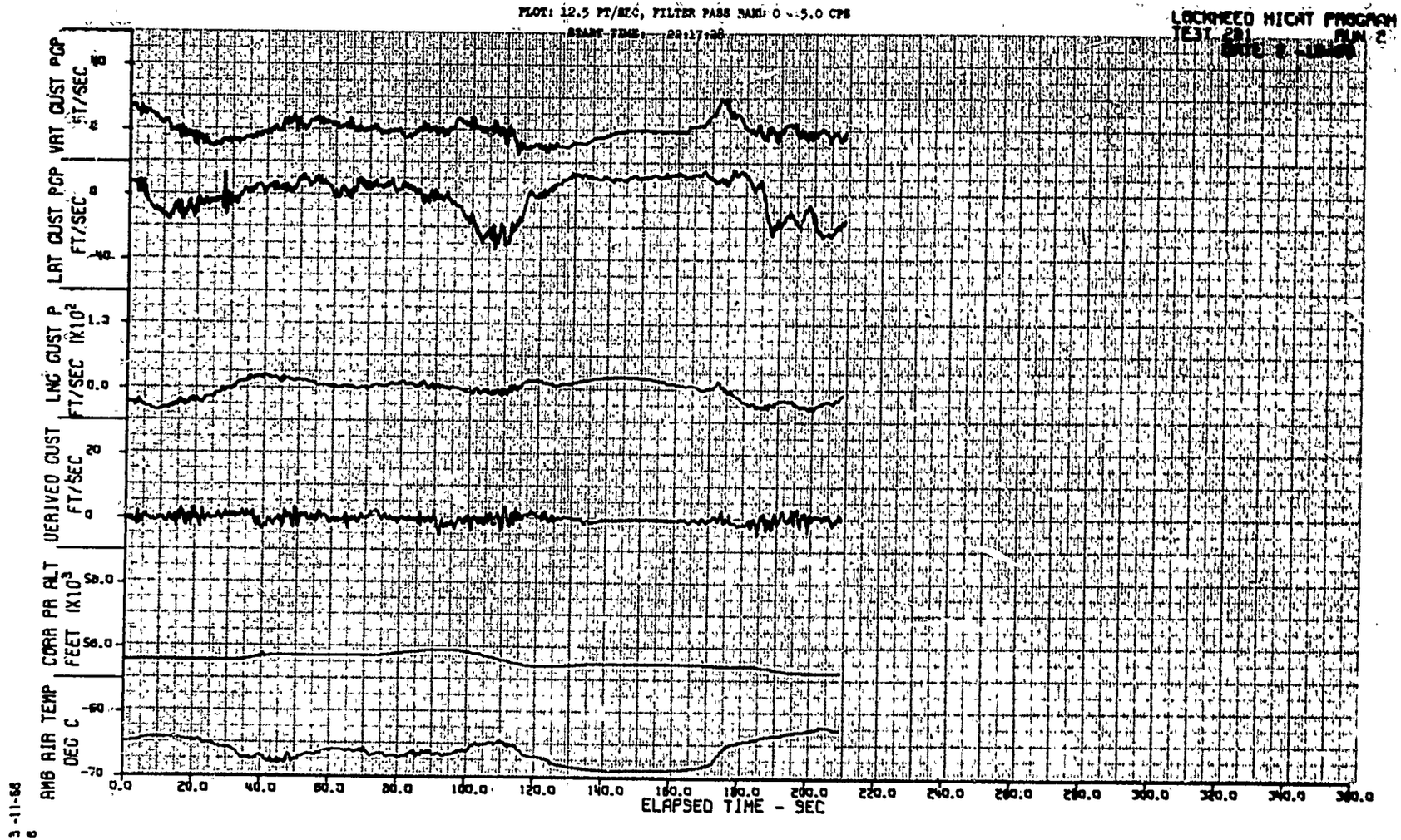


Figure 67A Gust Velocity Time Histories of Test 281, Run 2 - Edwards AFB, California, 16 Feb 68

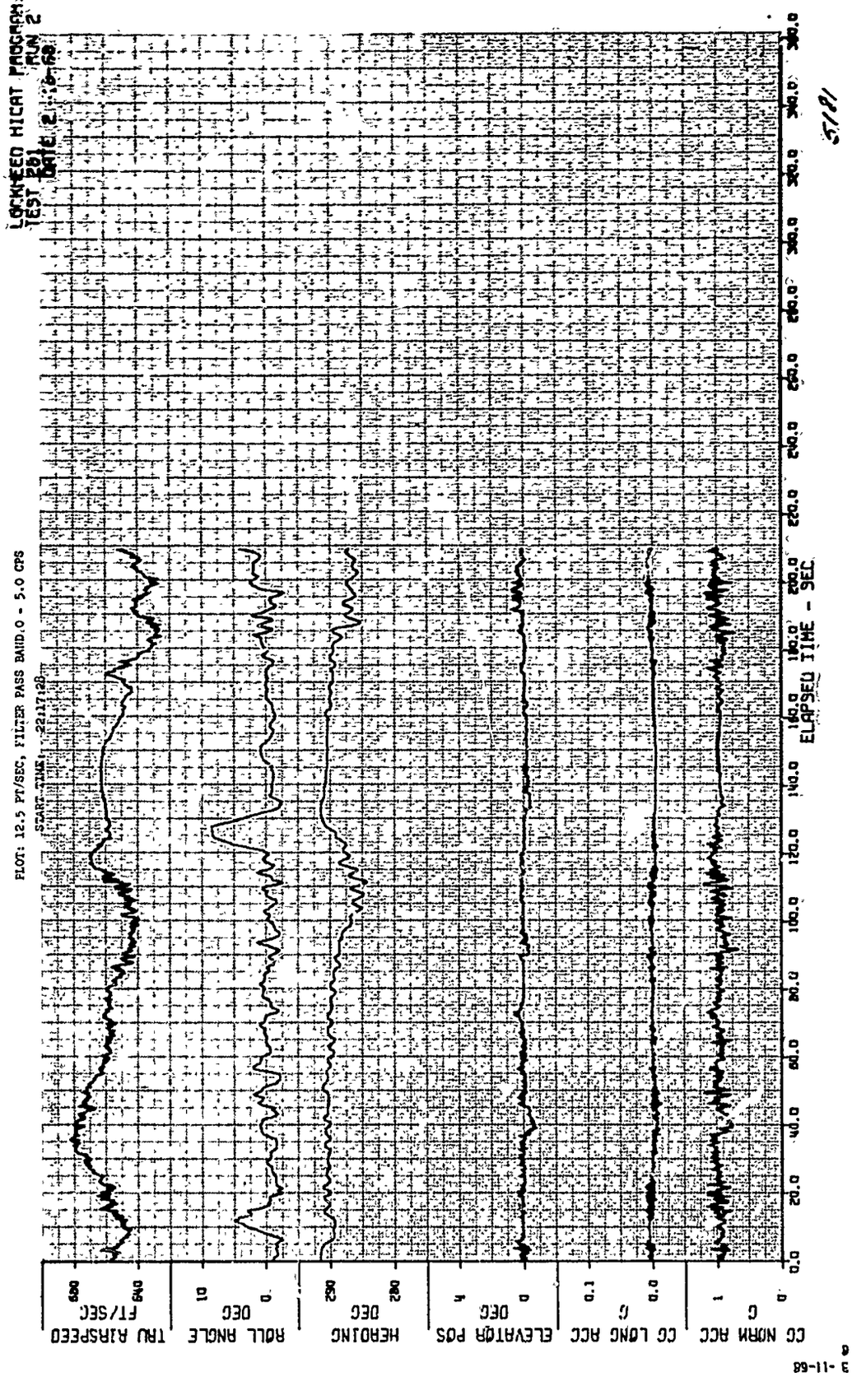


Figure 67S Flight Parameter Time Histories of Test 281, Run 2

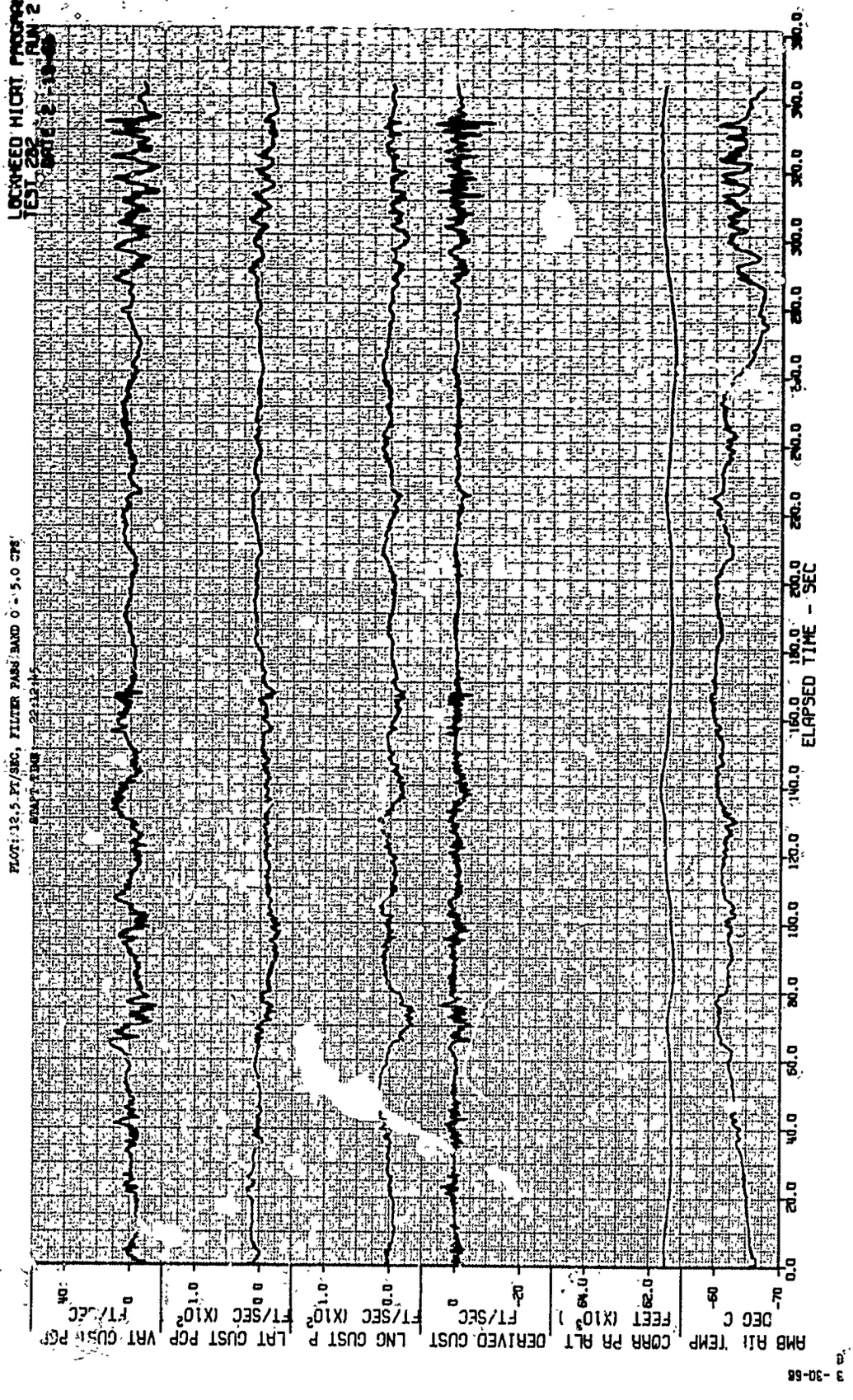


Figure 68A Gust Velocity Time Histories of Test 282, Run 2 - Edwards AFB, California, 19 Feb 68

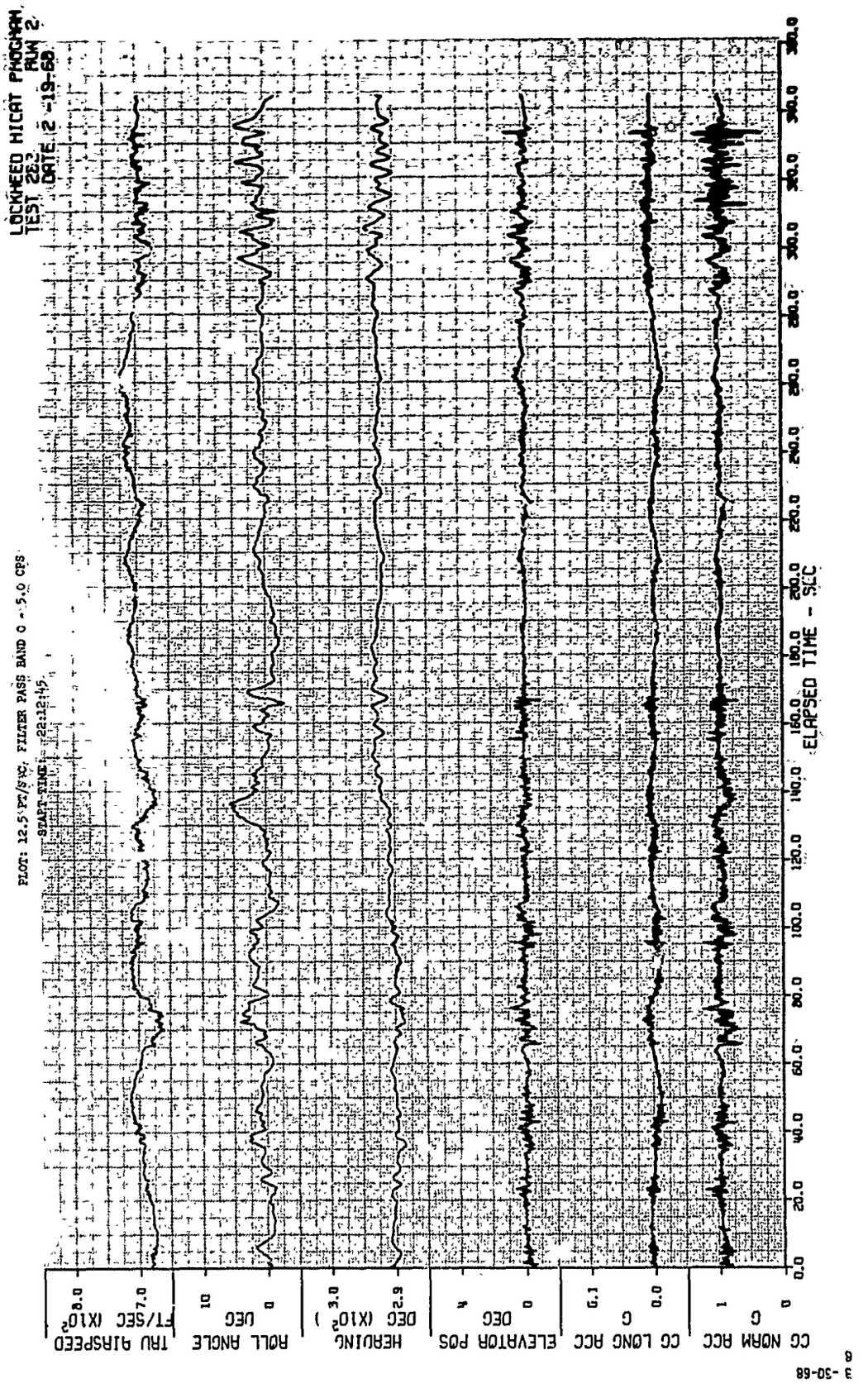


Figure 68B Flight Parameter Time Histories of Test 282, Run 2

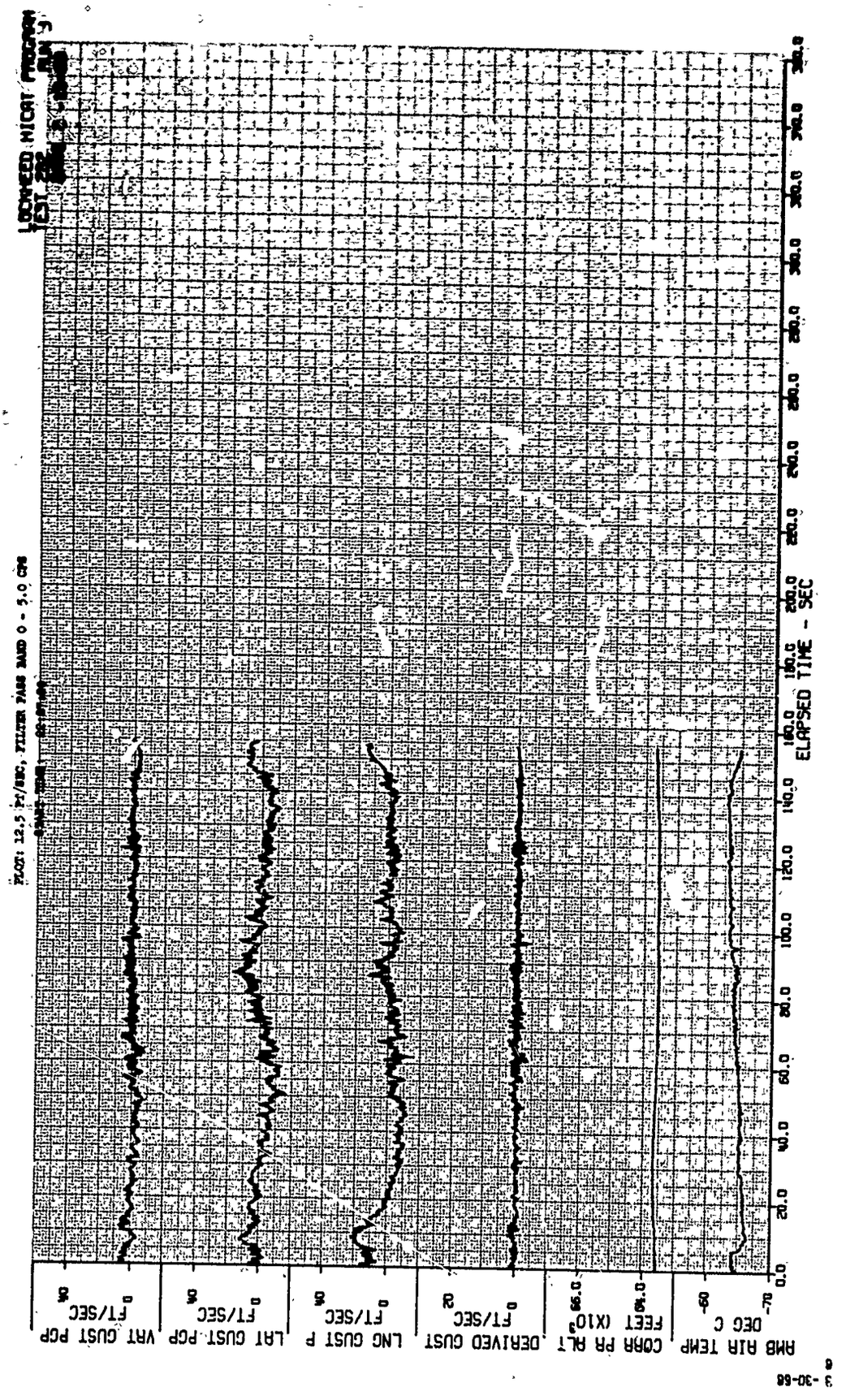


Figure 69A Gust Velocity Time Histories of Test 282, Run 3 - Edwards AFB, California, 19 Feb 68

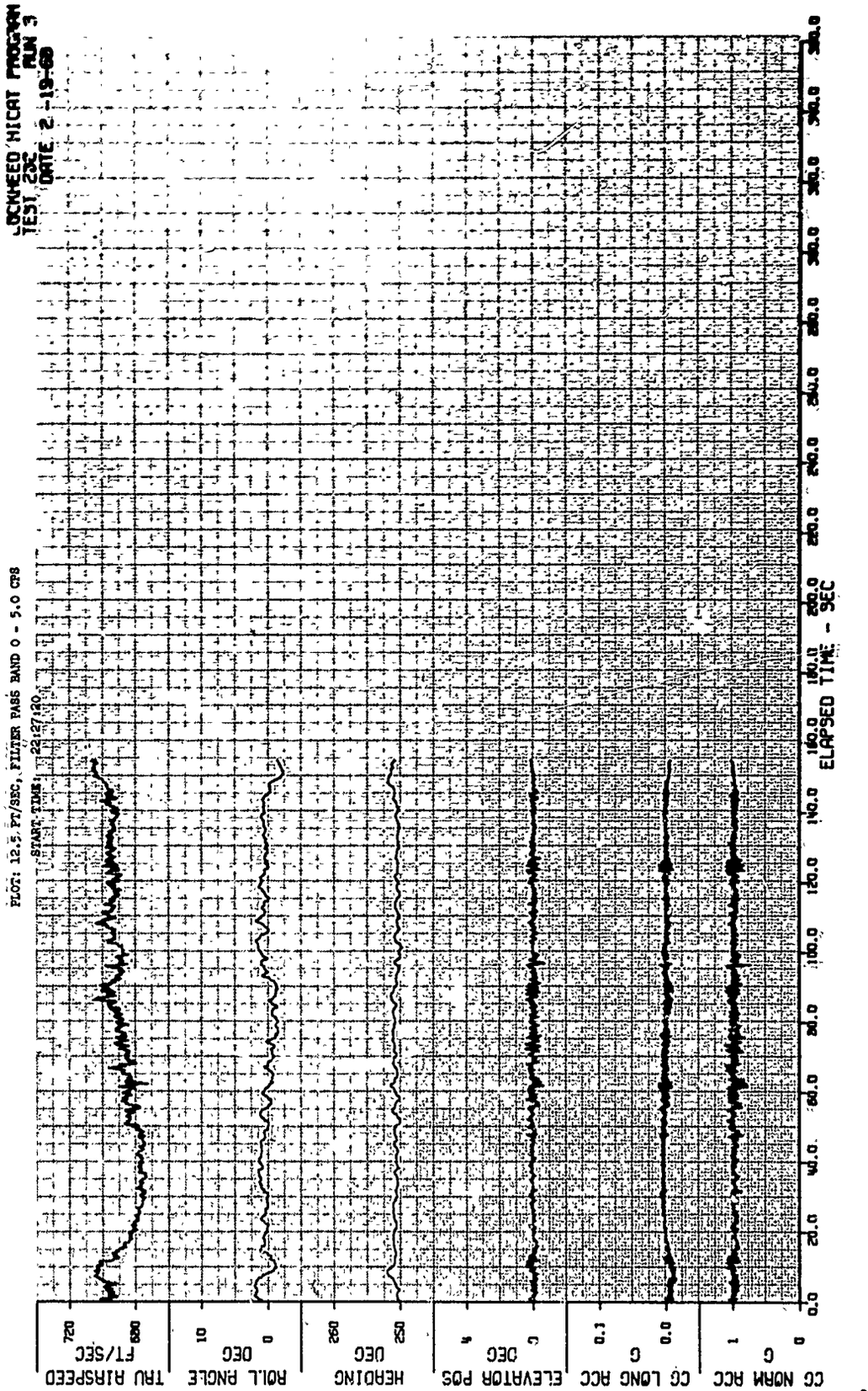


Figure 69B Flight Parameter Time Histories of Test 282, Run 3

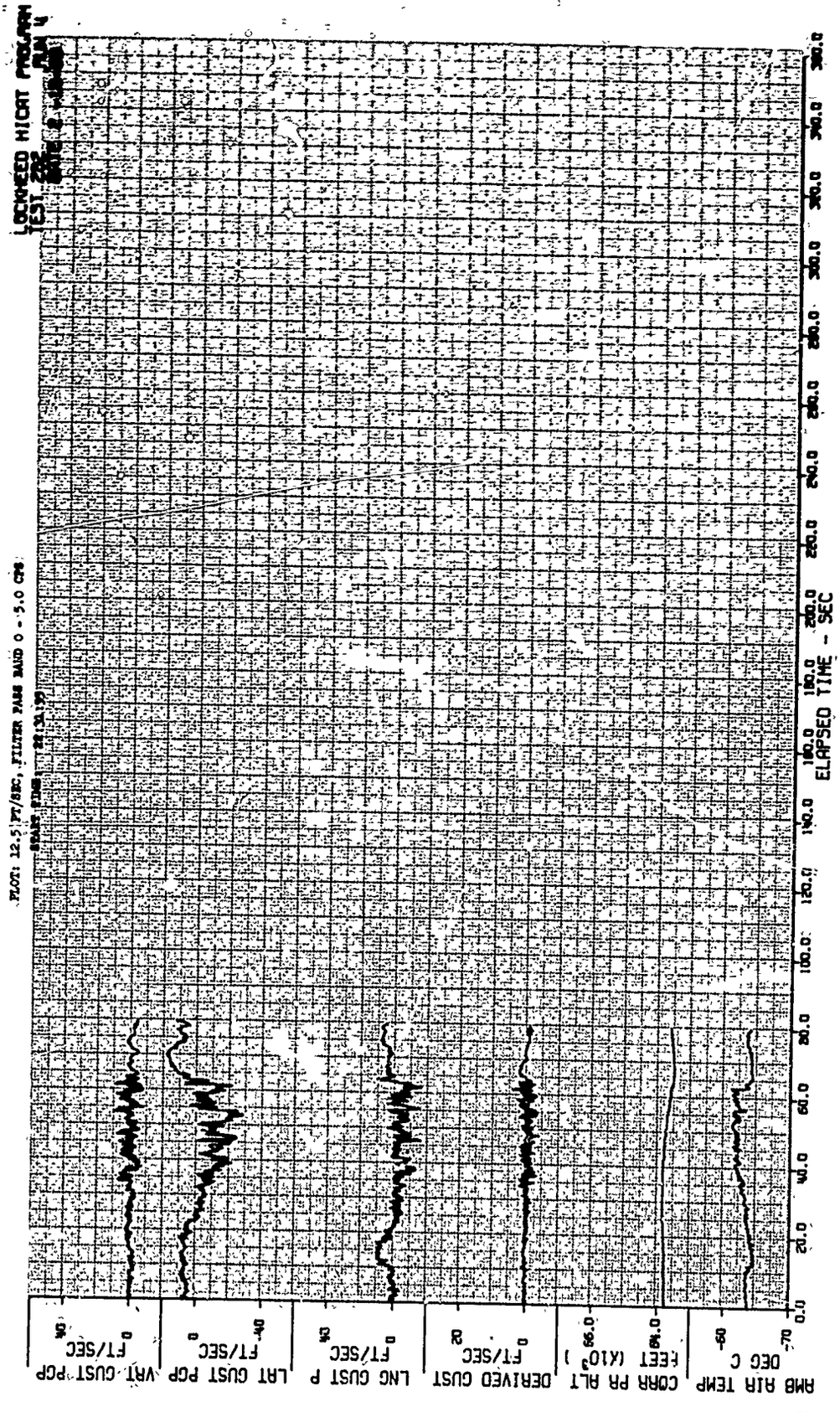


Figure 70A Gust Velocity Time Histories of Test 282, Run 4 - Edwards AFB, California, 19 Feb 68

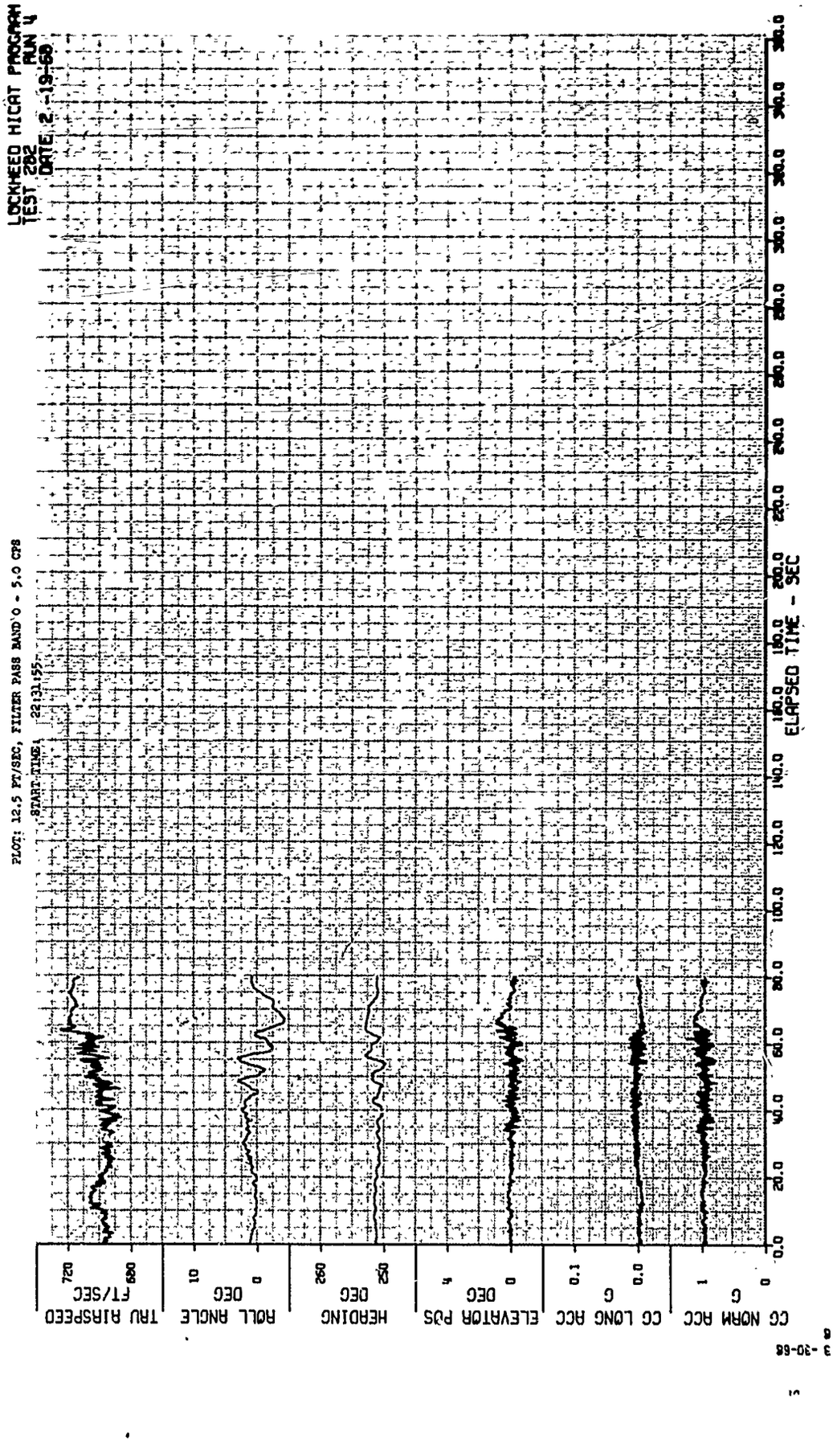


Figure 70B Flight Parameter Time Histories of Test 282, Run 4

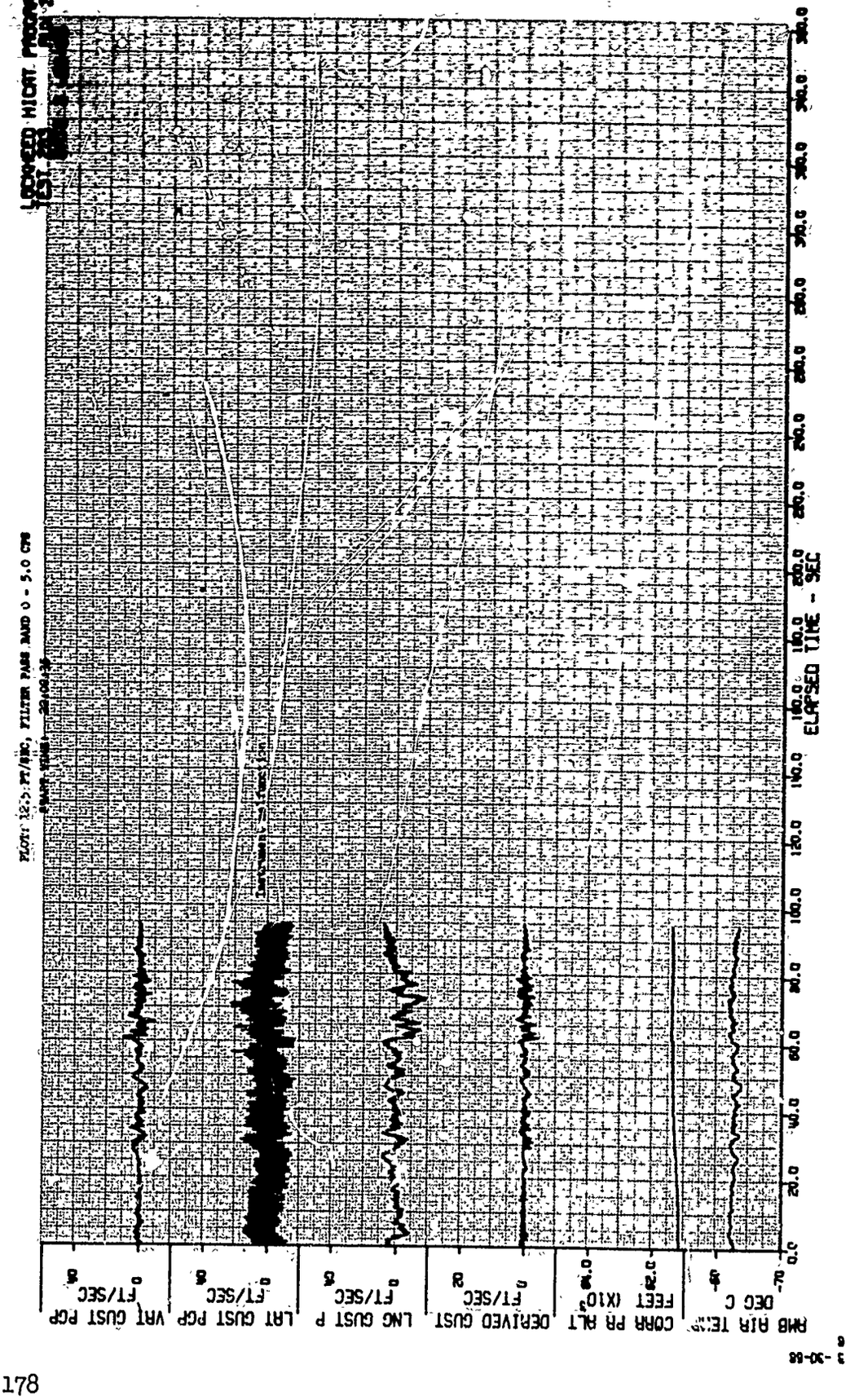


Figure 71A Gust Velocity Time Histories of Test 283, Run 2 - Edwards AFB, California, 26 Feb 68

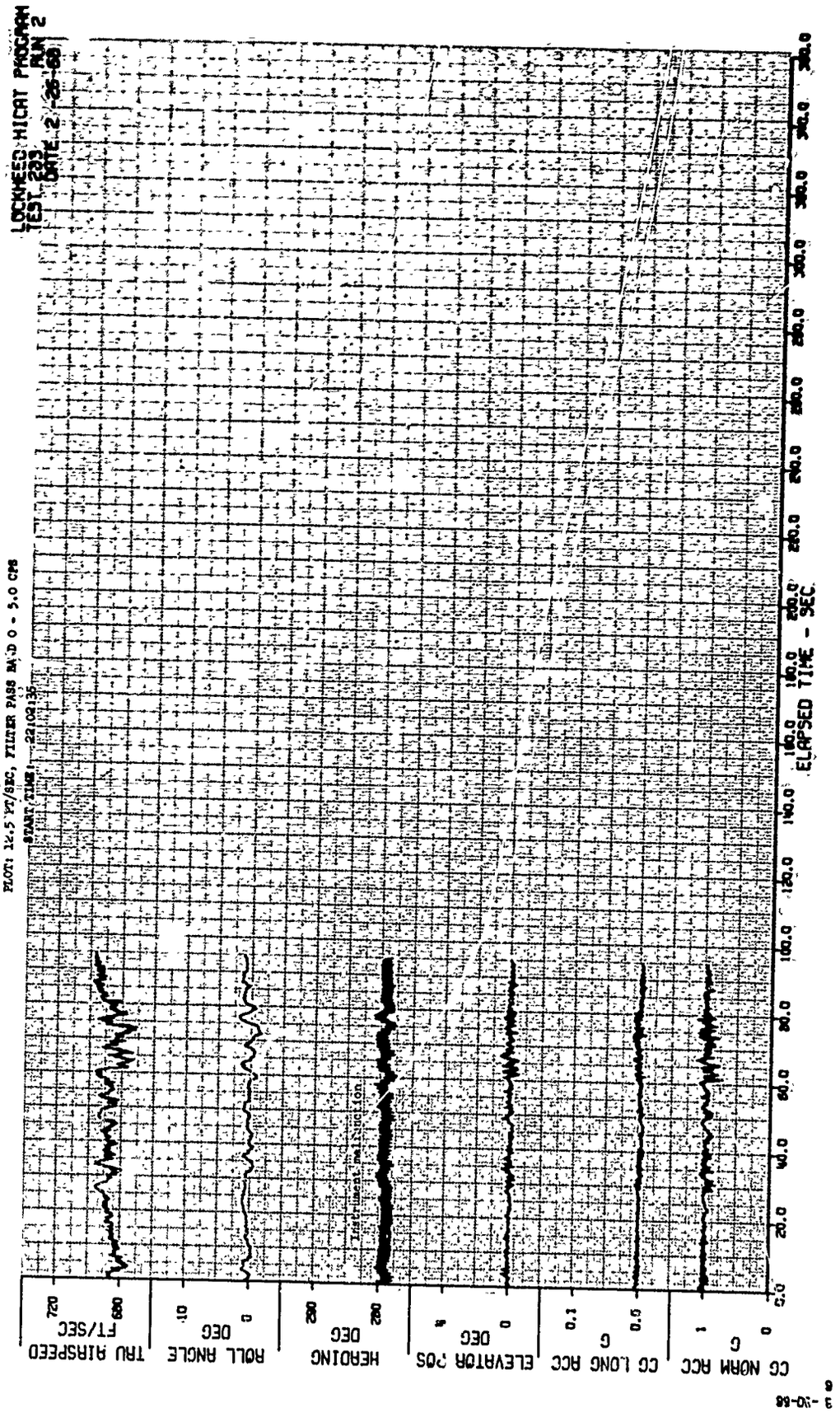


Figure 71B Flight Parameter Time Histories of Test 283, Run 2

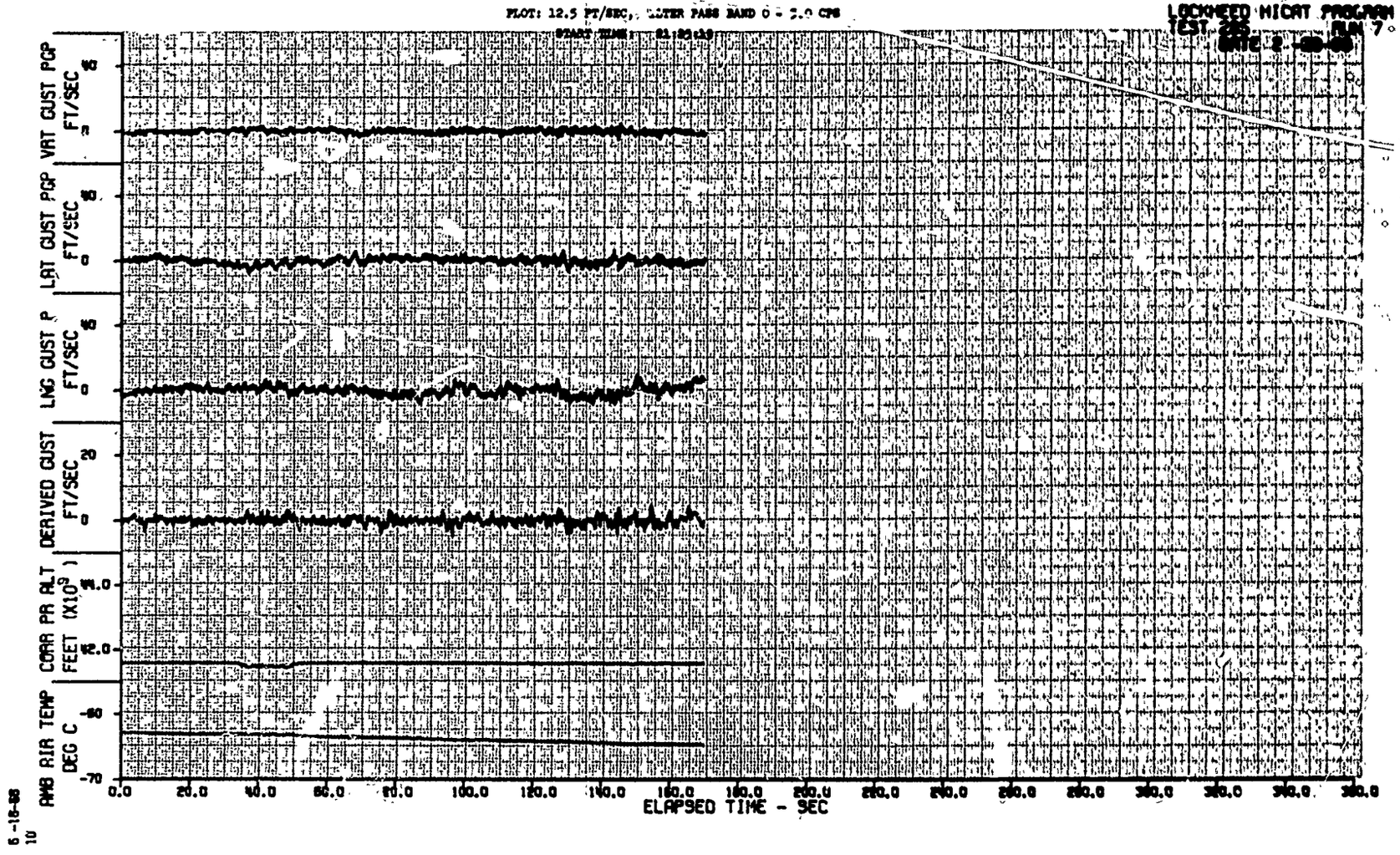


Figure 72A Gust Velocity Time Histories of Test 285, Run 7 (Middle Altitude Flight with Canadian NAE T-33) - Edwards AFB, California, 29 Feb 68

APPENDIX IV

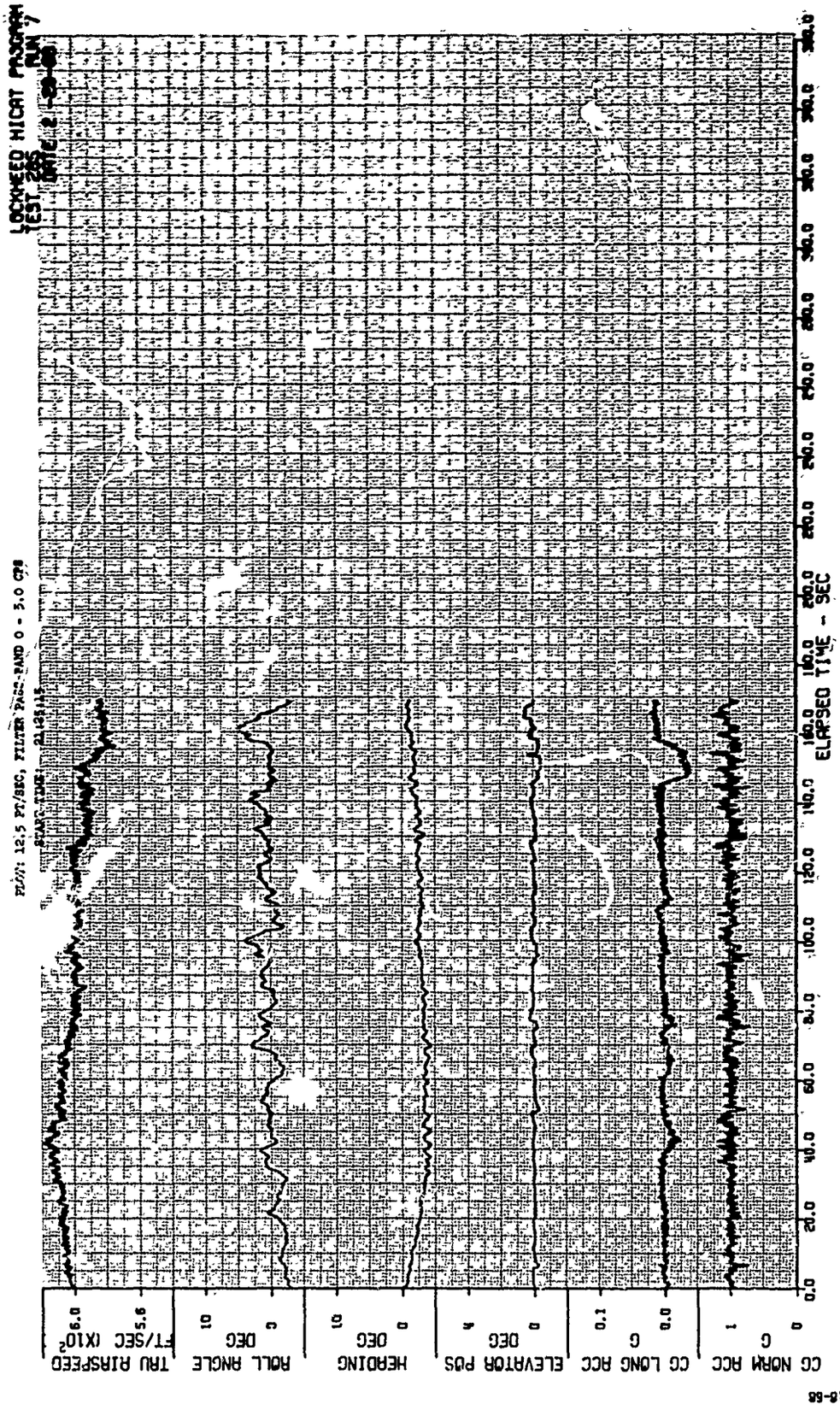


Figure 72B Flight Parameter Time Histories of Test 285, Run 7 (Middle Altitude Flight with Canadian NAE T-33)

APPENDIX V

GUST VELOCITY POWER SPECTRA

Gust velocity power spectra for qualifying CAT runs* are presented in order by test number in Figures 74 through 148. These are prewhitened, postdarkened spectra computed from gust velocity time histories with linear trends removed as described in Appendix II, Volume I.

The spectra labels are somewhat abbreviated and require explanation. The first three digits after "Test" are the test number. The fourth and, when required, the fifth digit comprise the run number. The next two letters indicate the base where the test flight originated, as follows:

HM - Hanscom Field, Bedford, Massachusetts, U.S.A.

BD - Royal Aircraft Establishment, Bedford, England, U.K.

BK - Barksdale AFB, Shreveport, Louisiana, U.S.A.

LM - Loring AFB, Limestone, Maine, U.S.A.

PC - Albrook AFB, Balboa, Canal Zone, Panama

PF - Patrick AFB, Cocoa, Florida, U.S.A.

EC - Edwards AFB, Edwards, California, U.S.A.

The next two digits are the altitude in thousands of feet followed by three digits designating the true airspeed in feet per second. The "Start Time" is the moment the run began in hours, minutes, and seconds, Greenwich time. "Duration" of run length is in minutes and seconds. The "No. Lags" is the number of separate estimates comprising the spectrum. The "Time Incr." is the time between data samples in seconds. "No. Points" is the number of data samples in the run.

"Deg Freedom" is the number of degrees of freedom contained in the data run and is used to evaluate the statistical reliability of the spectrum. For statistical reliability, the "Deg Freedom" should be large, preferably 80 or more. For 80 degrees of freedom, one may say that four out of five times, the measured spectrum is within ±20 percent of the "true" long term average spectrum. The confidence band at the 80 percent confidence level corresponding to a specific number of degrees of freedom is shown in Figure 73.

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*Edited runs of sufficient gust intensity to produce RMS 2 gust velocities of 1.0 ft/sec or more.

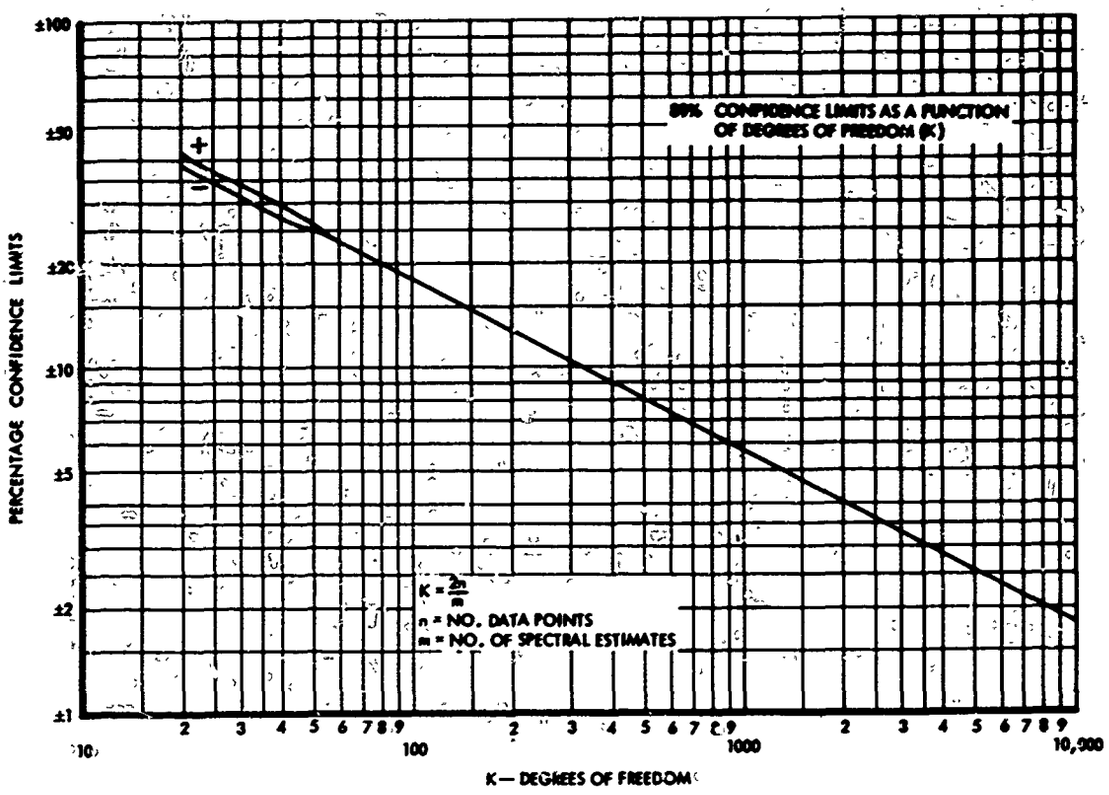


Figure 73. Eighty Percent Confidence Limits as a Function of Degrees of Freedom

"Wind" refers to the average wind direction and speed during the run. Following meteorological convention, the wind direction is measured from true north to the direction from which the wind is blowing. The small diagram shows the wind direction with respect to the aircraft flight direction. When wind information was unavailable, the space was left blank.

The root mean square (rms) gust velocity value (in ft/sec) of the vertical gust velocity spectrum is tabulated in the lower left corner, followed by other rms values corresponding to the various wavelength cutoffs contained within the spectrum; these cutoffs are designated in thousands of feet by the numbers following the abbreviation RMS, i.e., 10 refers to a 10,000-ft cutoff, 2 refers to a 2000-foot cutoff, etc. Similar information for the lateral and longitudinal components is also presented.

Note that several non-HICAT spectra are presented in this section for reference and comparison. The figures for tests 202-10, 220-10, and 257-15 present examples of very low altitude spectra obtained from U-2 landing approaches in moderate turbulence. Test 285-7 (Figure 148) shows spectra for a short patch of light turbulence encountered at about 42,000 ft in side-by-side flight with the gust measuring T-33 of the Canadian National Aeronautical Establishment.

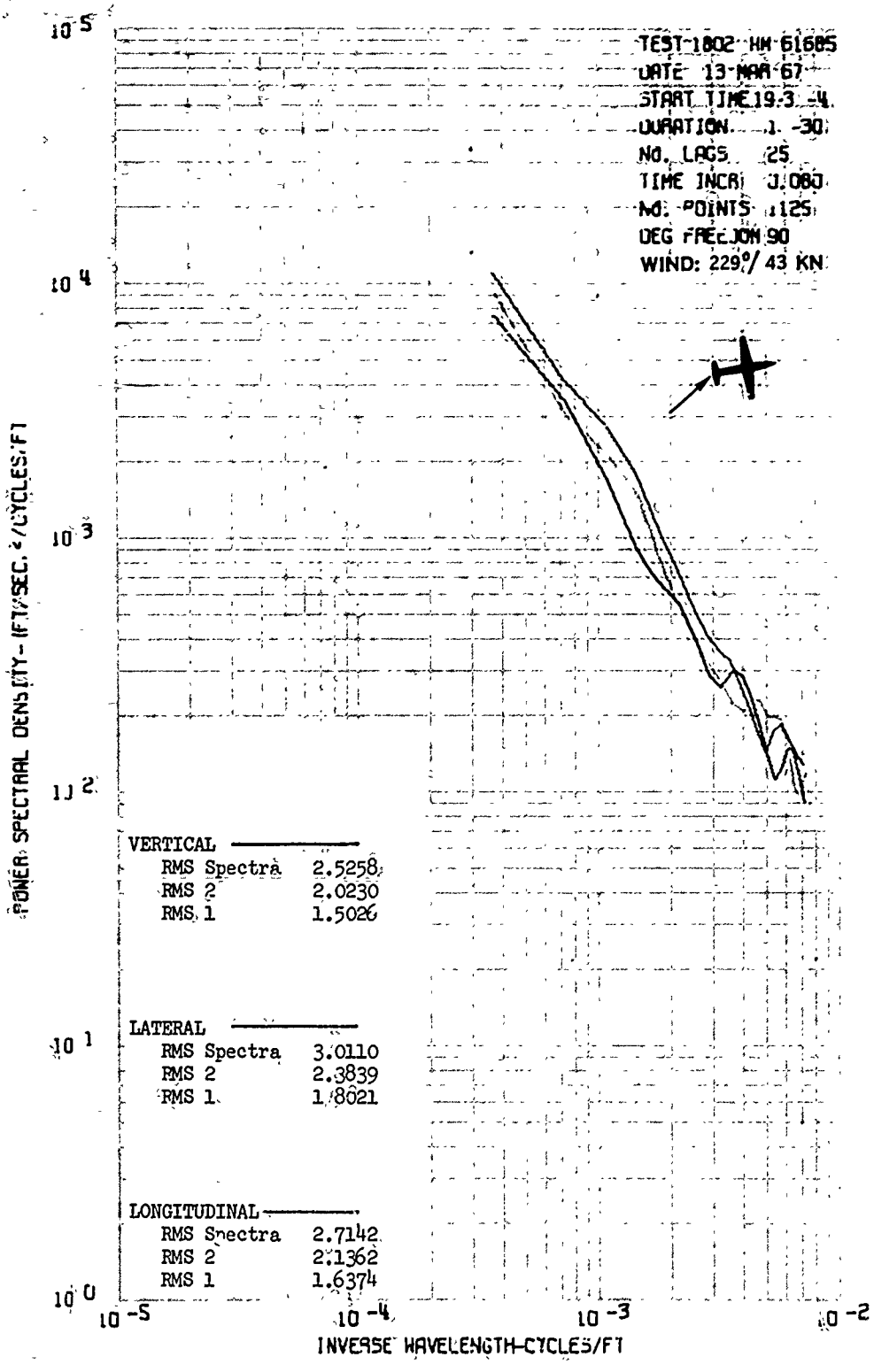


Figure 74 Gust Velocity Power Spectra for Test 180, Run 2
Maximum Standard λ = 2000 Feet

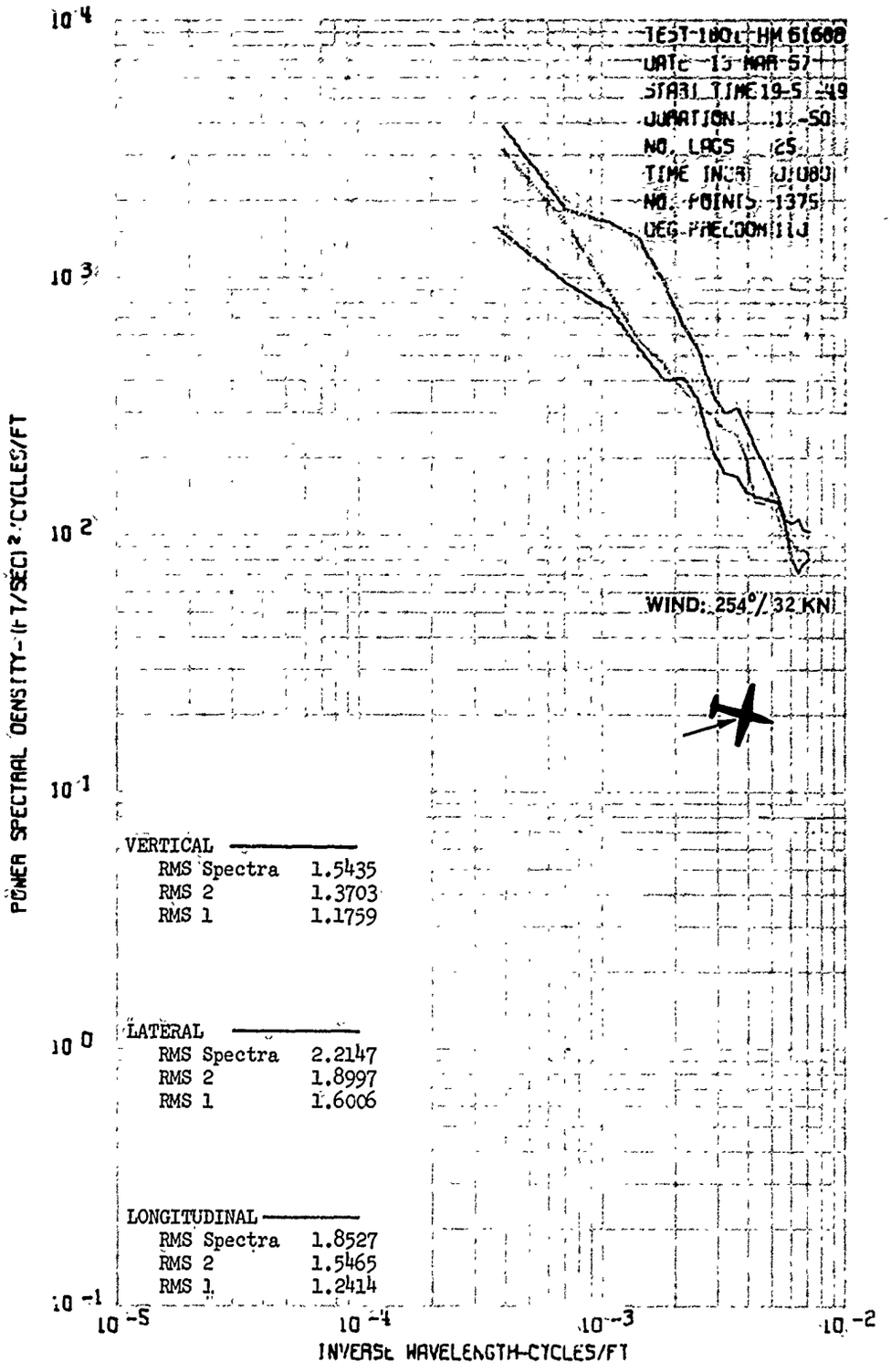


Figure 75 Gust Velocity Power Spectra for Test 180, Run 4
Maximum Standard λ = 2000 Feet

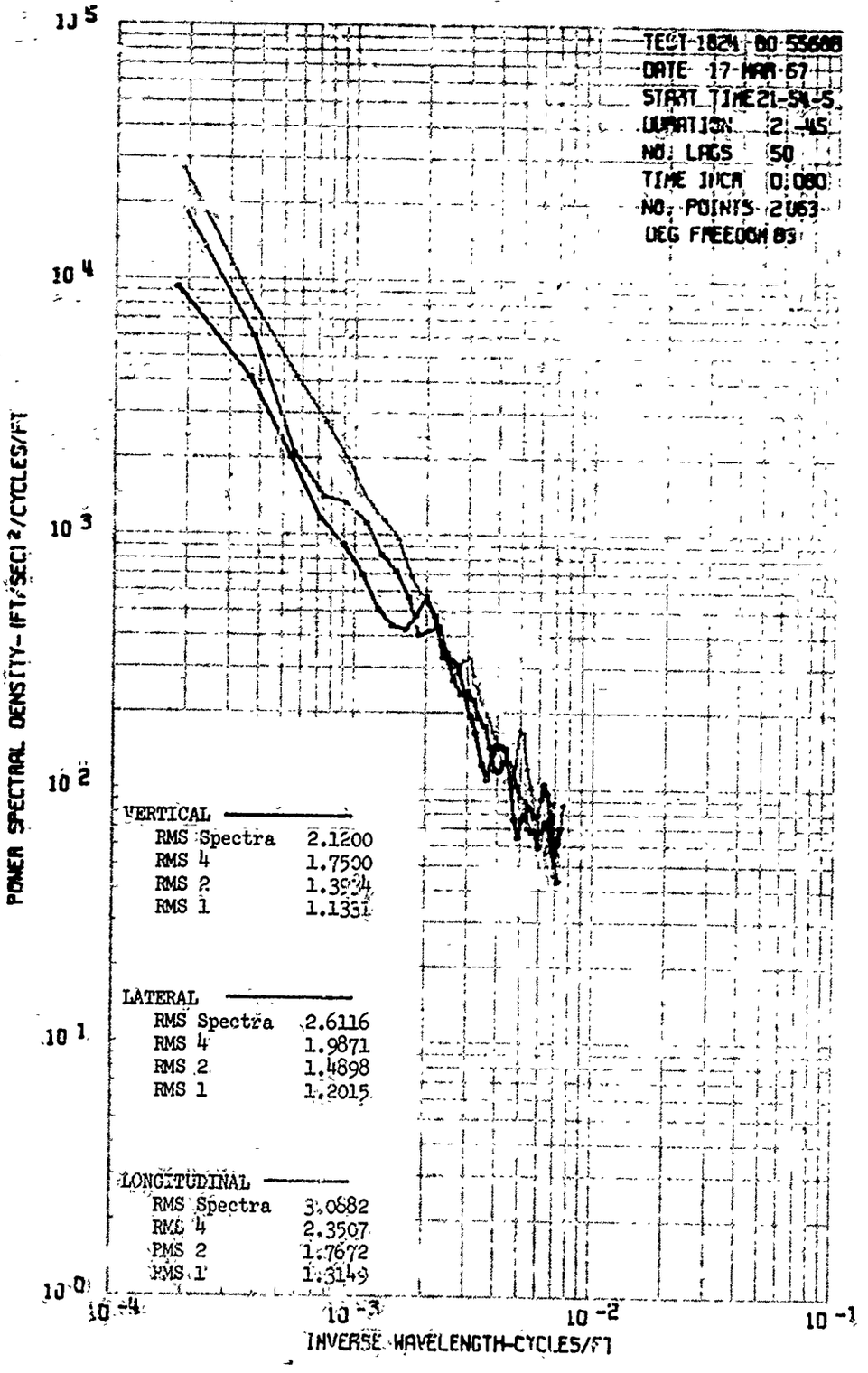


Figure 76 Gust Velocity Power Spectra for Test 182, Run 4
Maximum Standard λ = 4000 Feet

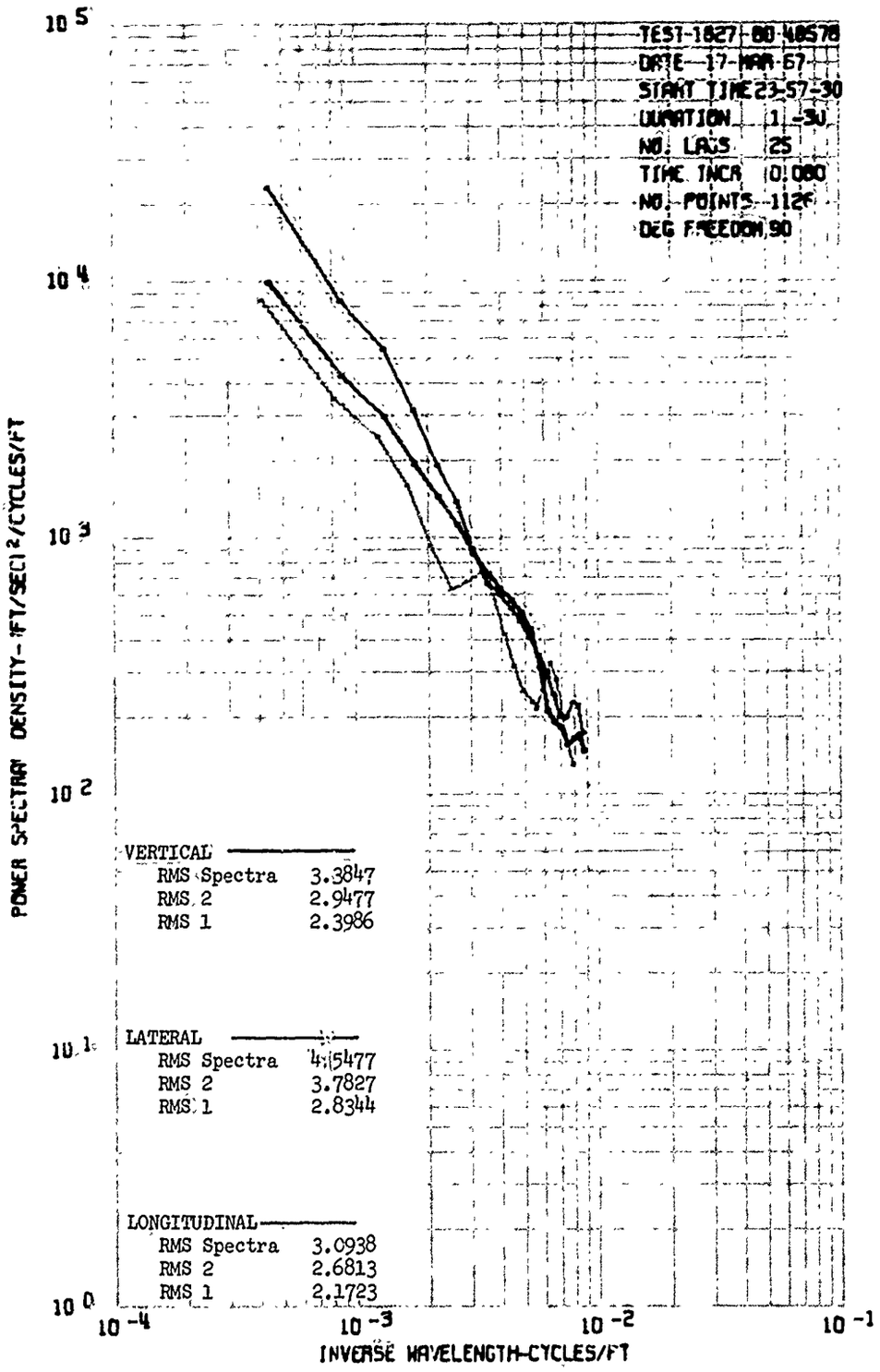


Figure 77 Gust Velocity Power Spectra for Test 182, Run 7
Maximum Standard λ = 2000 Feet

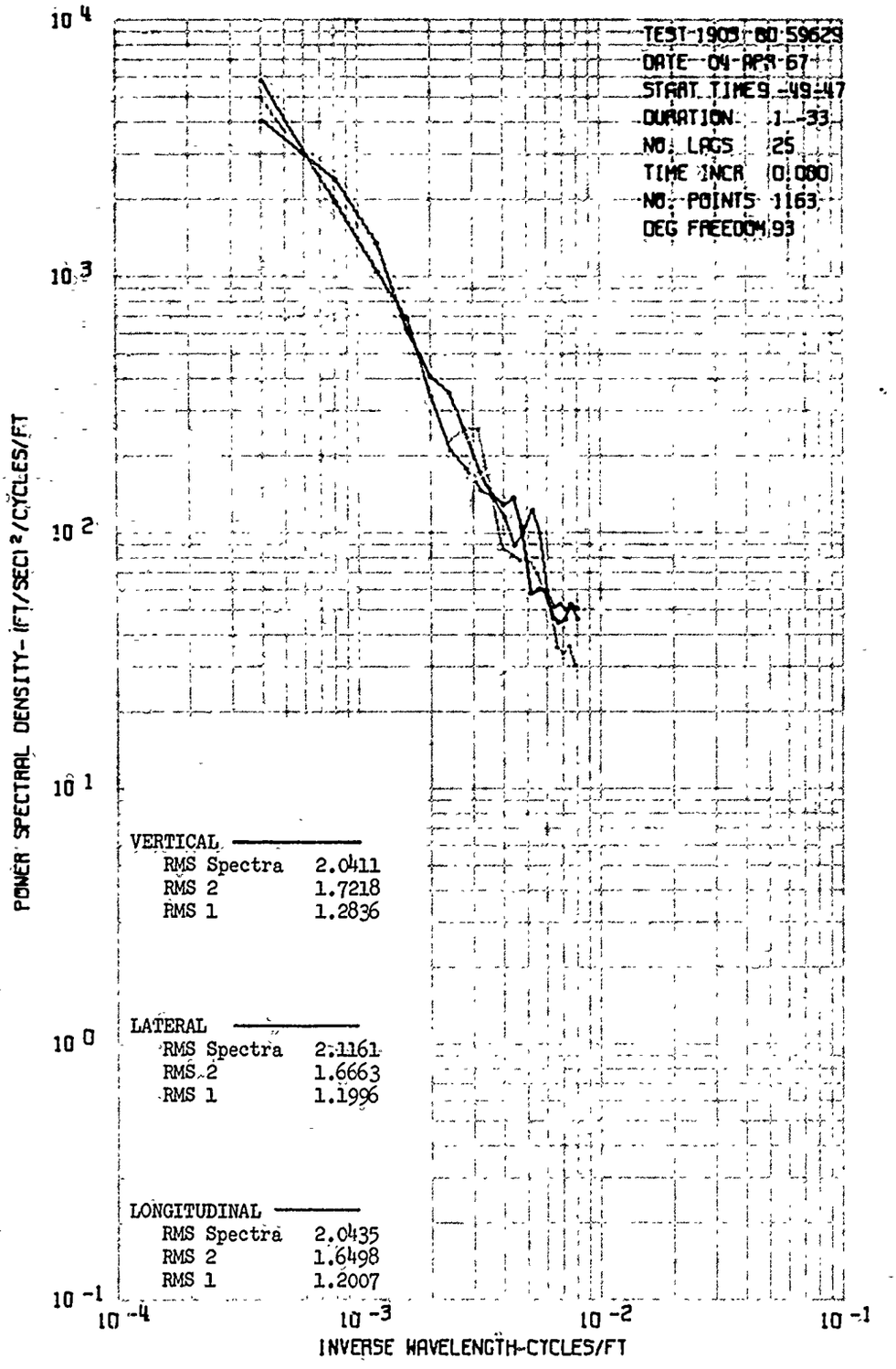


Figure 78 Gust Velocity Power Spectra for Test 190, Run 3
Maximum Standard λ = 2000 Feet

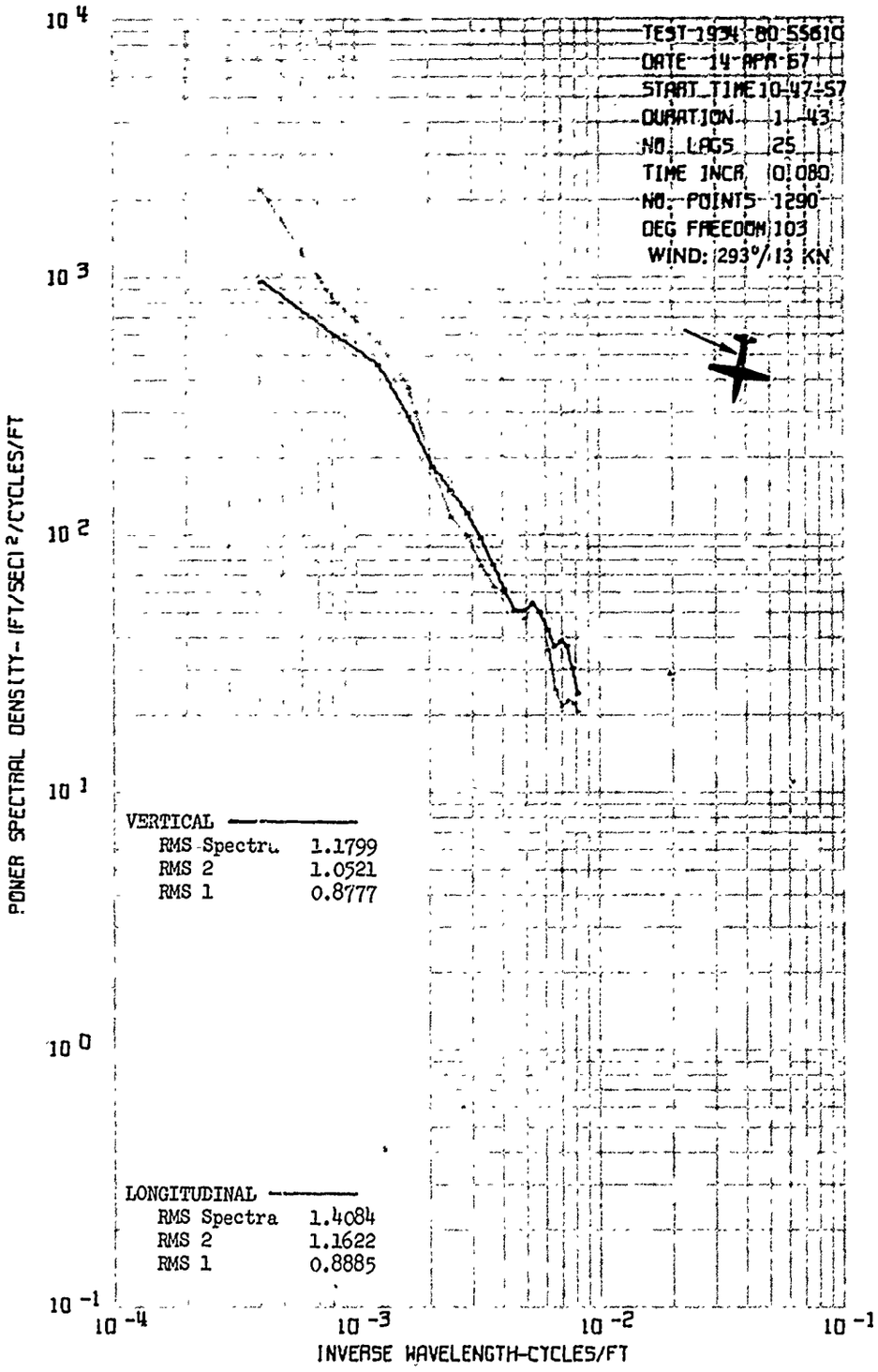


Figure 79 Gust Velocity Power Spectra for Test 193, Run 4
Maximum Standard λ = 2000 Feet

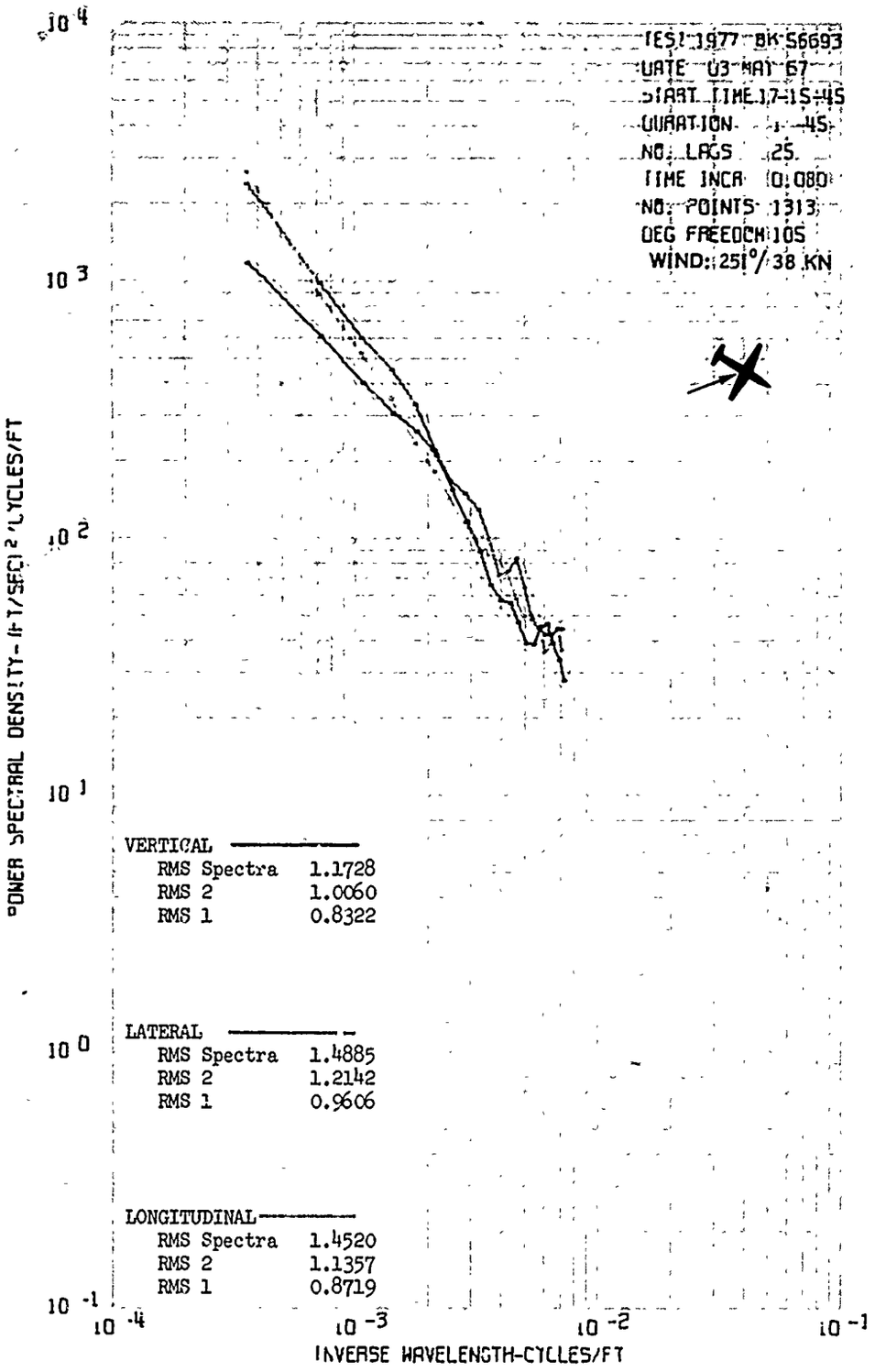


Figure 80 Gust Velocity Power Spectra for Test 197, Run 7
Maximum Standard λ = 2000 Feet

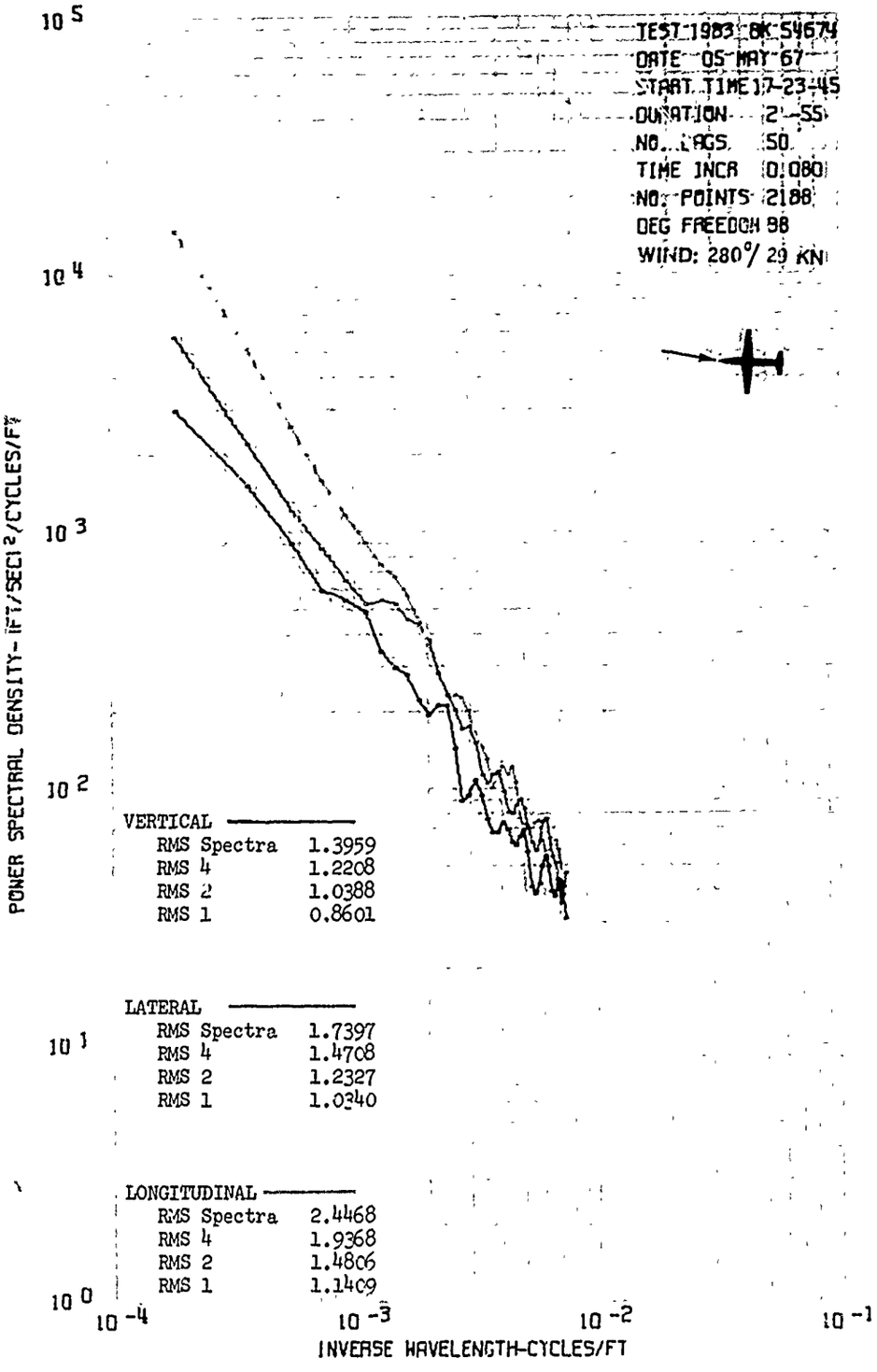


Figure 81 Gust Velocity Power Spectra for Test 198, Run 3
Maximum Standard λ = 4000 Feet

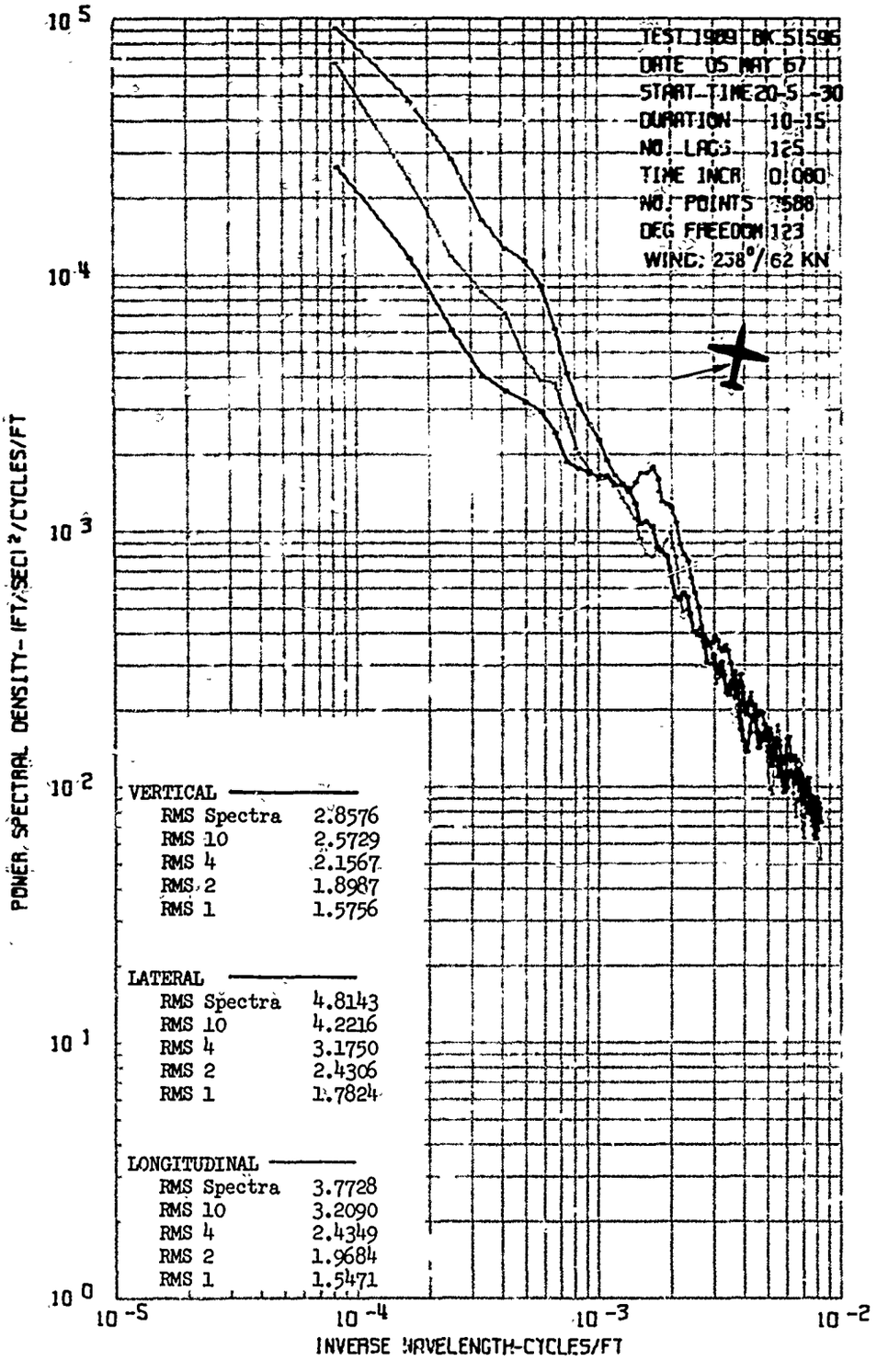


Figure 82 Gust Velocity Power Spectra for Test 198, Run 9
Maximum Standard λ = 10,000 Feet

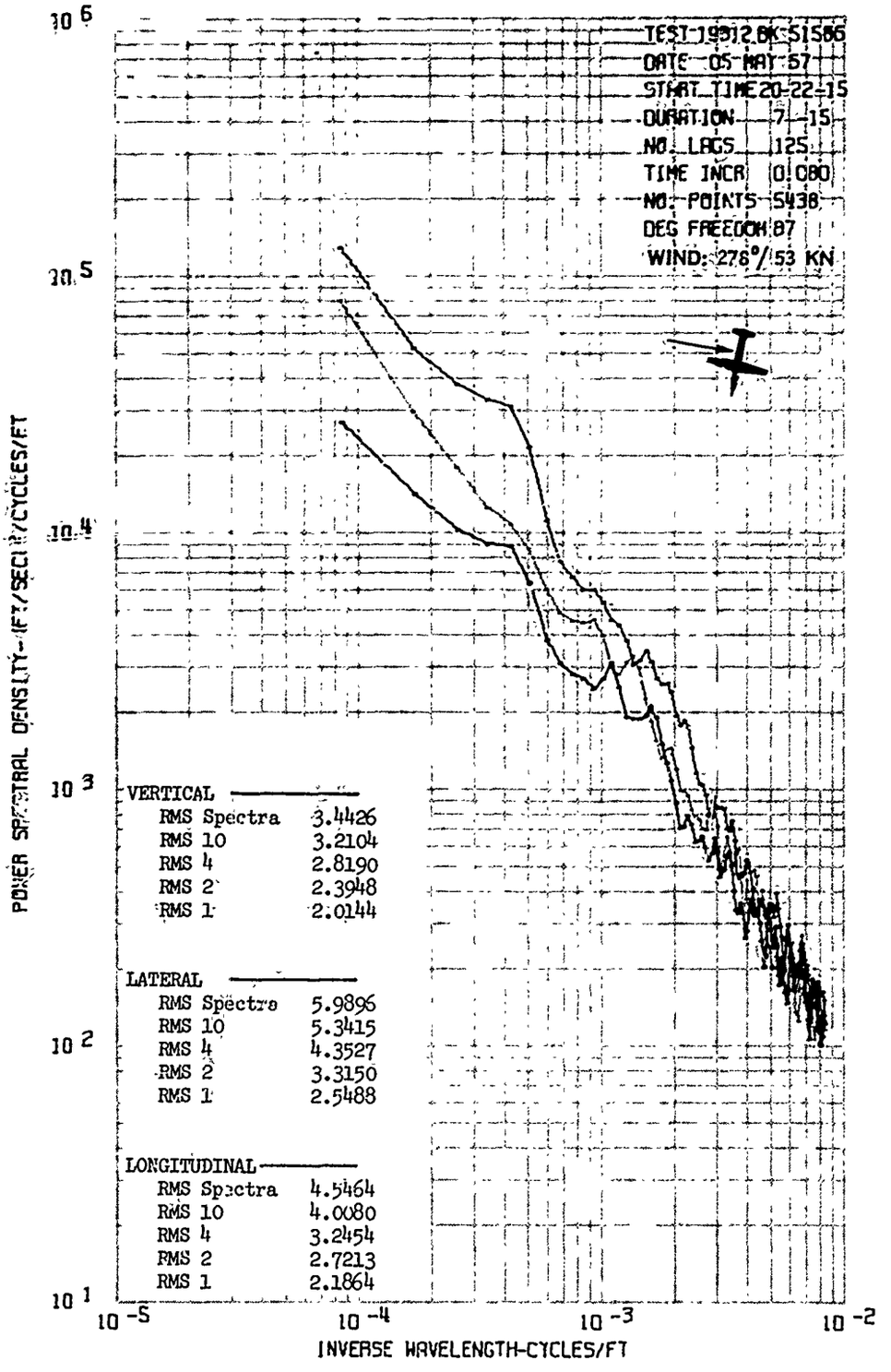


Figure 83 Gust Velocity Power Spectra for Test 198, Run 12
Maximum Standard λ = 10,000 Feet

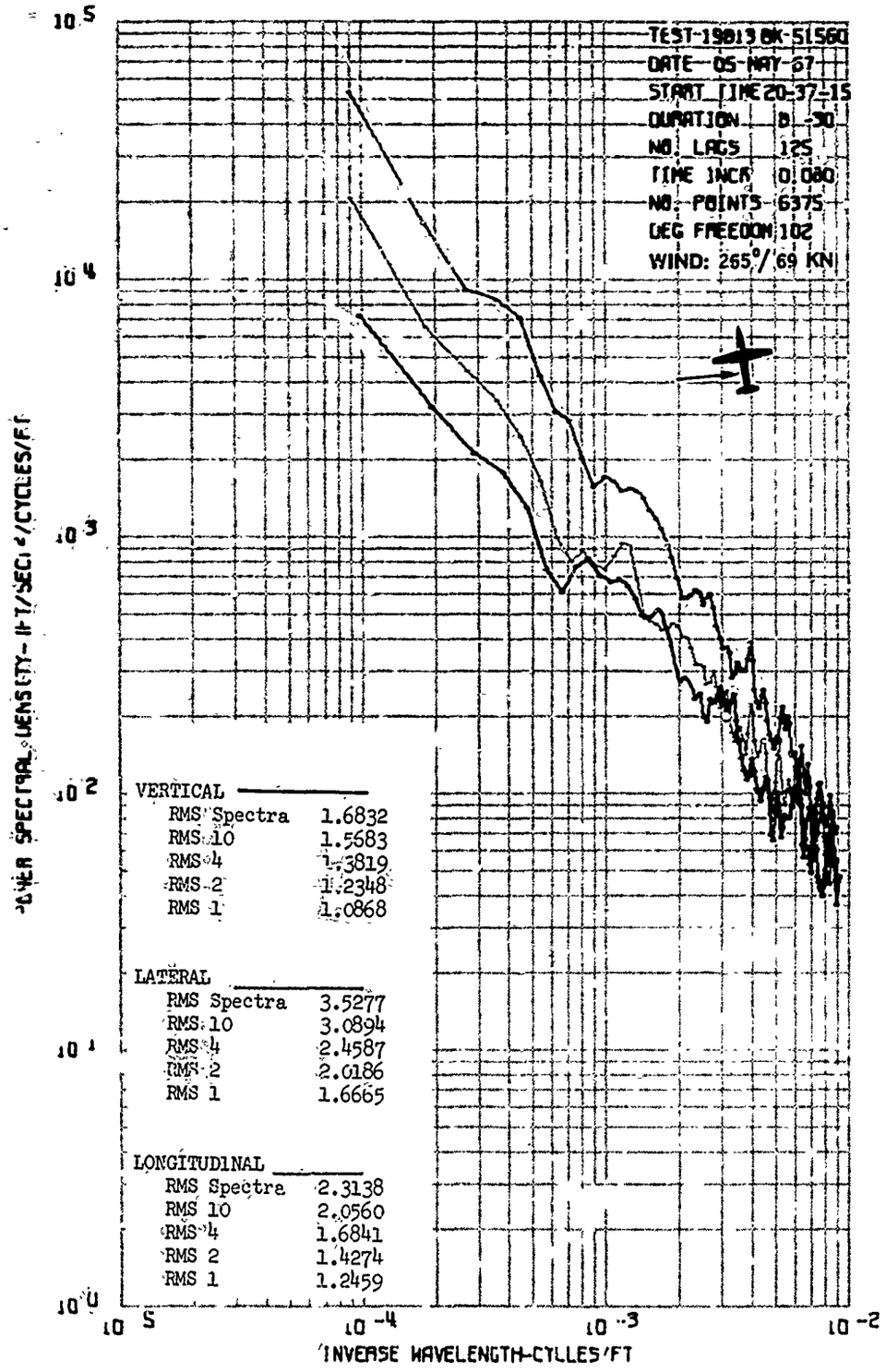


Figure 84 Gust Velocity Power Spectra for Test 198, Run 13
Maximum Standard λ = 10,000 Feet

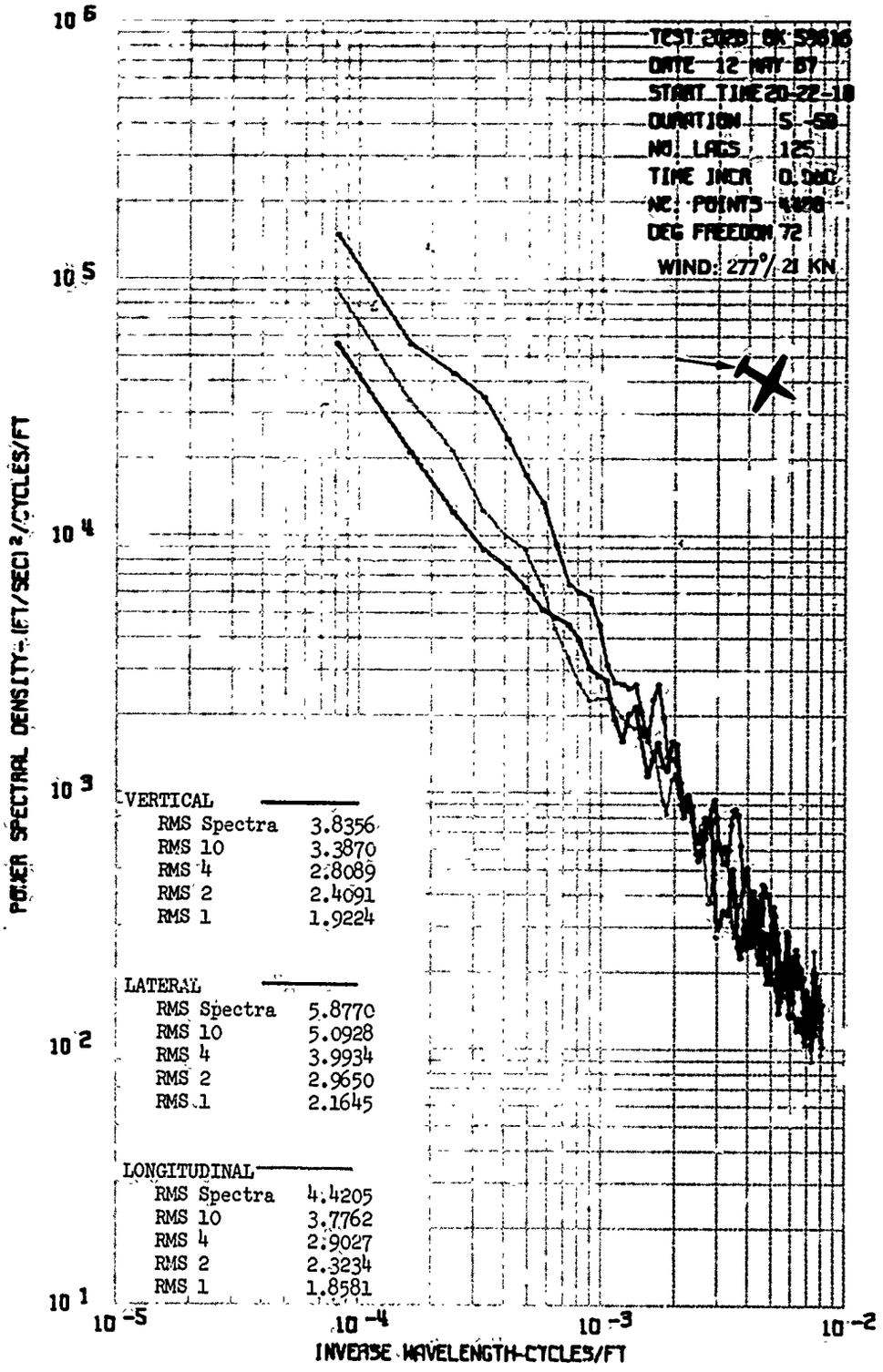


Figure 85 Gust Velocity Power Spectra for Test 202, Run 8
Maximum Standard λ = 4000 Feet

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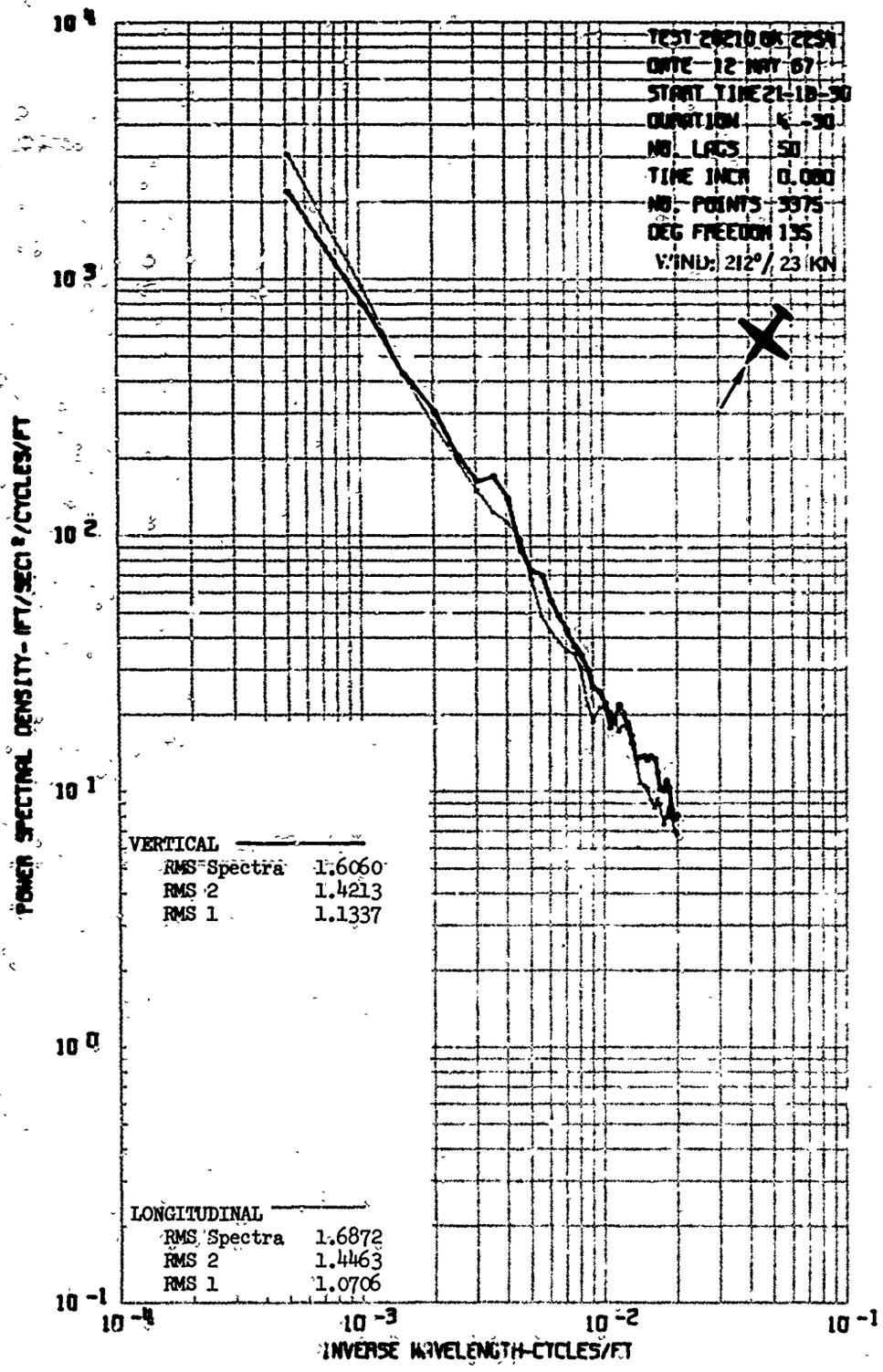


Figure 86 Gust Velocity Power Spectra for Test 202, Run 10 (Landing Approach)
Maximum Standard λ = 2000 Feet

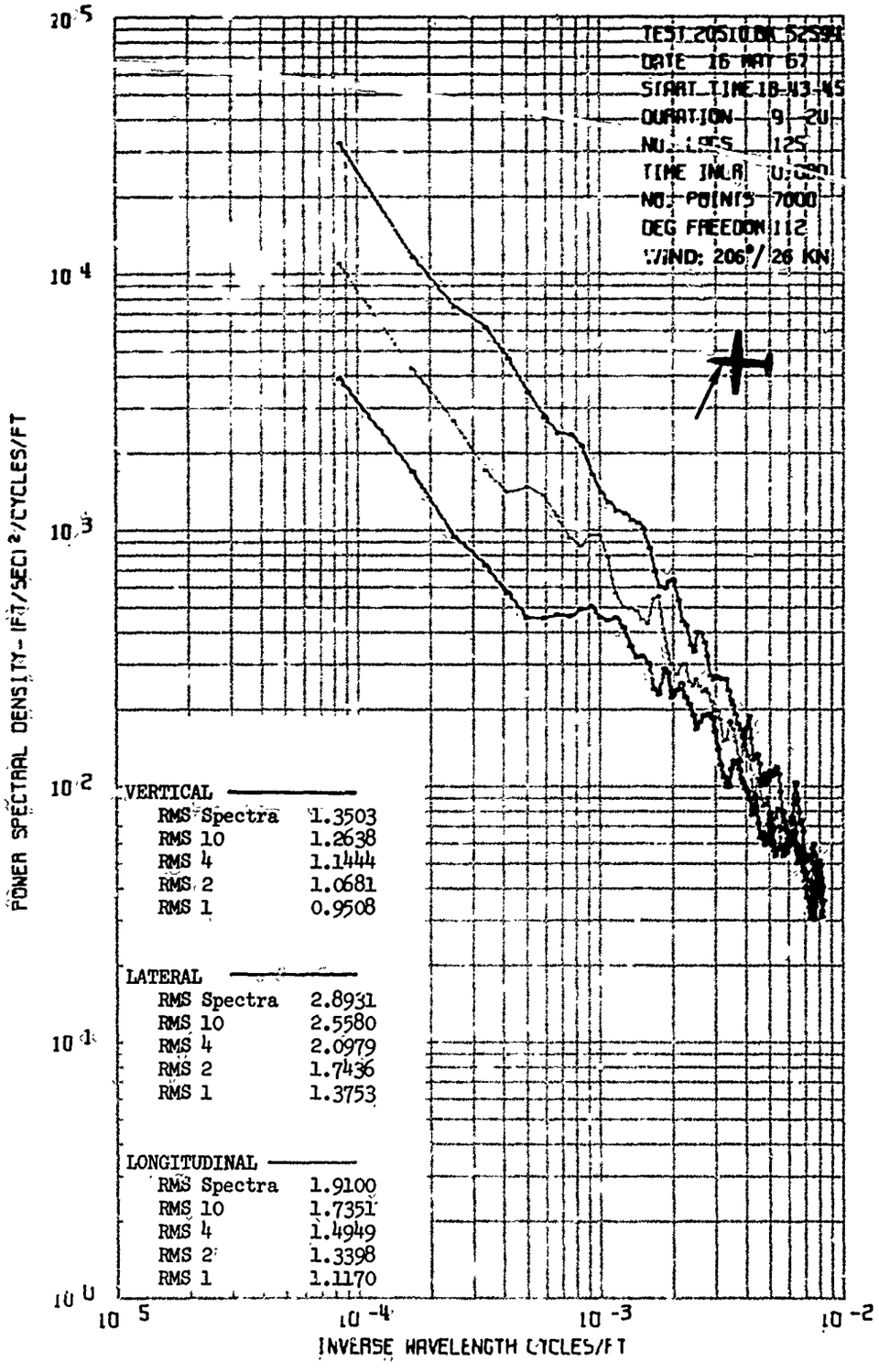


Figure 87 Gust Velocity Power Spectra for Test 205, Run 10
Maximum Standard λ = 10,000 Feet

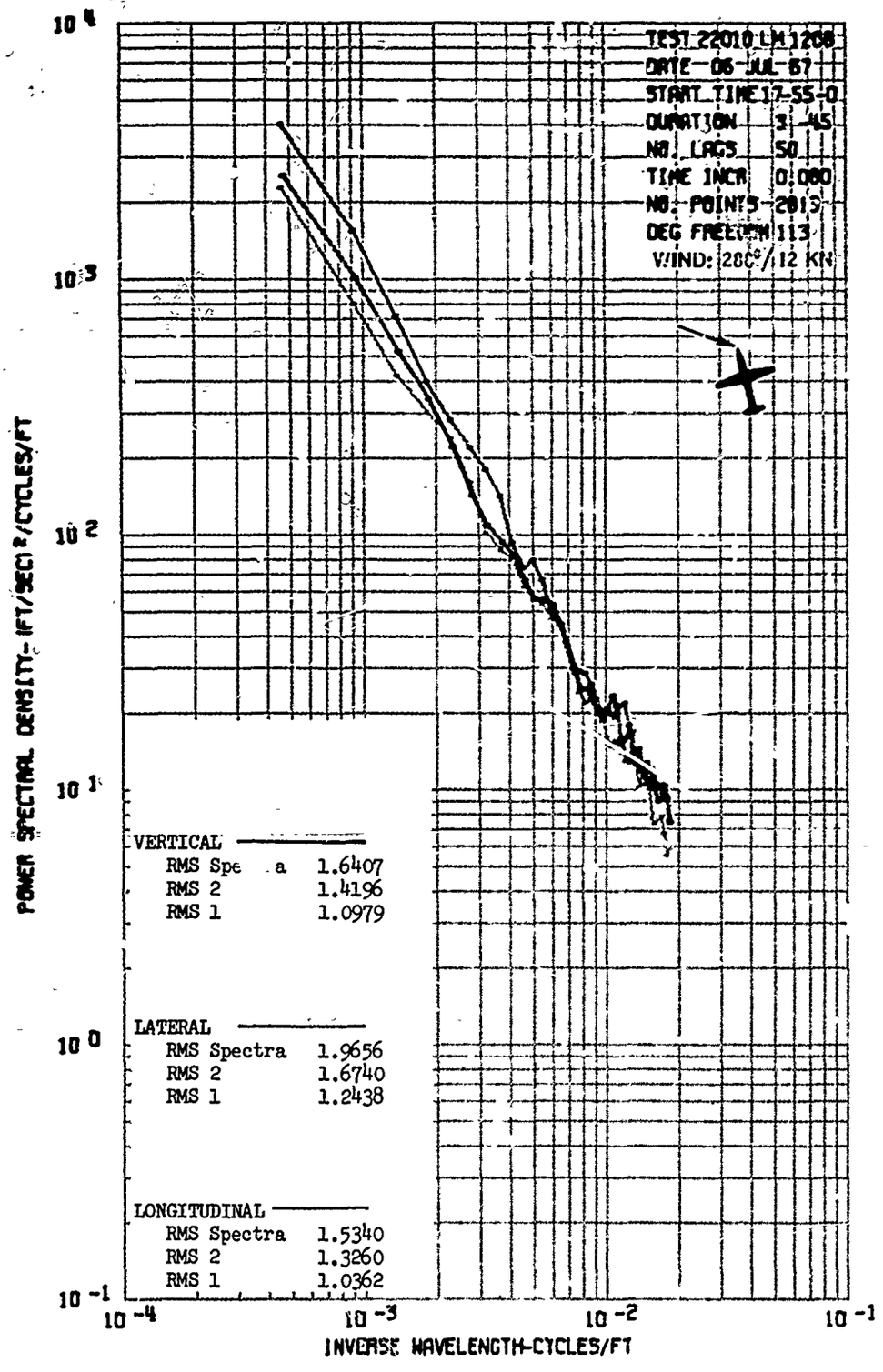


Figure 88 Gust Velocity Power Spectra for Test 220, Run 10 (Landing Approach) Maximum Standard λ = 2000 Feet

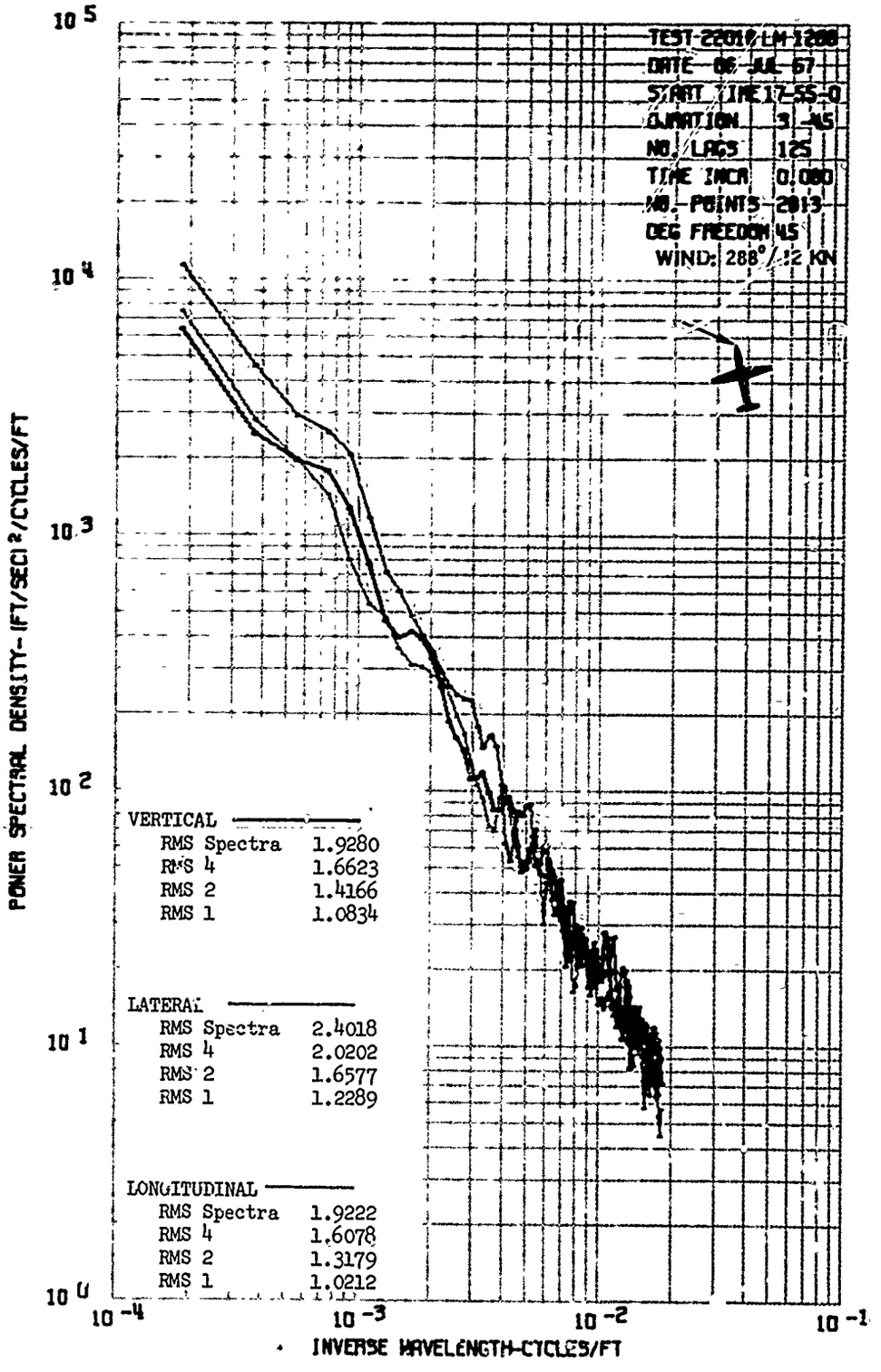


Figure 89 Gust Velocity Power Spectra for Test 220, Run 10 (Landing Approach) Maximum Standard λ = 4000 Feet

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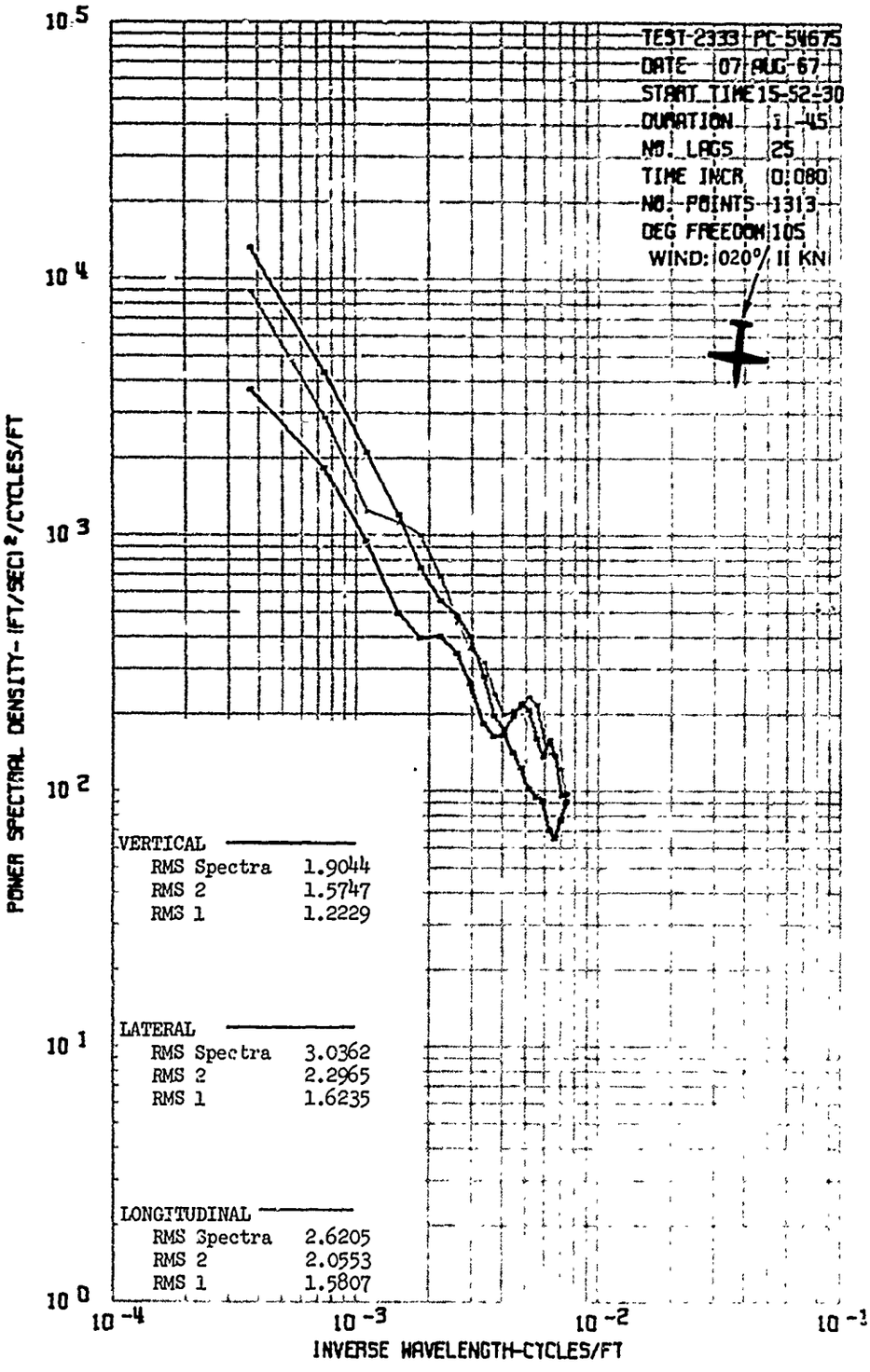


Figure 90 Gust Velocity Power Spectra for Test 233, Run 3
Maximum Standard λ = 2000 Feet

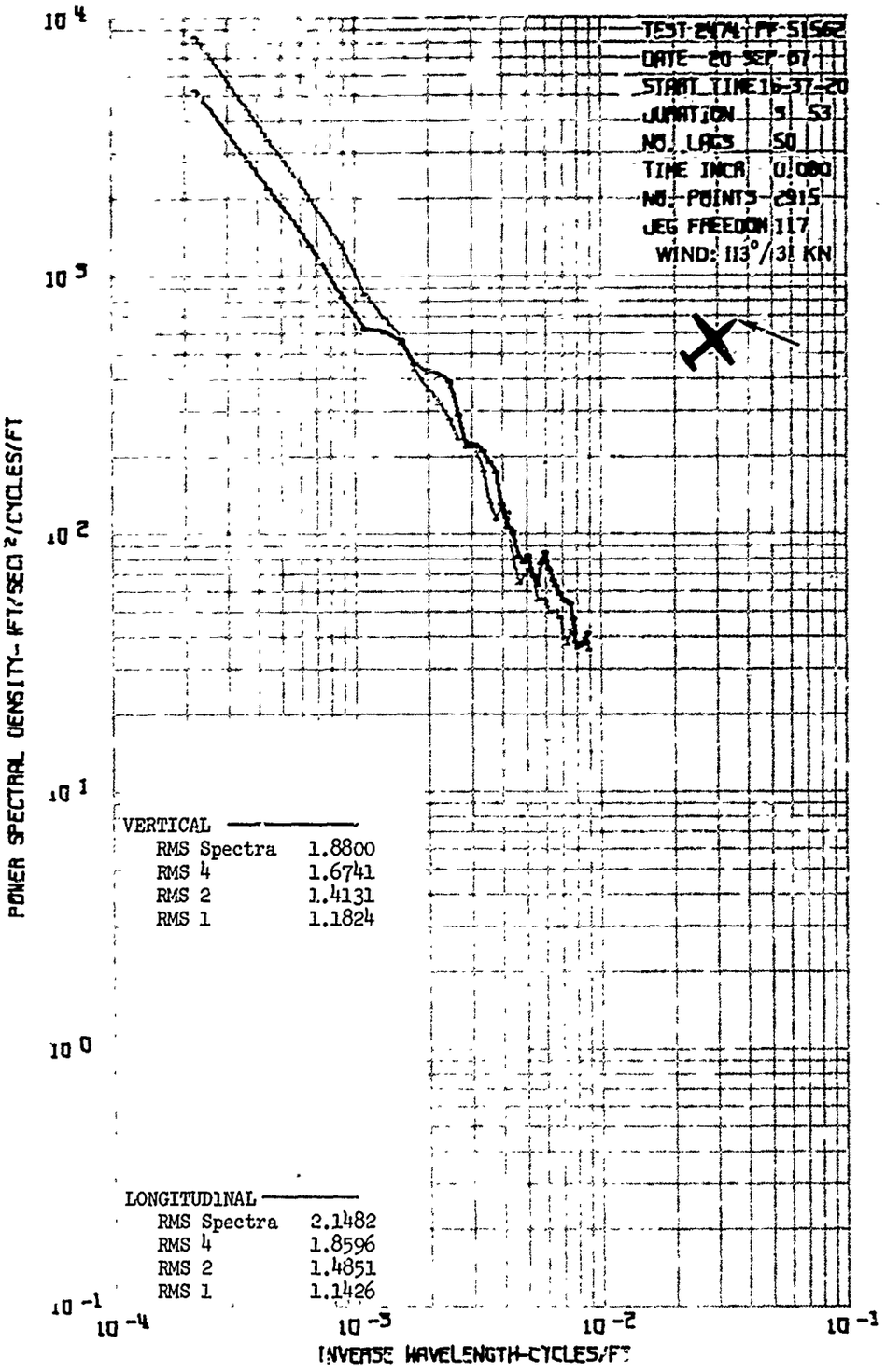


Figure 91 Gust Velocity Power Spectra for Test 247, Run 4
Maximum Standard λ = 4000 Feet

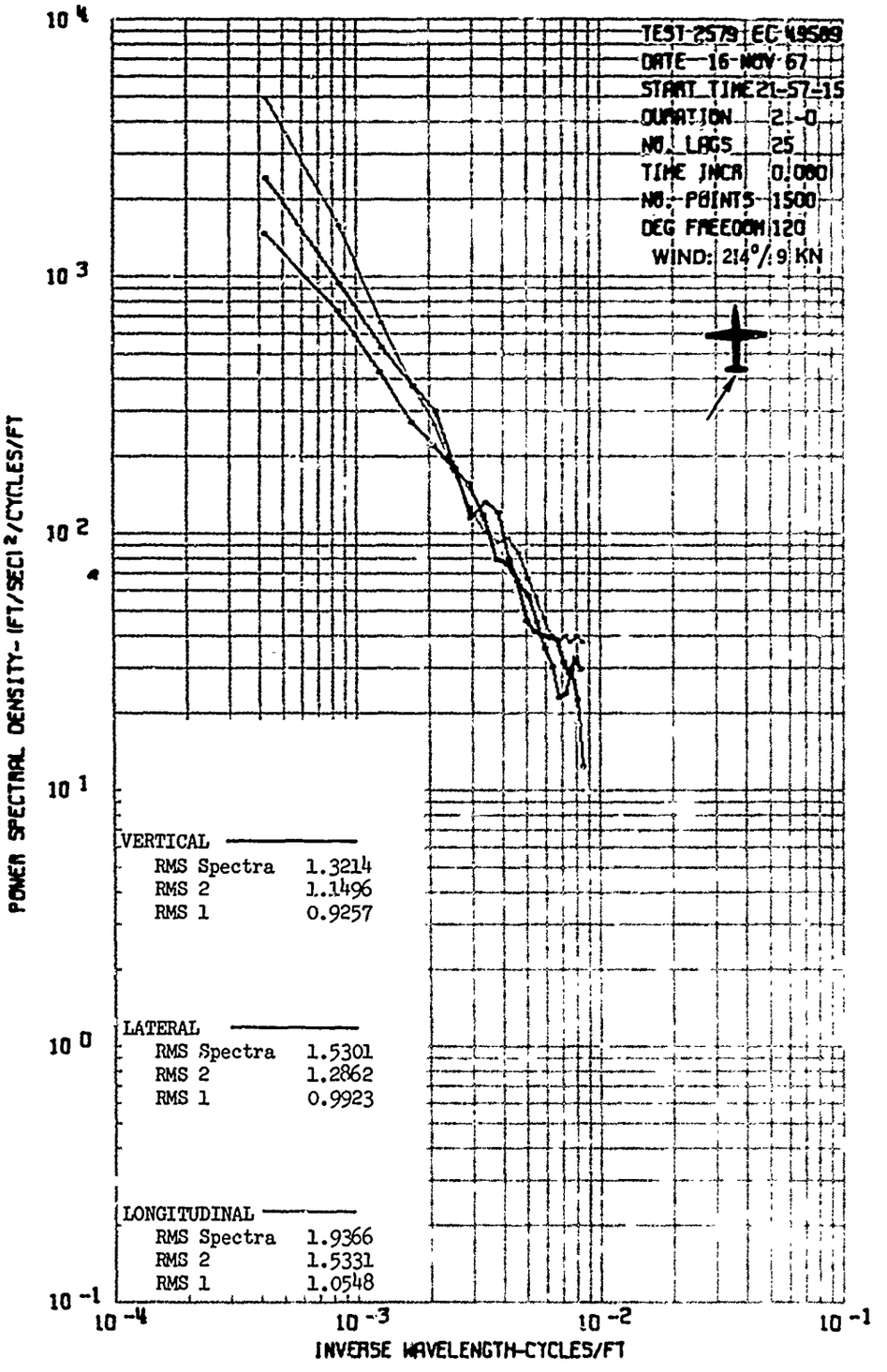


Figure 92 Gust Velocity Power Spectra for Test 257, Run 9
Maximum Standard λ = 2000 Feet

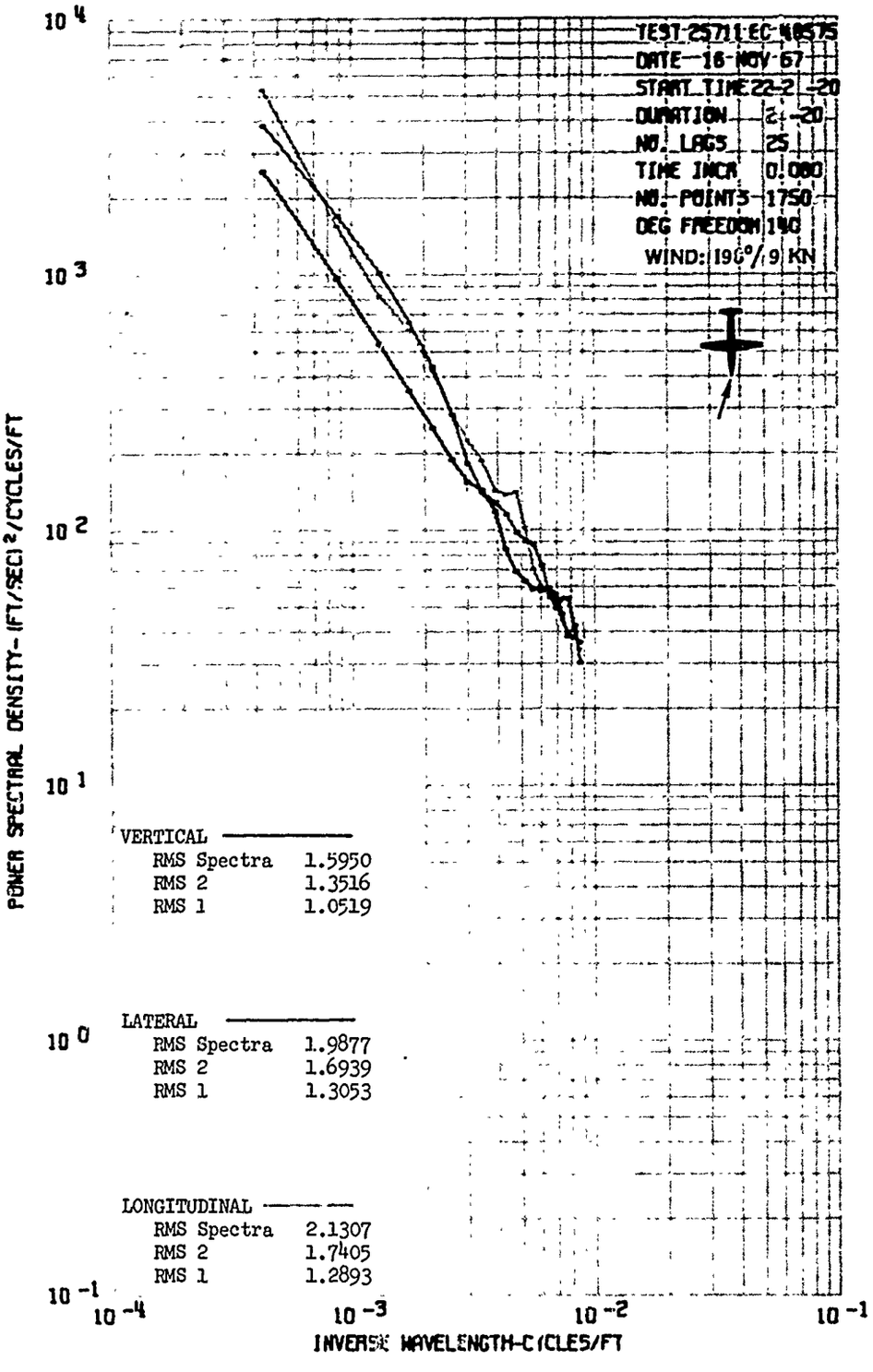


Figure 93 Gust Velocity Power Spectra for Test 257, Run 11
Maximum Standard λ = 2000 Feet

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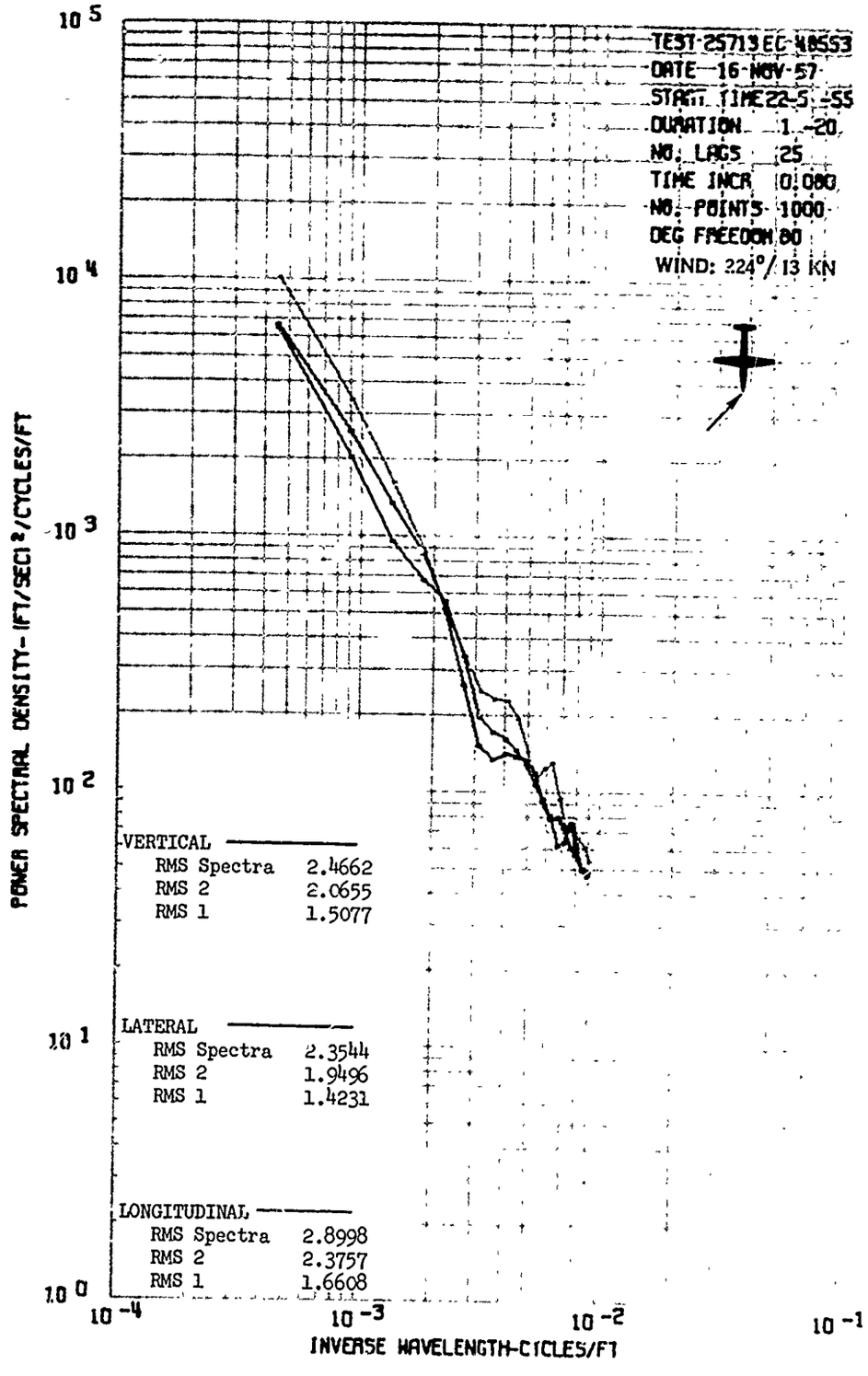


Figure 94 Gust Velocity Power Spectra for Test 257, Run 13
Maximum Standard λ = 2000 Feet

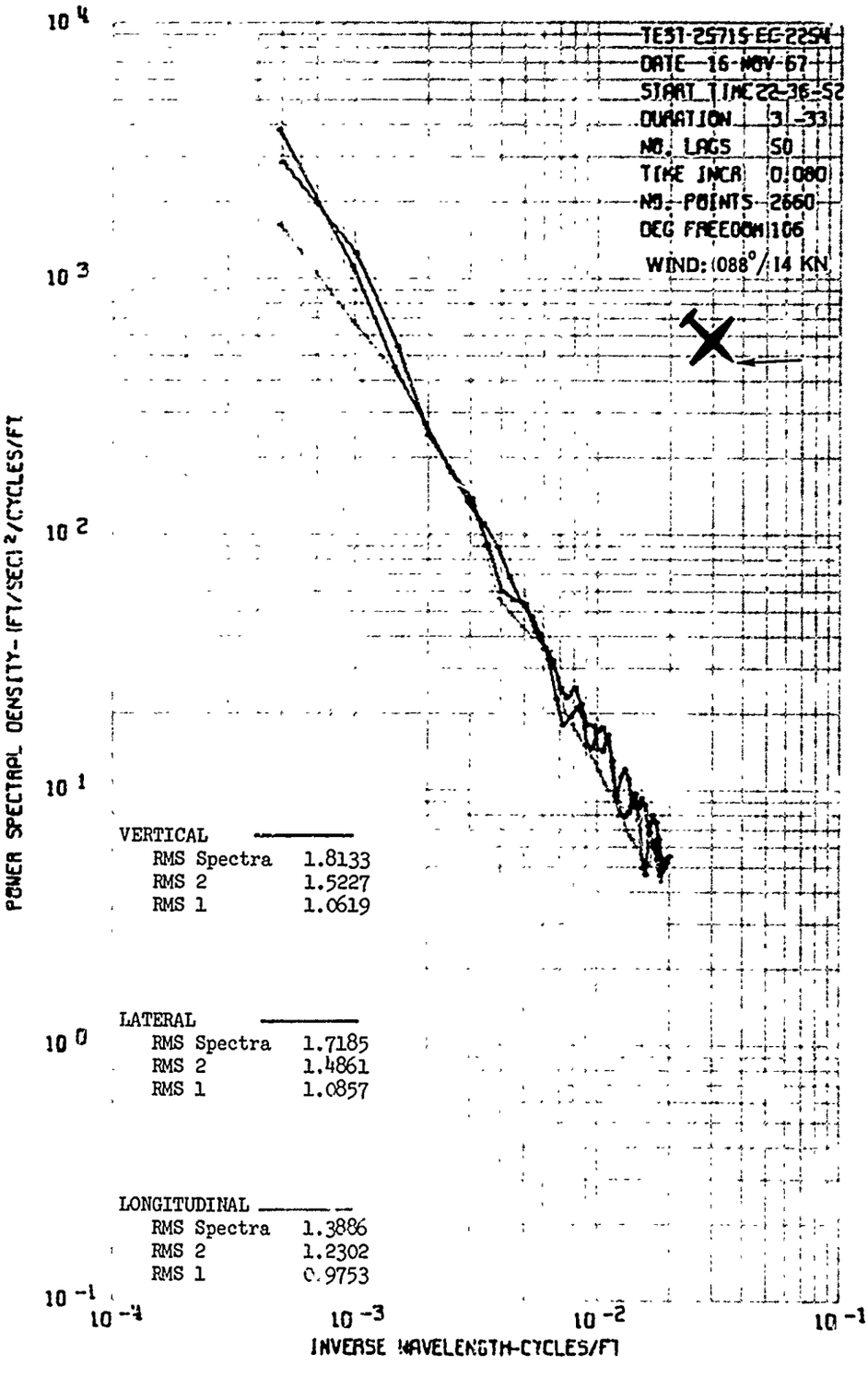


Figure 95 Gust Velocity Power Spectra for Test 257, Run 15 (Landing Approach) Maximum Standard λ = 2000 Feet

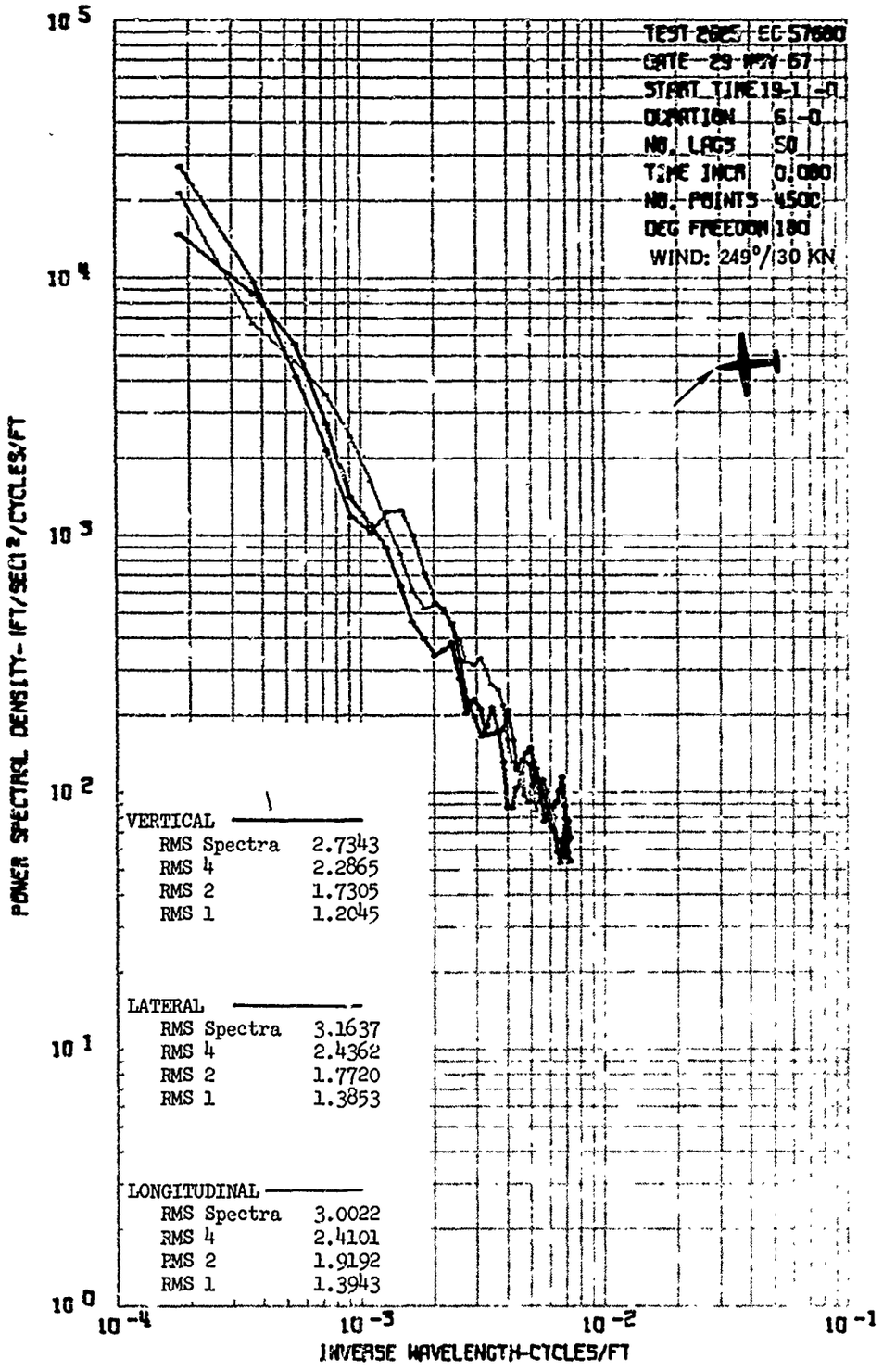


Figure 96 Gust Velocity Power Spectra for Test 262, Run 5
Maximum Standard λ = 4000 Feet

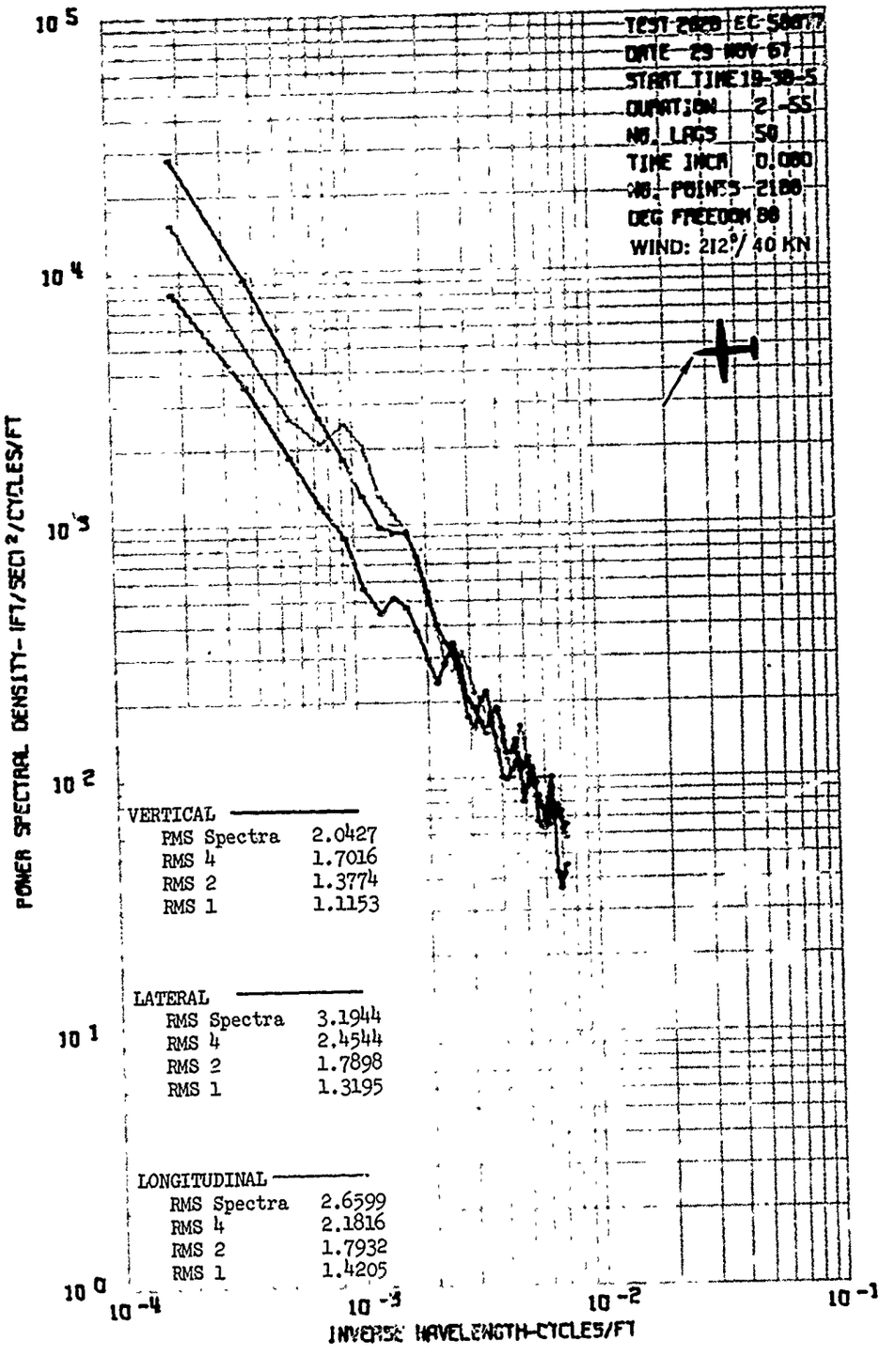


Figure 97 Gust Velocity Power Spectra for Test 262, Run 8
Maximum Standard λ = 4000 Feet

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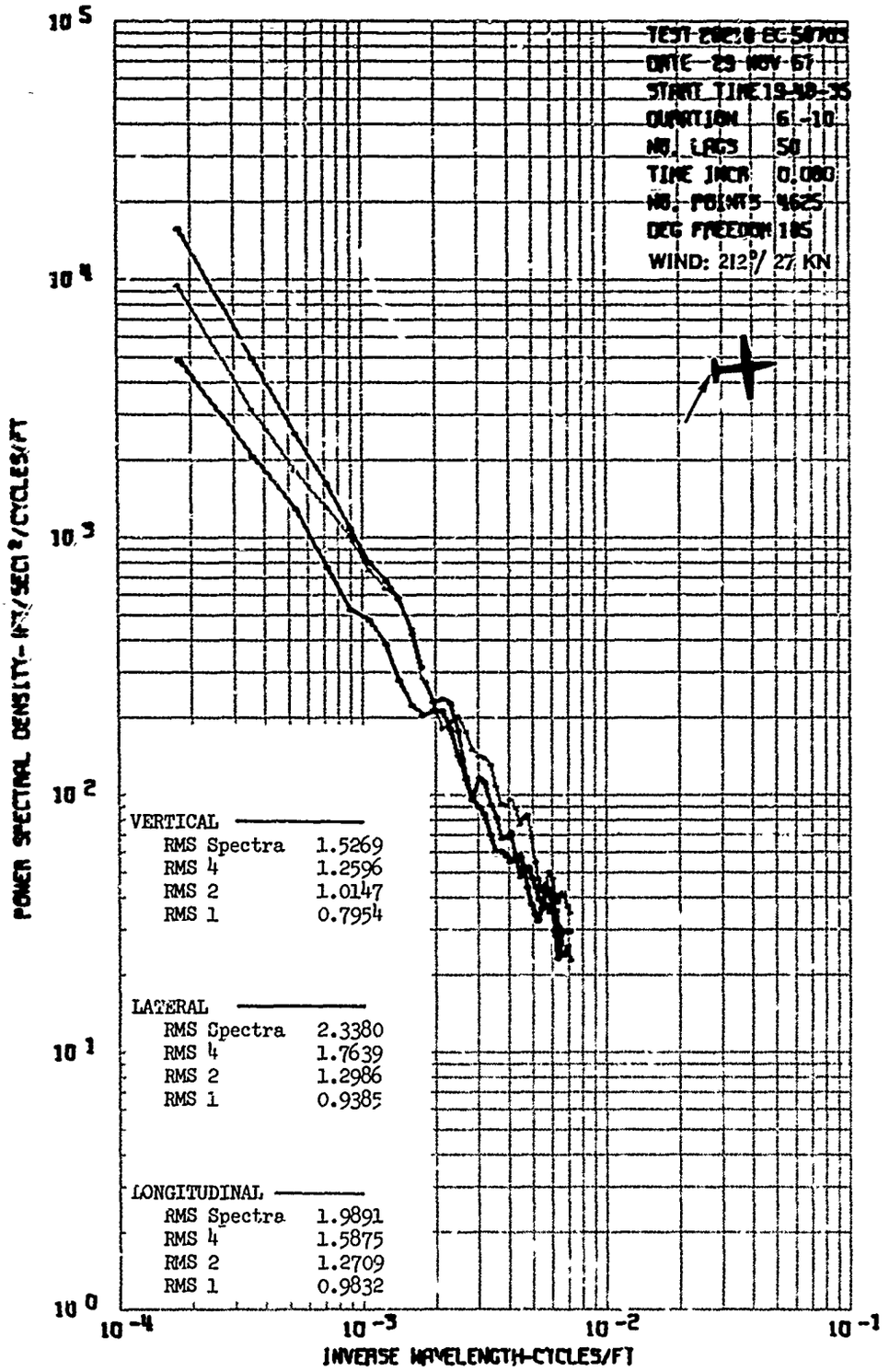


Figure 98 Gust Velocity Power Spectra for Test 262, Run 10
Maximum Standard λ = 4000 Feet

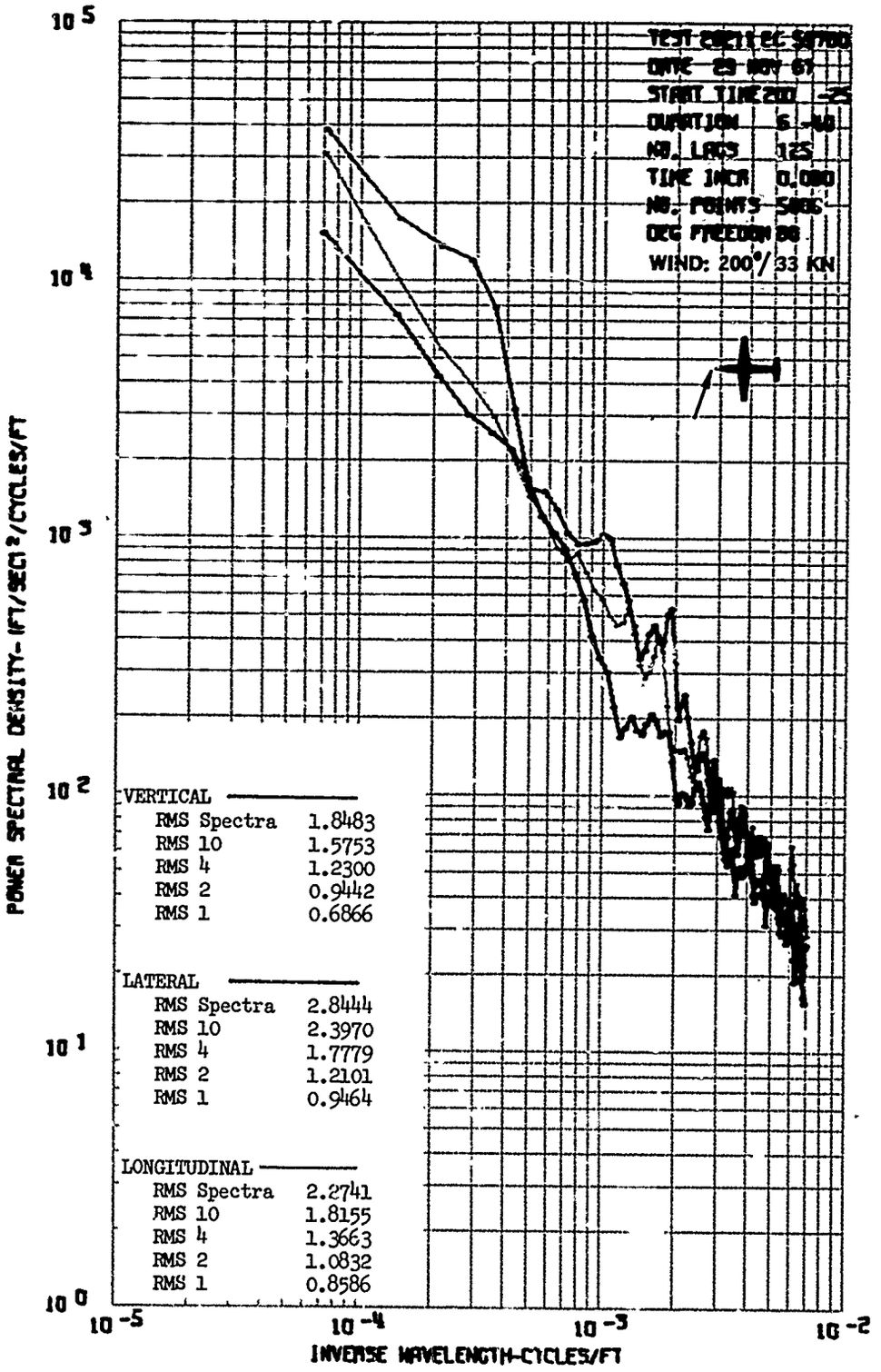


Figure 99 Gust Velocity Power Spectra for Test 262, Run 11
Maximum Standard λ = 10,000 Feet

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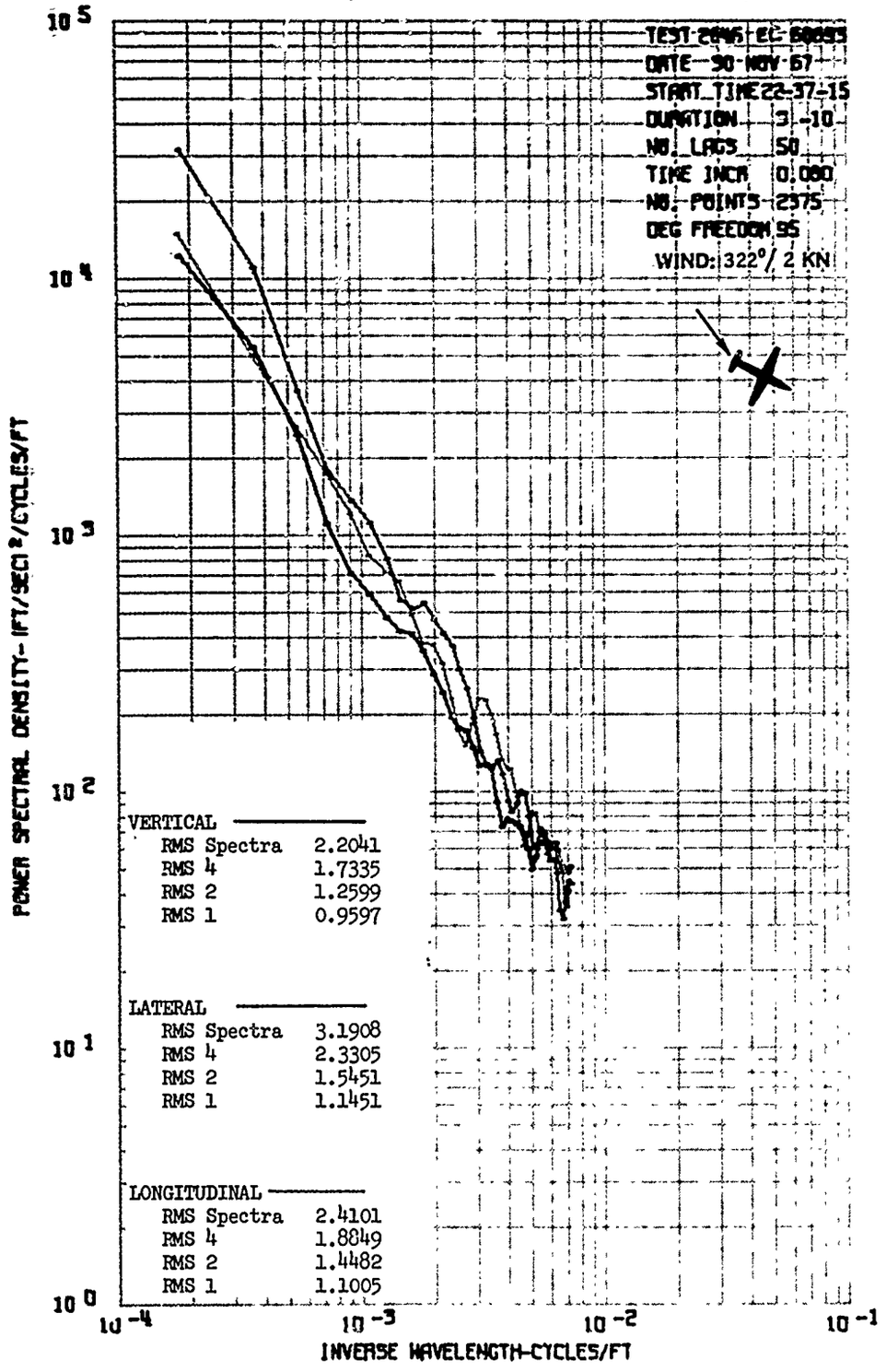


Figure 100 Gust Velocity Power Spectra for Test 264, Run 6
Maximum Standard λ = 4000 Feet

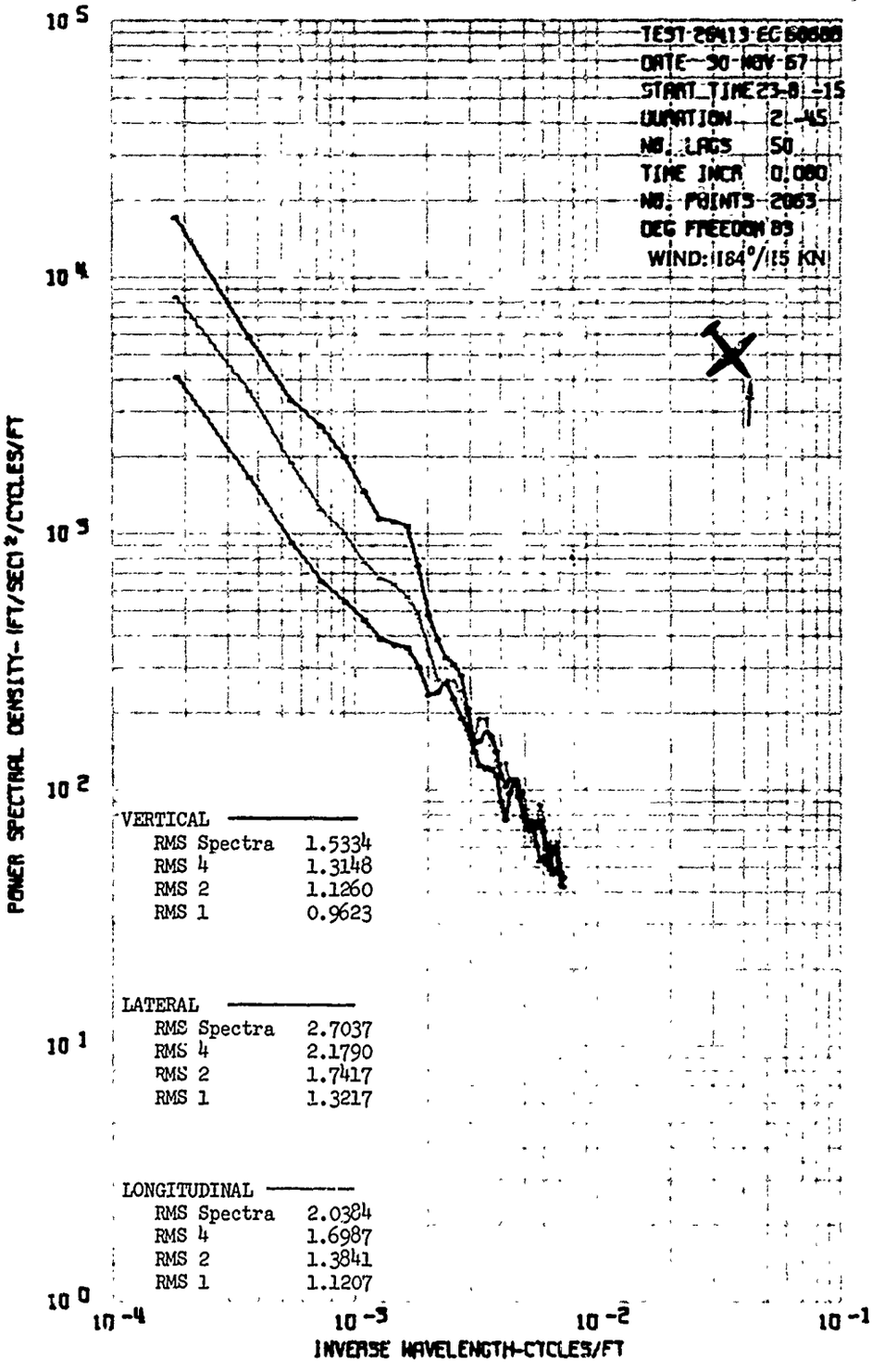


Figure 101 Gust Velocity Power Spectra for Test 264, Run 13
Maximum Standard λ = 4000 Feet

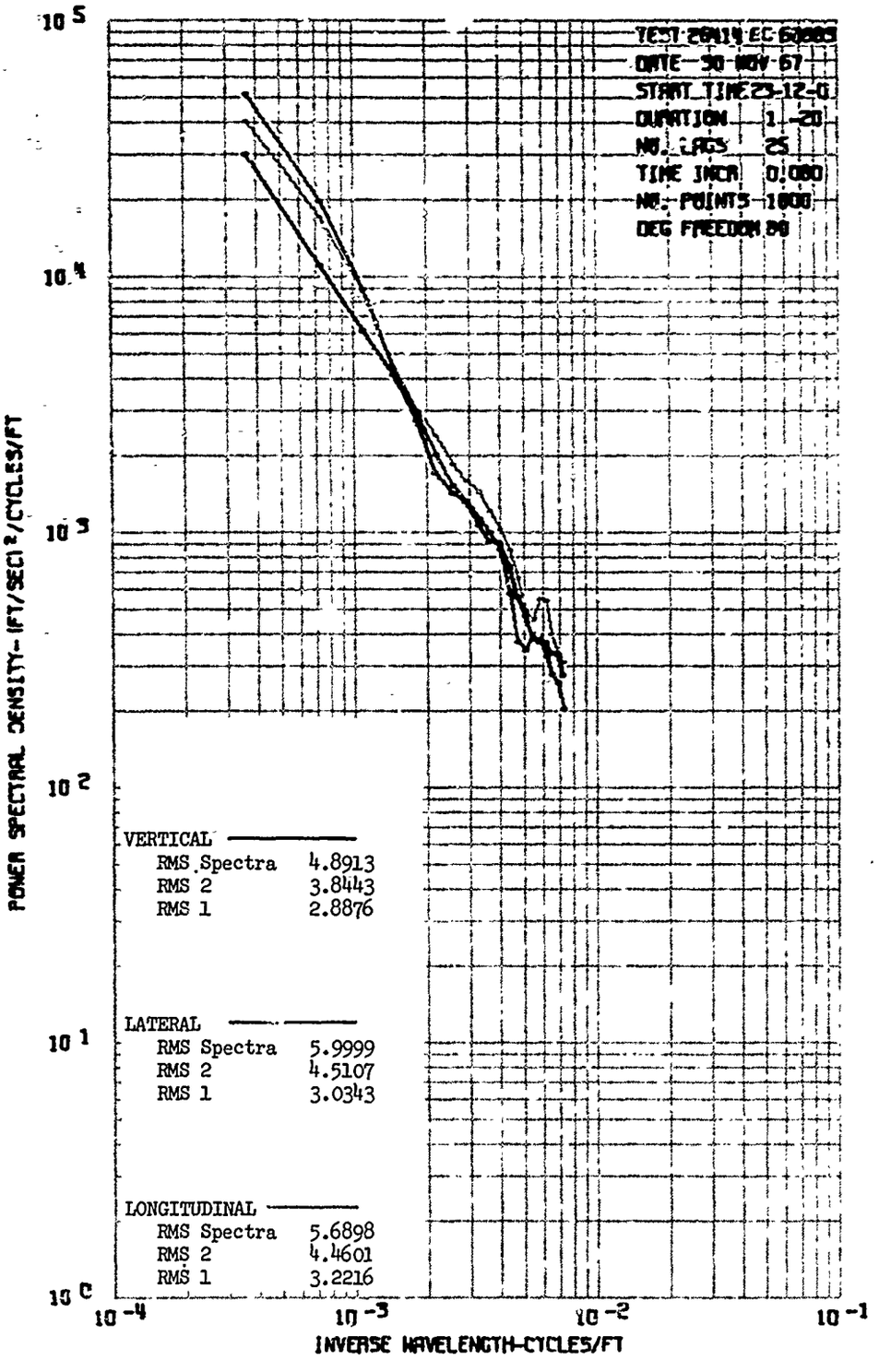


Figure 102 Gust Velocity Power Spectra for Test 264, Run 14
Maximum Standard λ = 2000 Feet

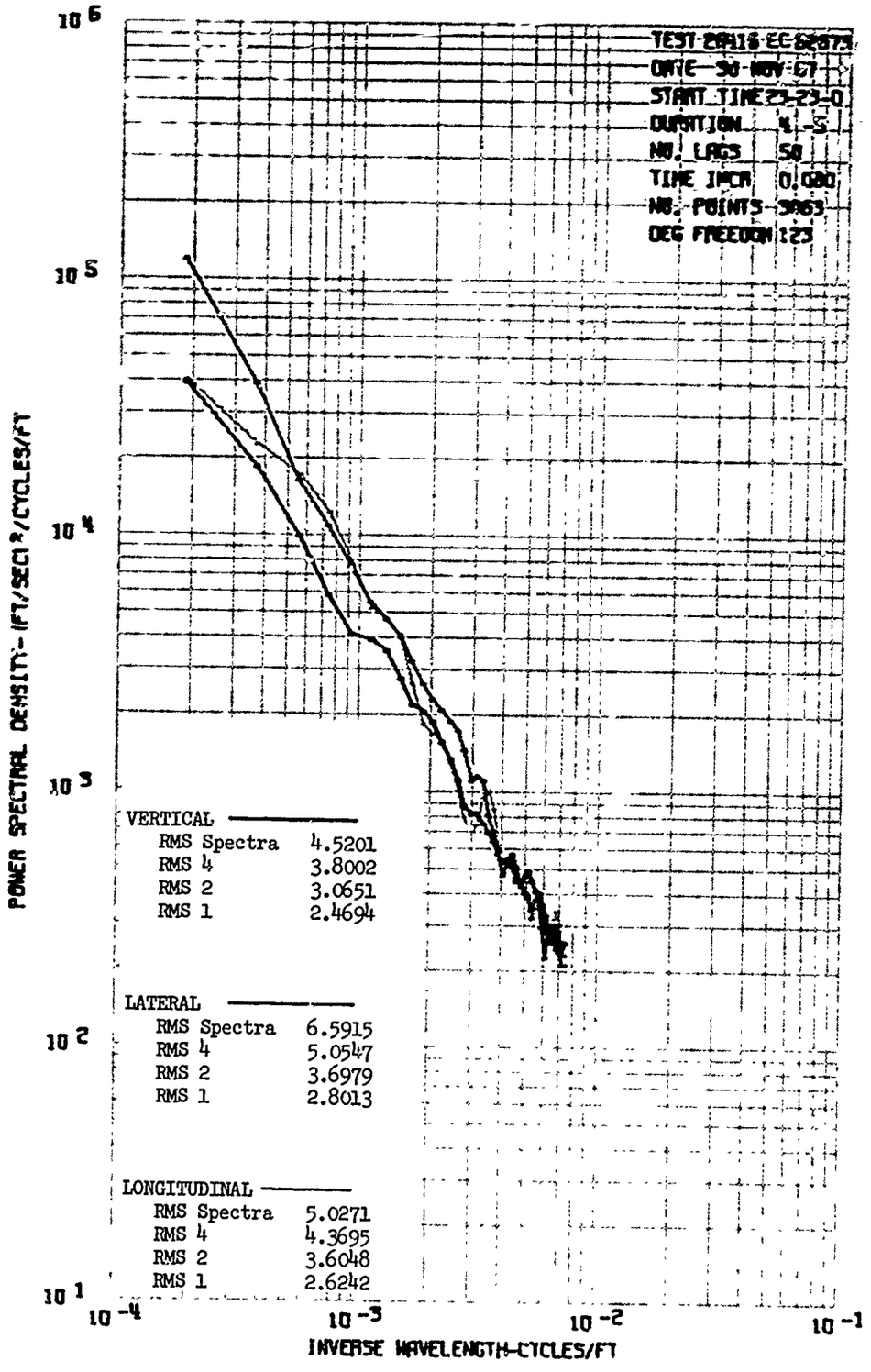


Figure 103 Gust Velocity Power Spectra for Test 264, Run 16
Maximum Standard λ = 4000 Feet

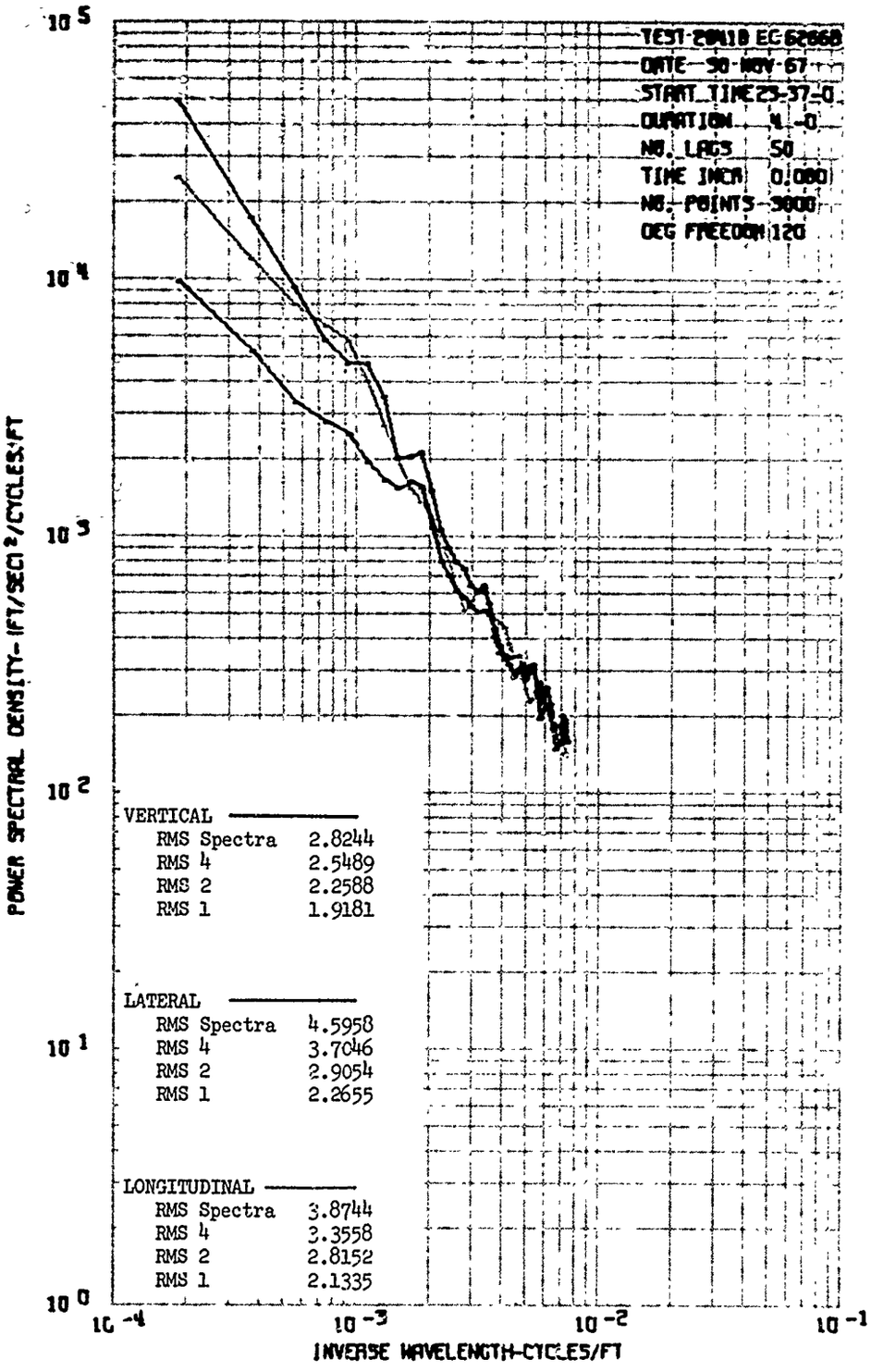


Figure 104 Gust Velocity Power Spectra for Test 264, Run 18
Maximum Standard λ = 4000 Feet

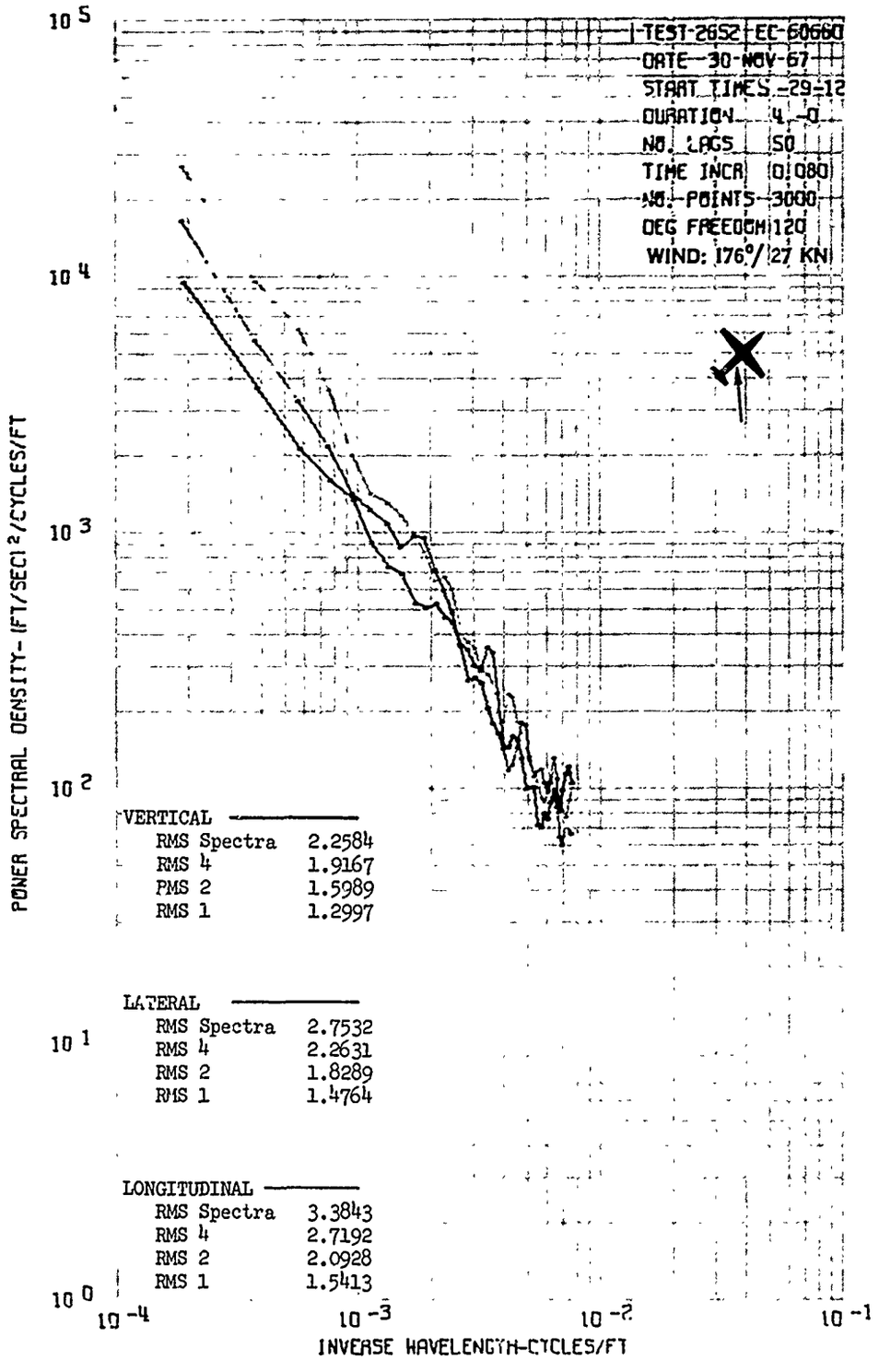


Figure 105 Gust Velocity Power Spectra for Test 265, Run 2
Maximum Standard λ = 4000 Feet

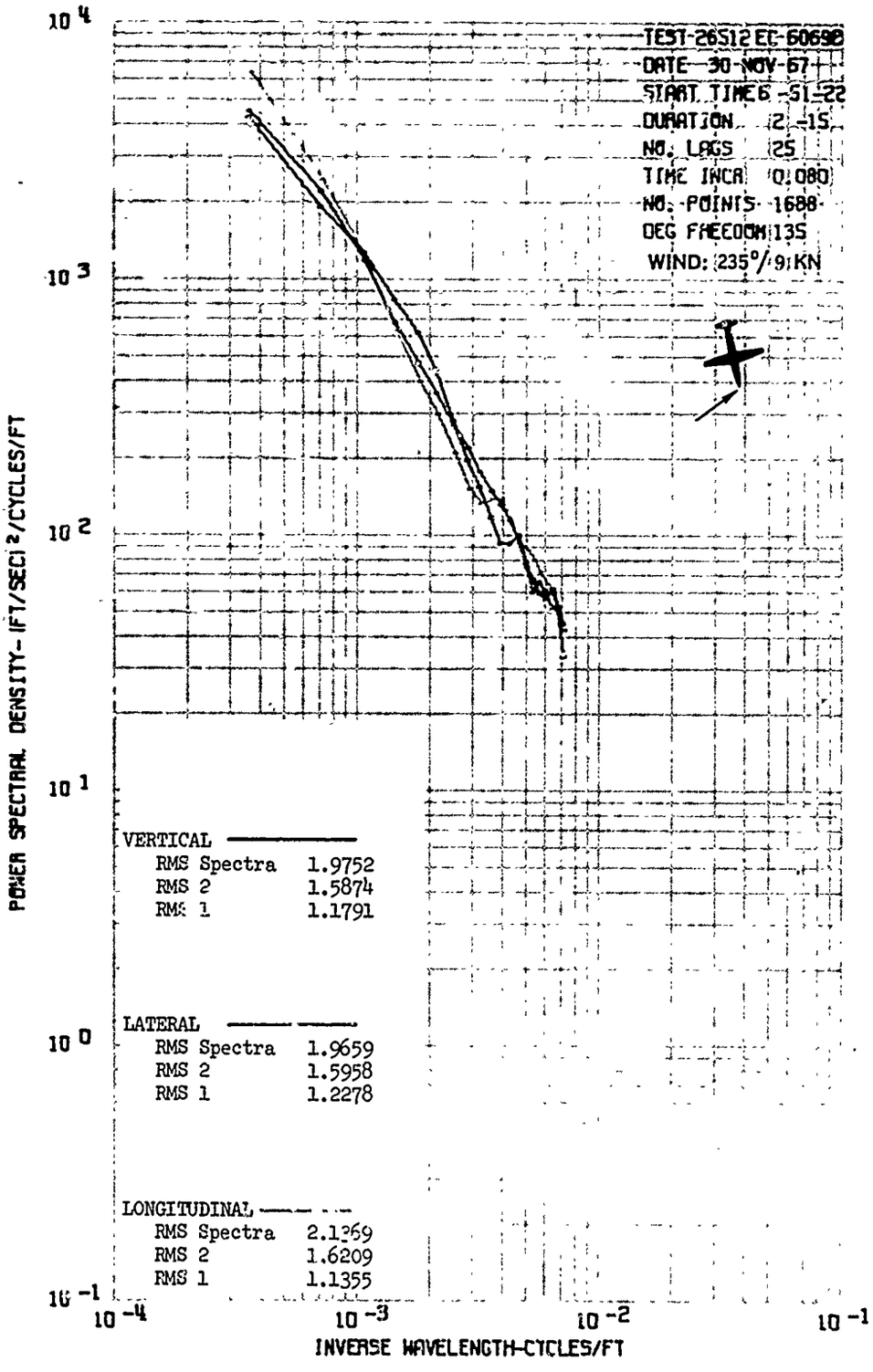


Figure 106 Gust Velocity Power Spectra for Test 265, Run 12
Maximum Standard λ = 2000 Feet

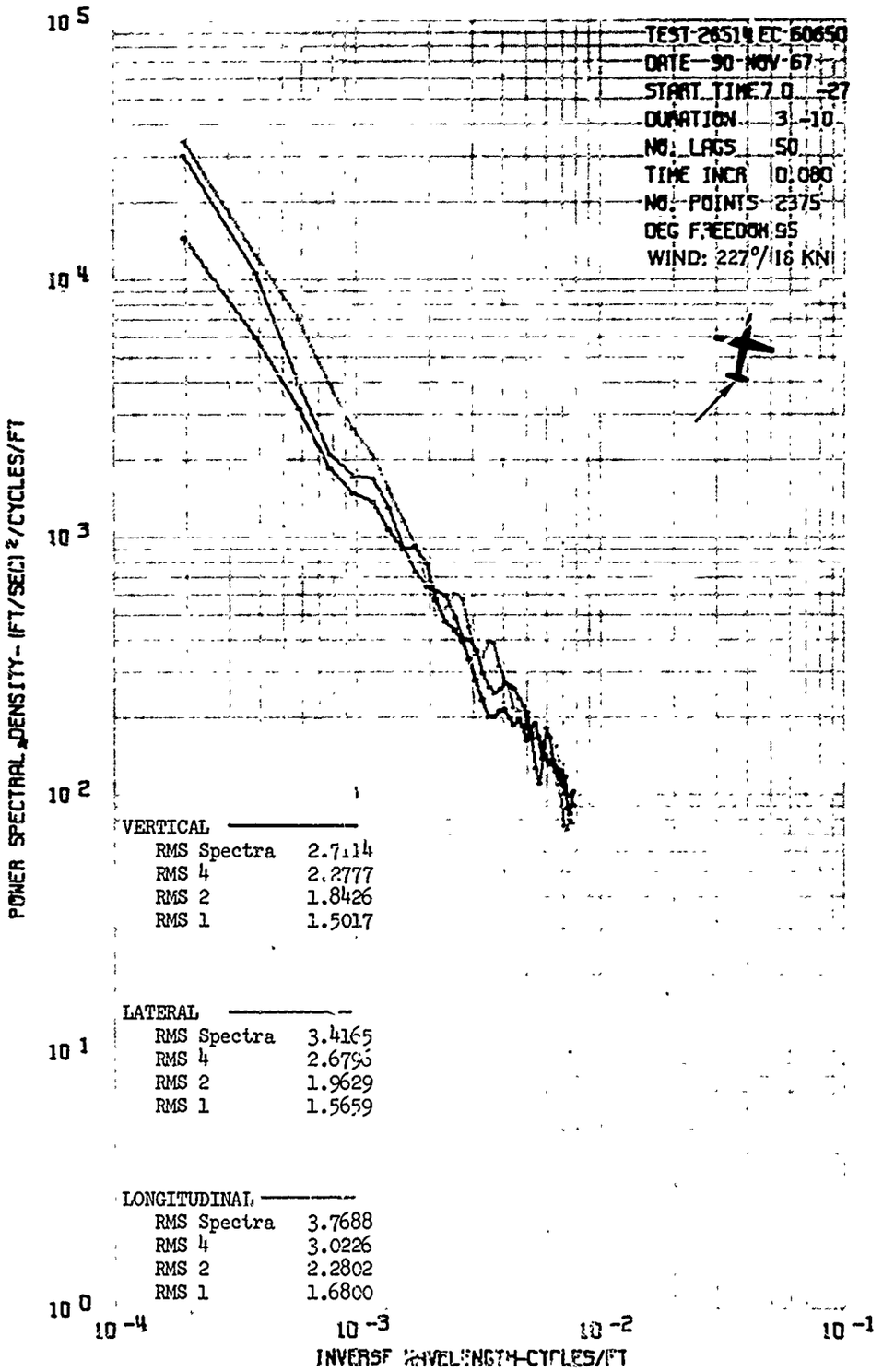


Figure 107 Gust Velocity Power Spectra for Test 265, Run 14
Maximum Standard λ = 4000 Feet

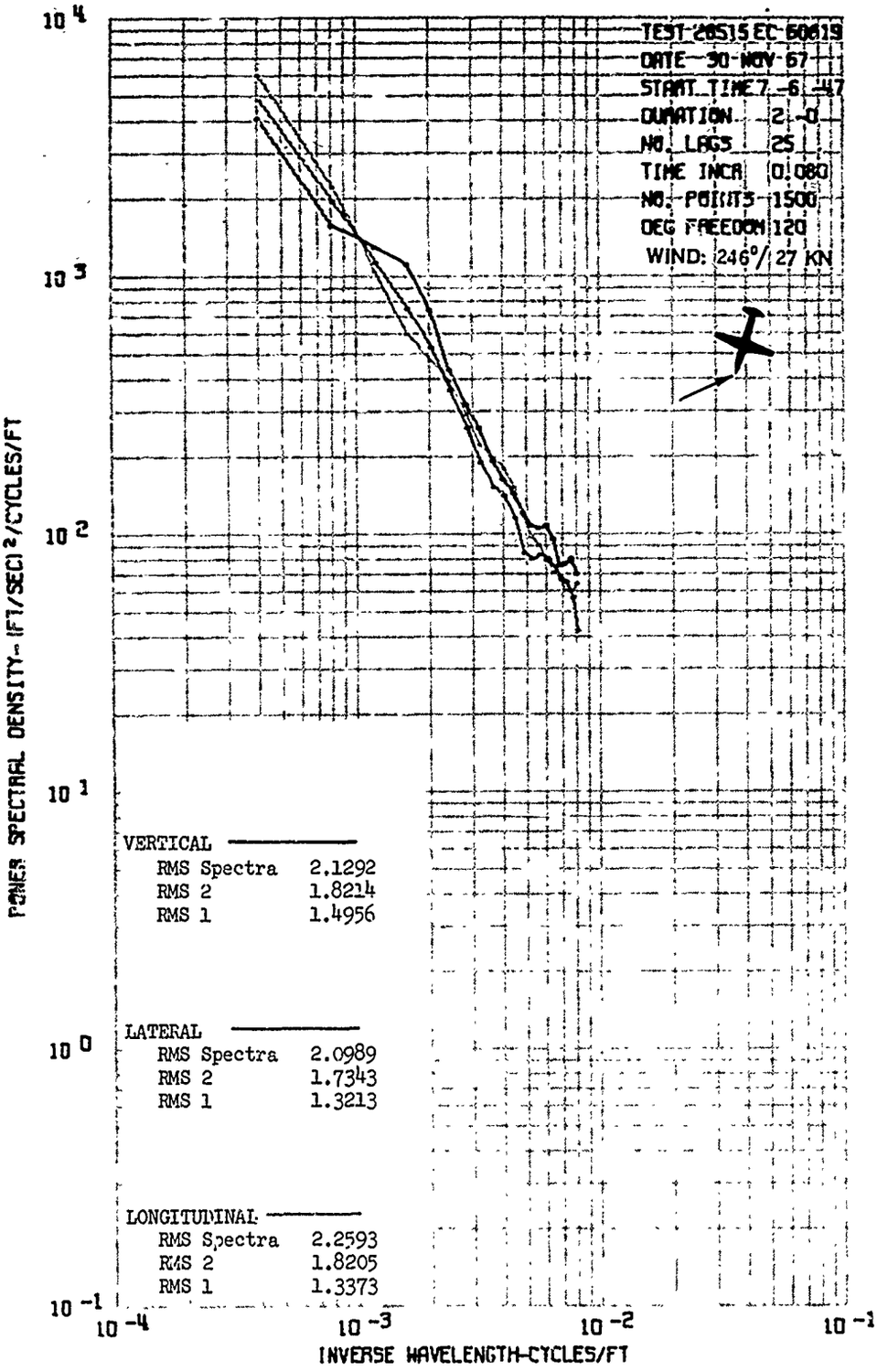


Figure 108 Gust Velocity Power Spectra for Test 265, Run 15
Maximum Standard λ = 2000 Feet

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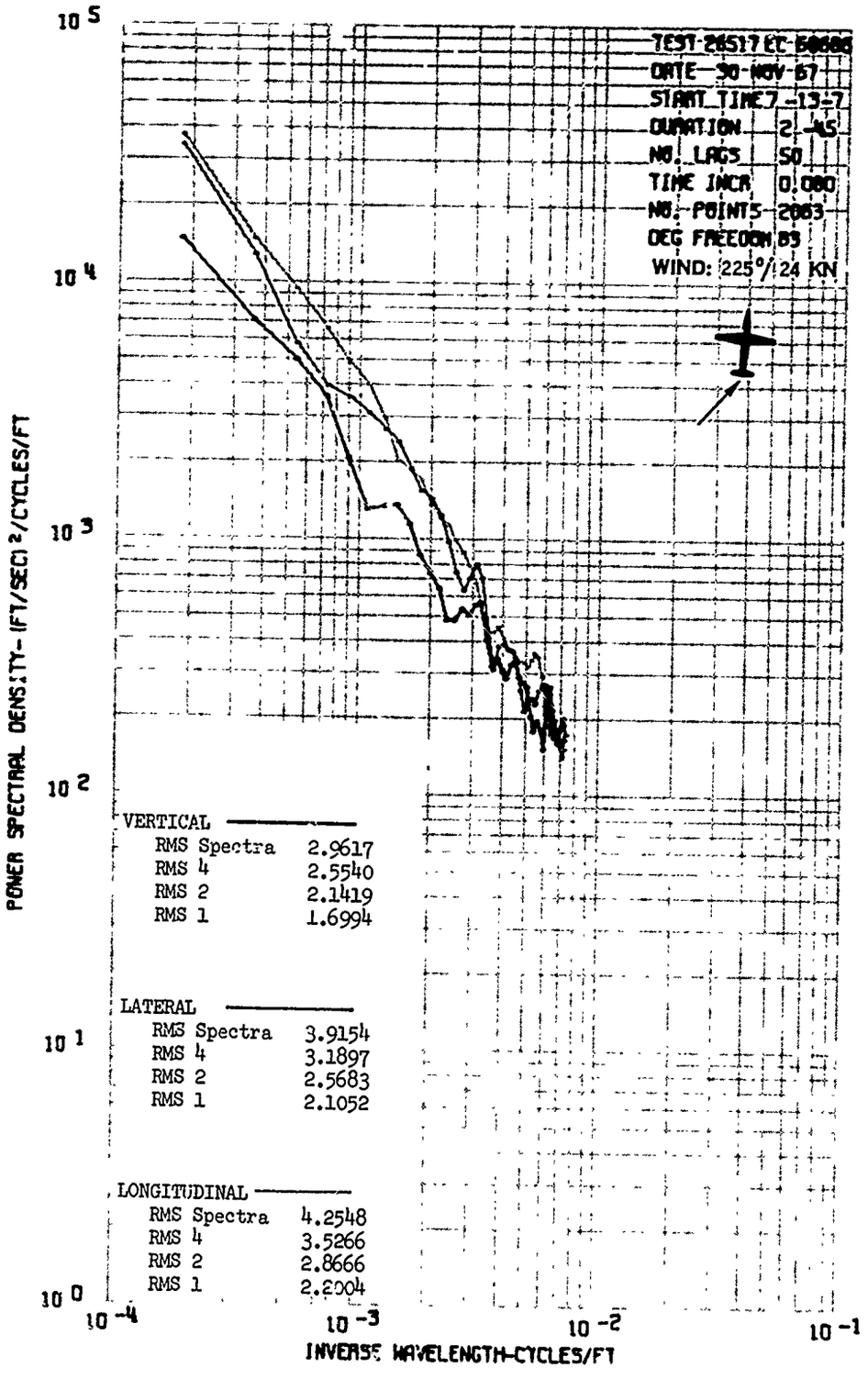


Figure 109 Gust Velocity Power Spectra for Test 265, Run 17
Maximum Standard λ = 4000 Feet

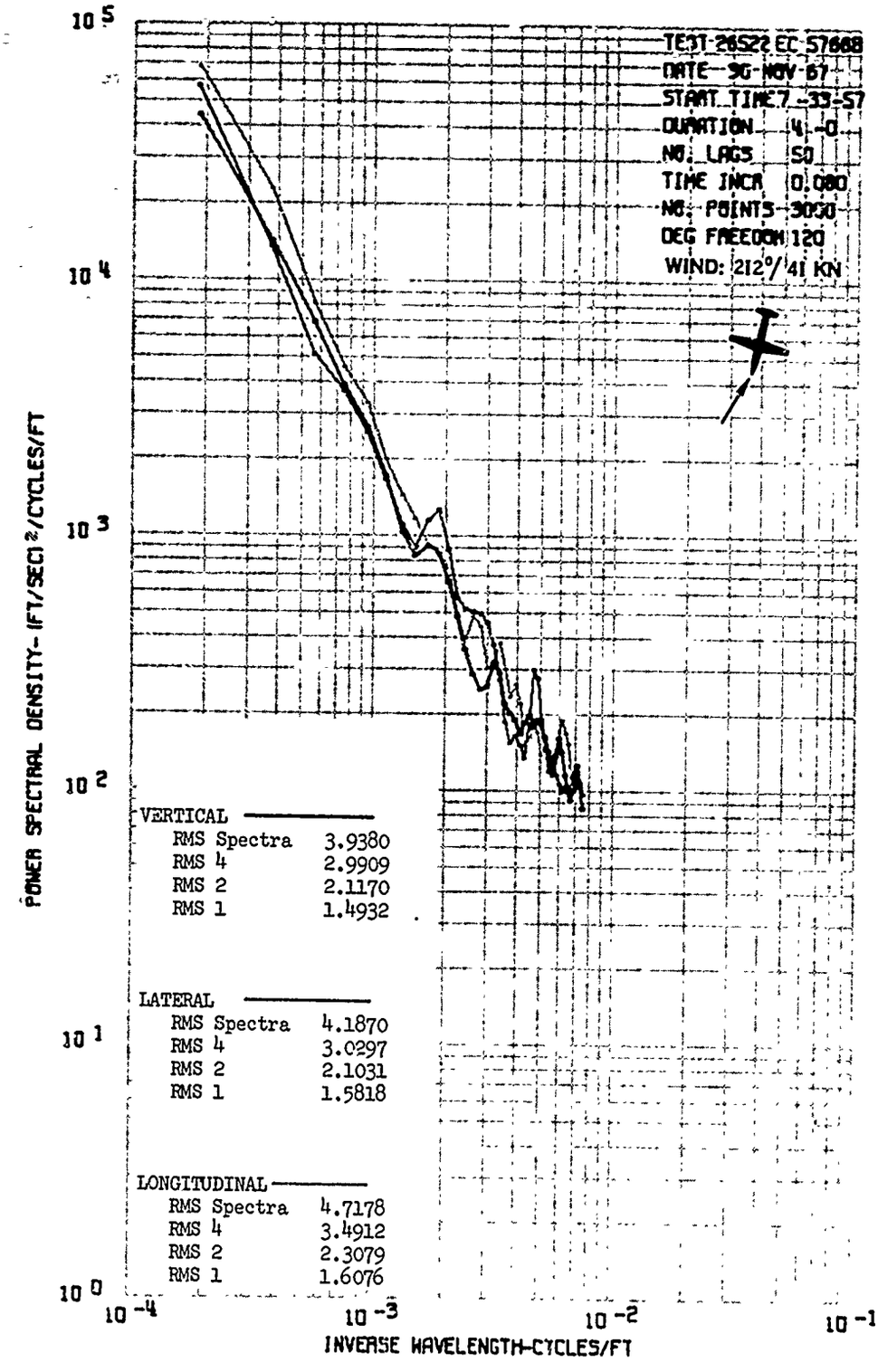


Figure 110 Gust Velocity Power Spectra for Test 265, Run 22
Maximum Standard λ = 4000 Feet

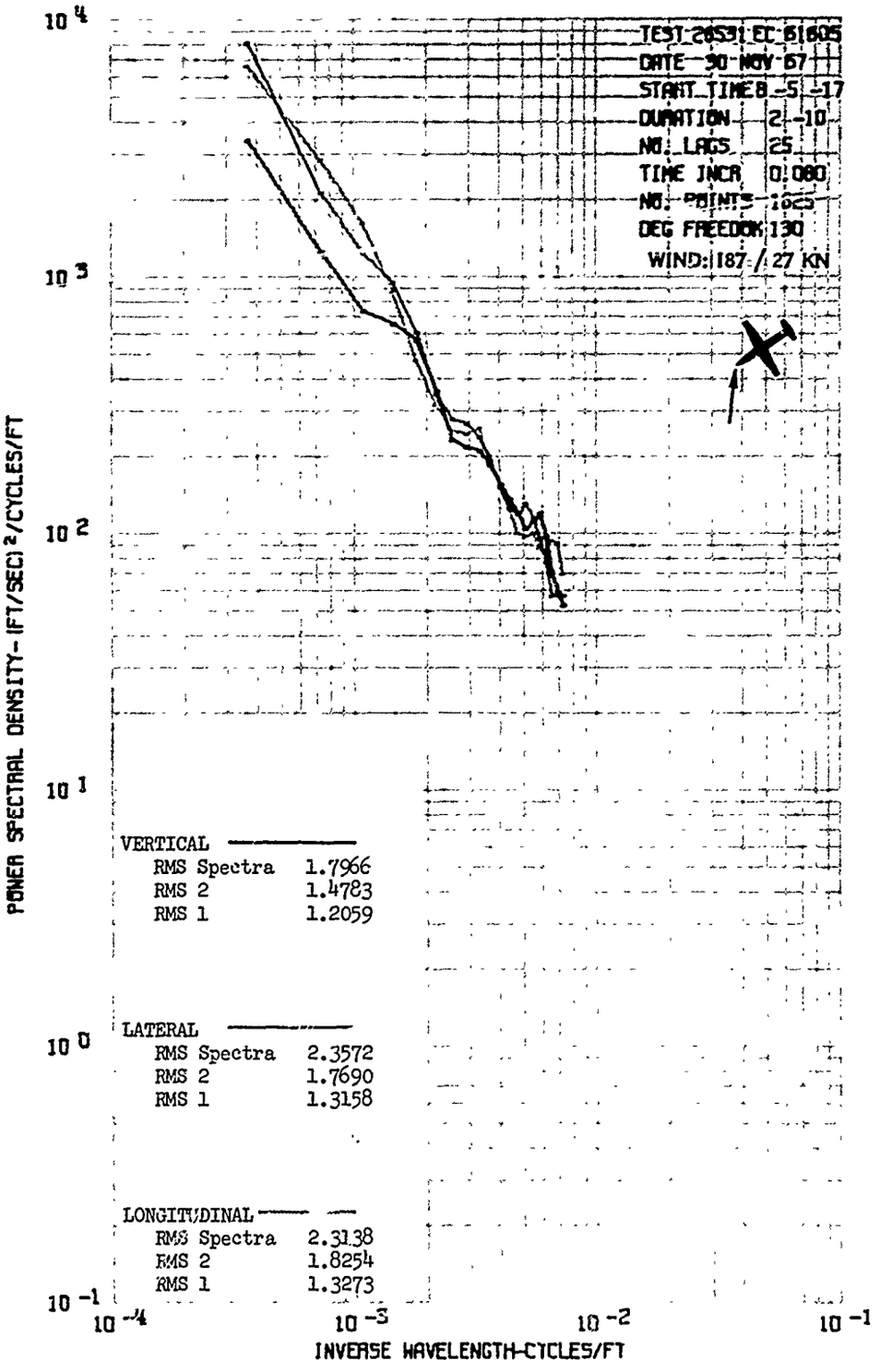


Figure 111 Gust Velocity Power Spectra for Test 265, Run 31
Maximum Standard λ = 2000 Feet

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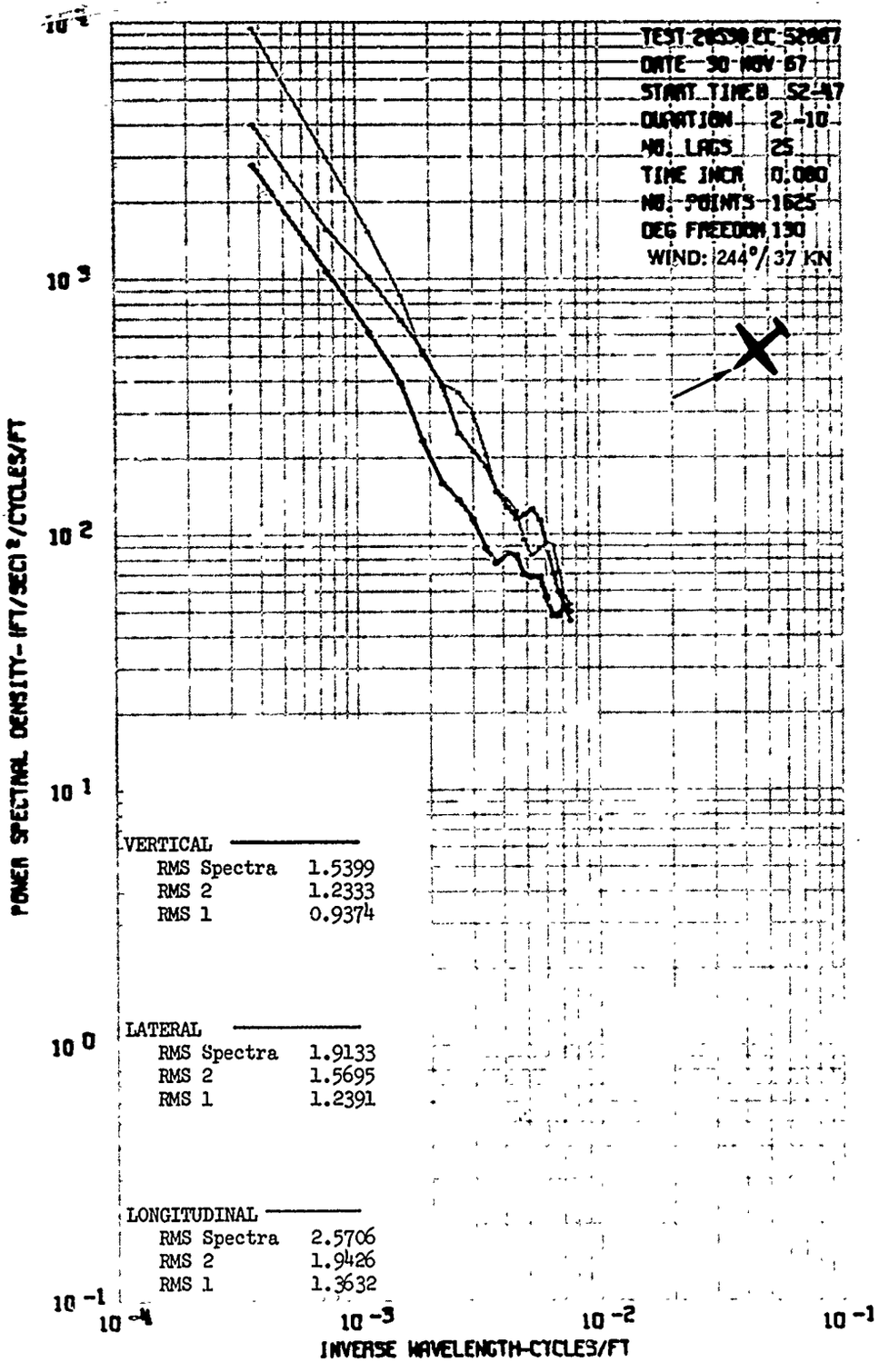


Figure 112 Gust Velocity Power Spectra for Test 265, Run 38
Maximum Standard λ = 2000 Feet

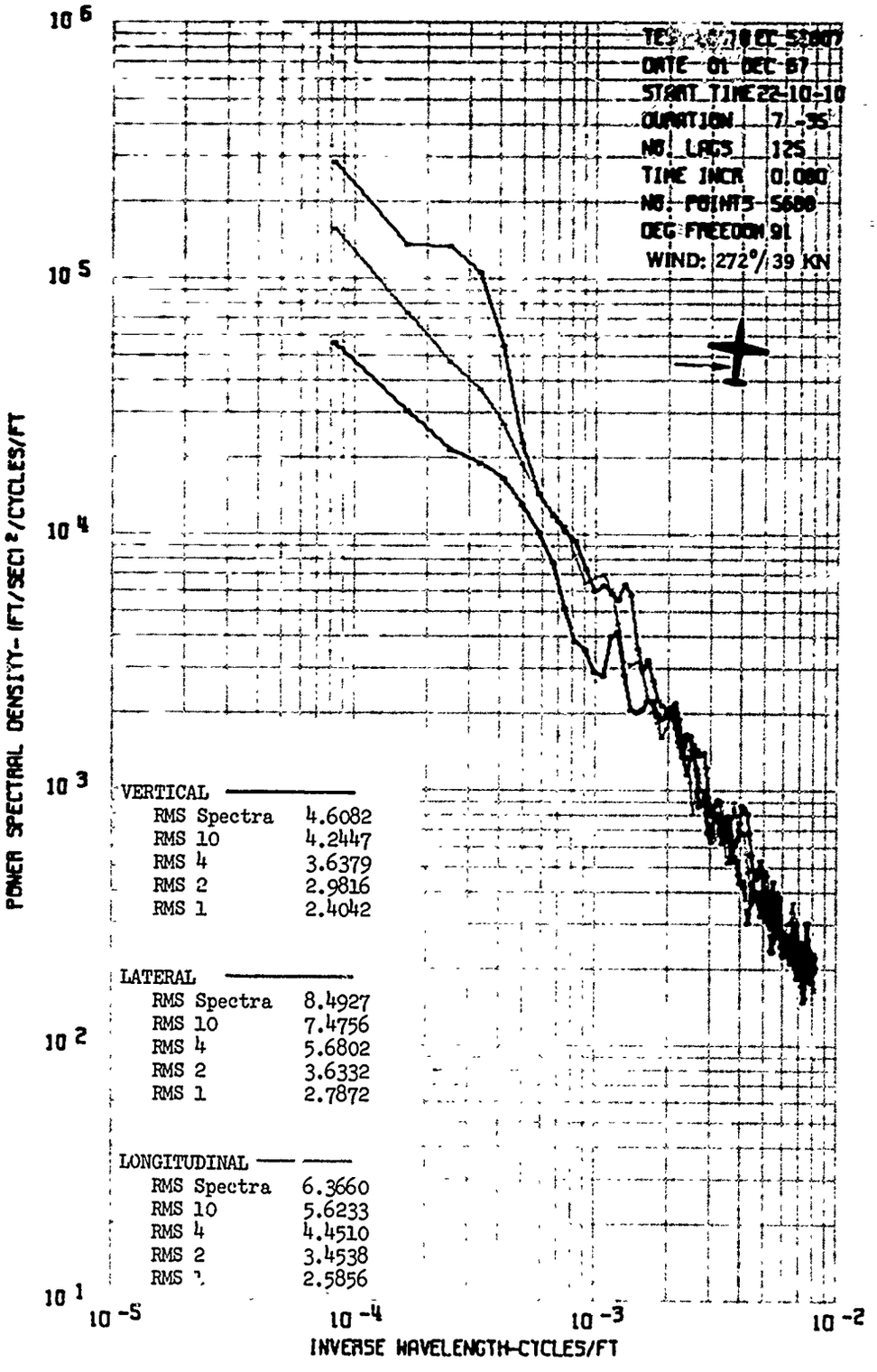


Figure 113 Gust Velocity Power Spectra for Test 266, Run 10
Maximum Standard λ = 10,000 Feet

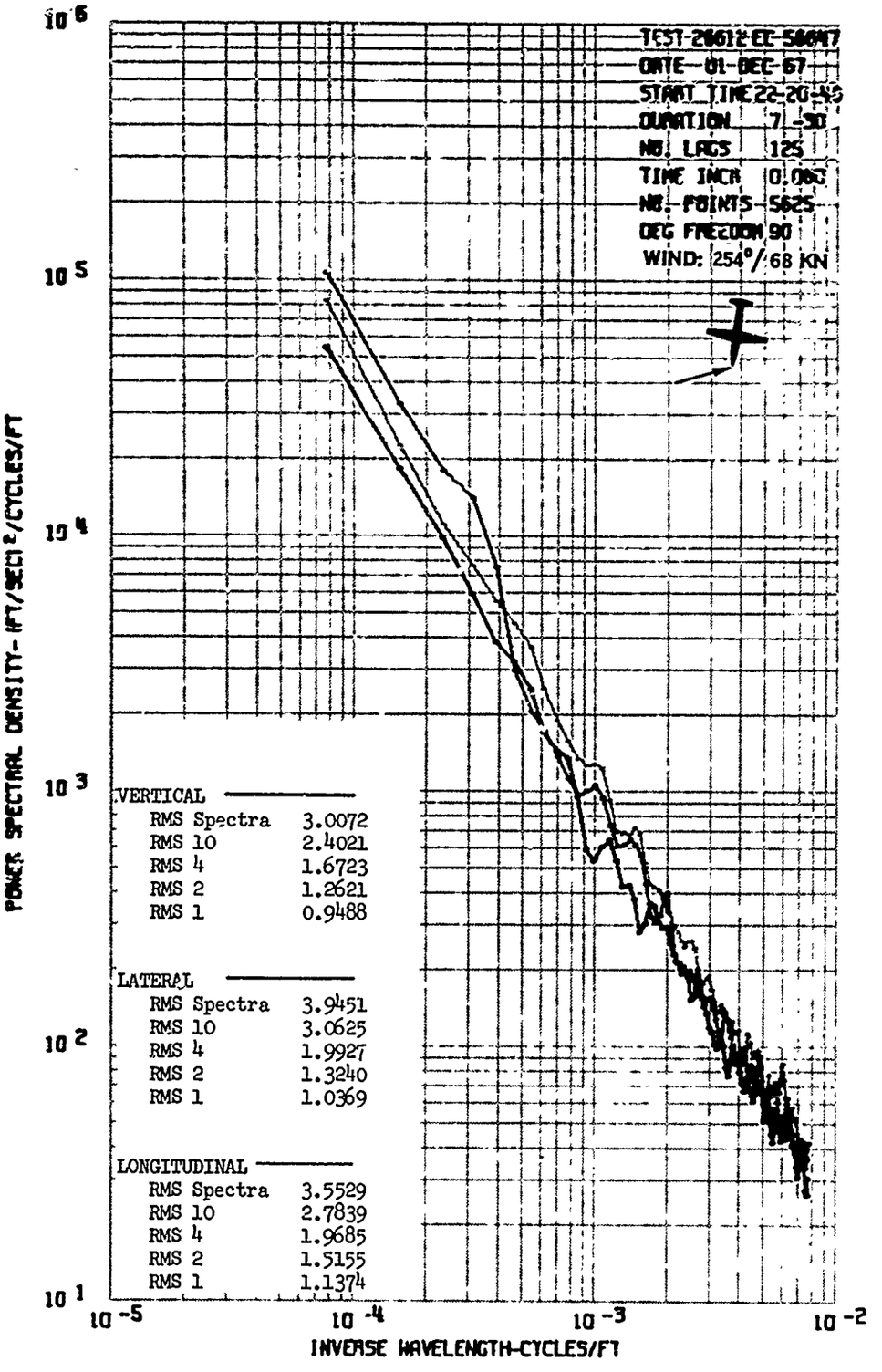


Figure 114 Gust Velocity Power Spectra for Test 266, Run 12
Maximum Standard λ = 10,000 Feet

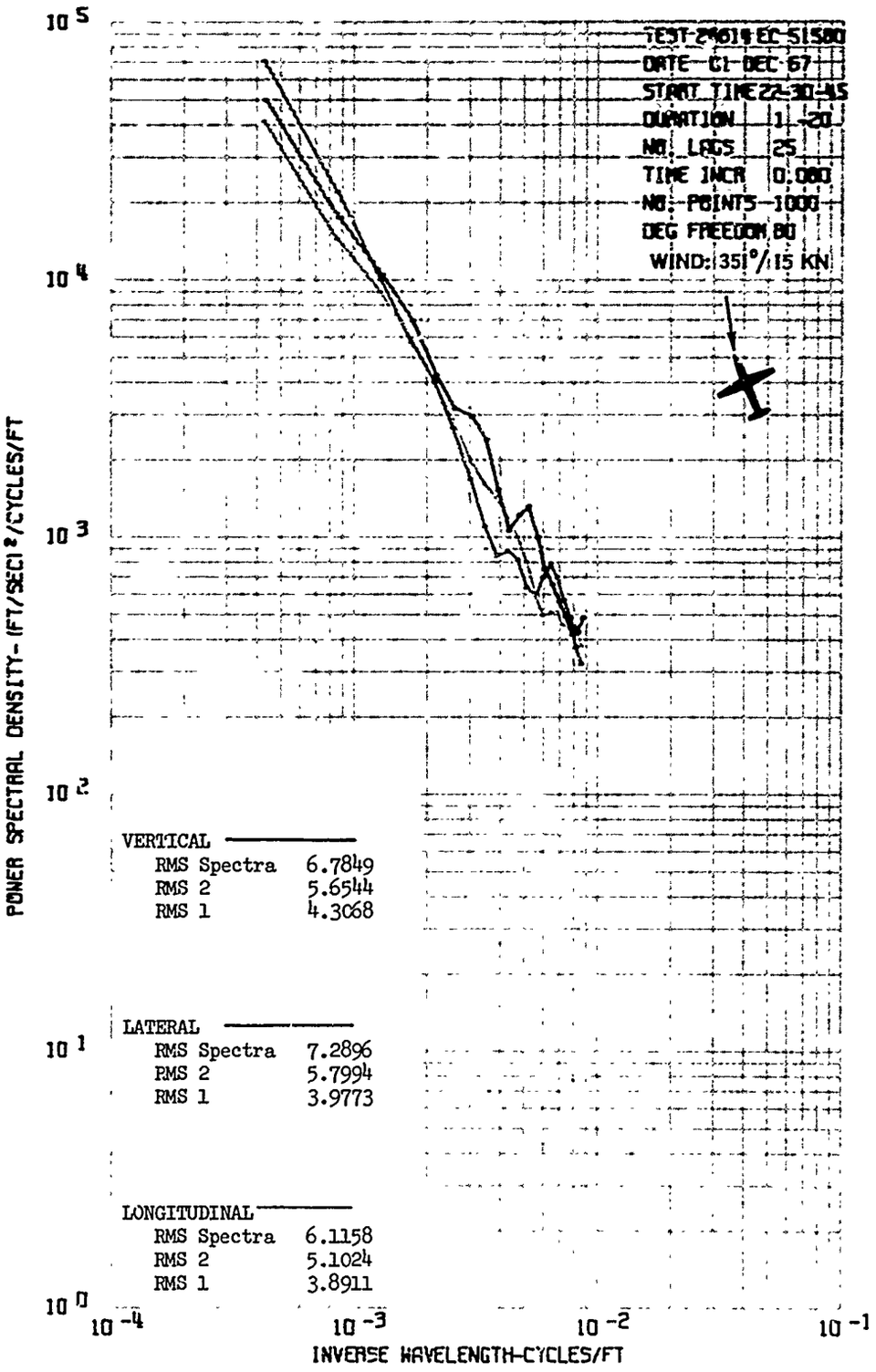


Figure 115 Gust Velocity Power Spectra for Test 266, Run 14
Maximum Standard λ = 2000 Feet

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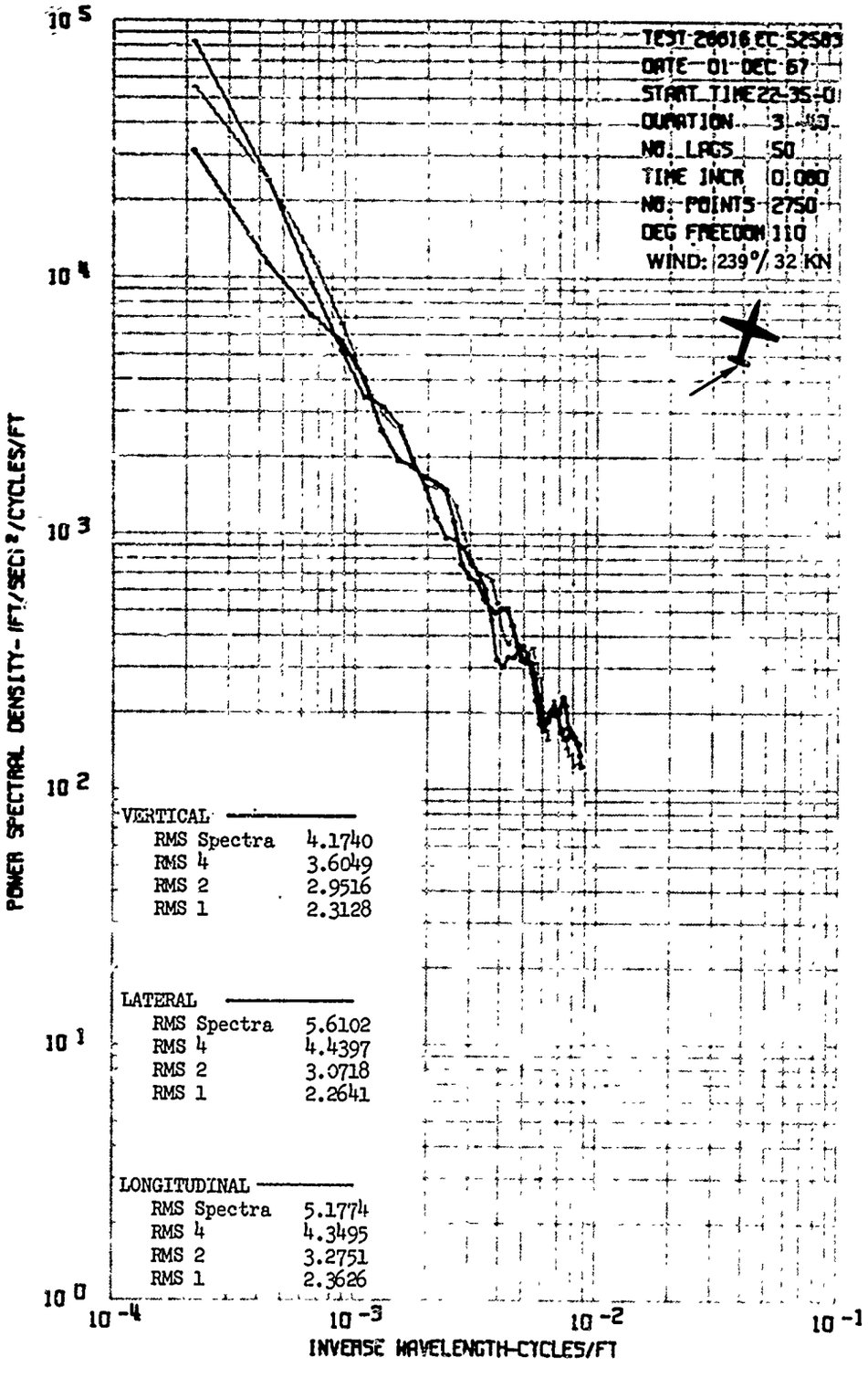


Figure 116 Gust Velocity Power Spectra for Test 266, Run 16
Maximum Standard λ = 4000 Feet

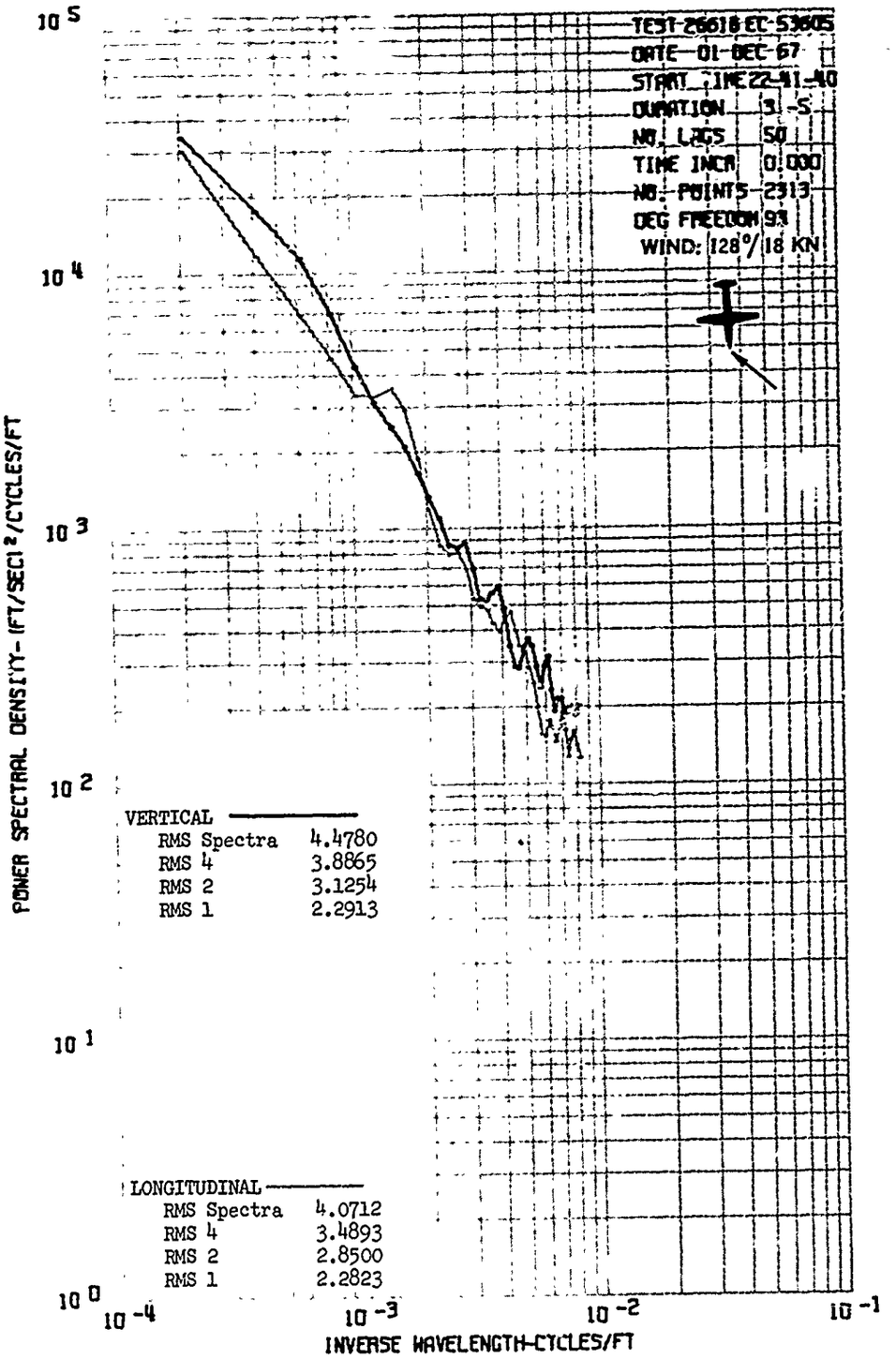


Figure 117 Gust Velocity Power Spectra for Test 266, Run 18
Maximum Standard λ = 4000 Feet

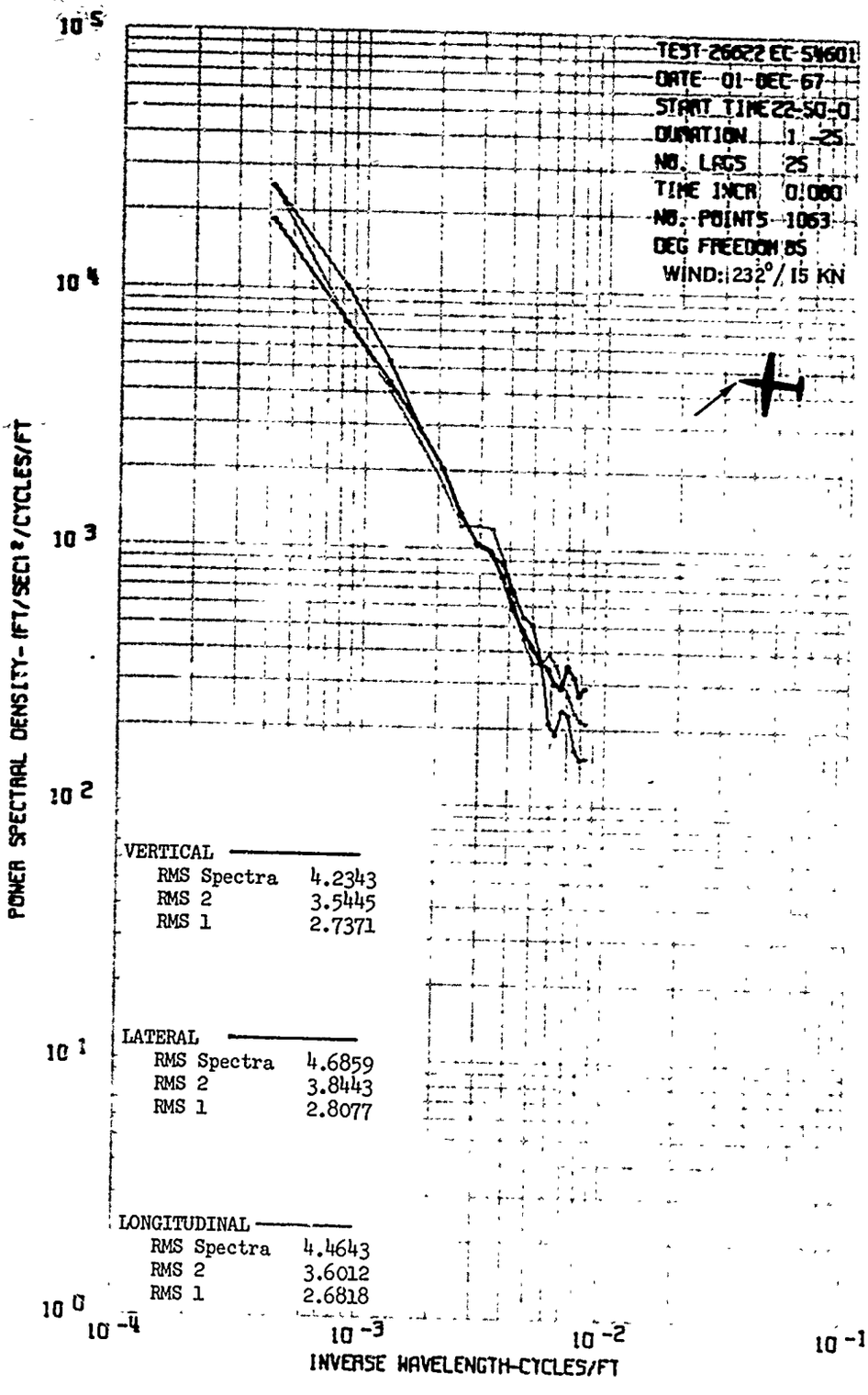


Figure 118 Gust Velocity Power Spectra for Test 266, Run 22
Maximum Standard λ = 2000 Feet

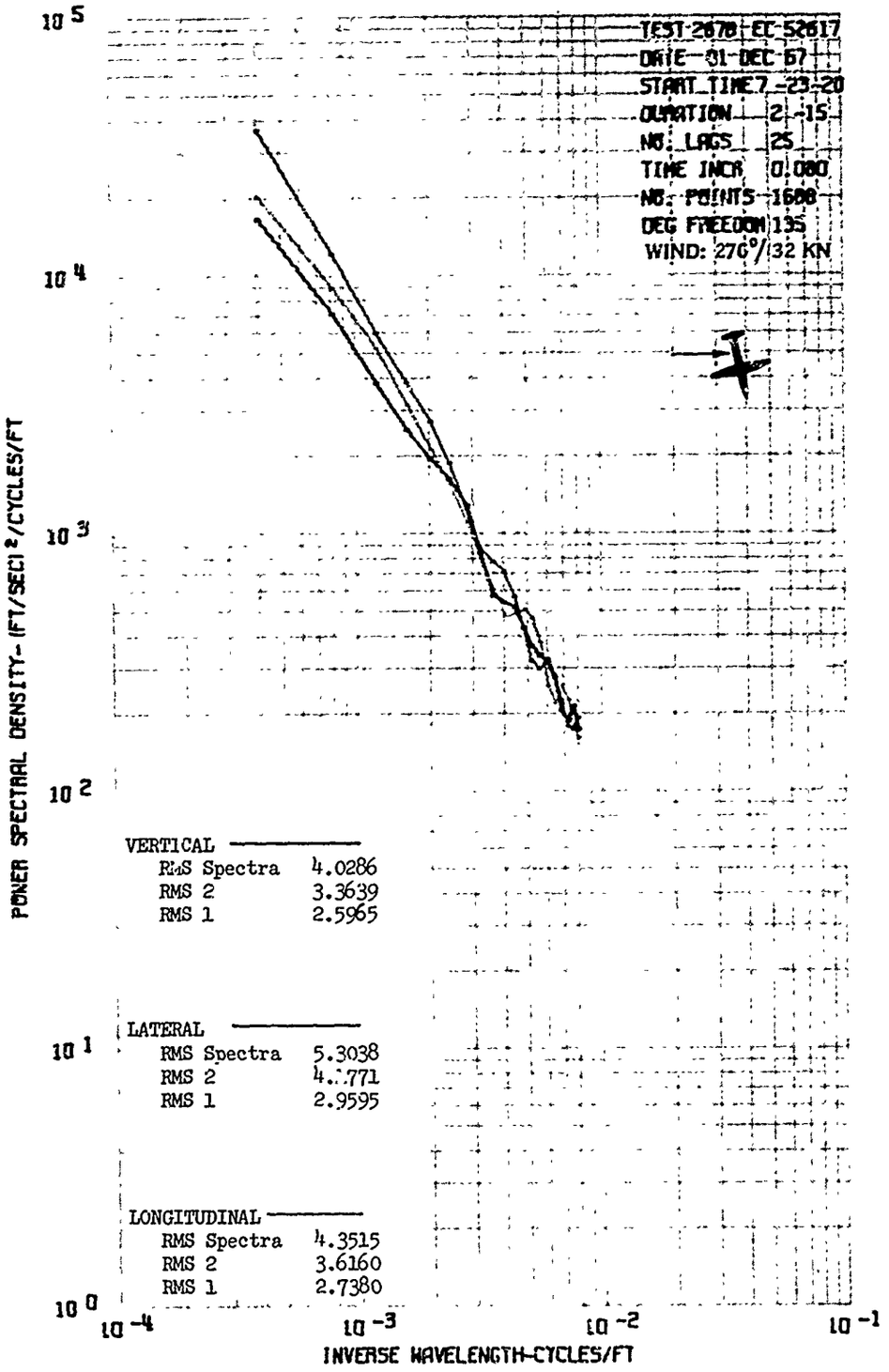


Figure 119 Gust Velocity Power Spectra for Test 267, Run 8
Maximum Standard λ = 2000 Feet

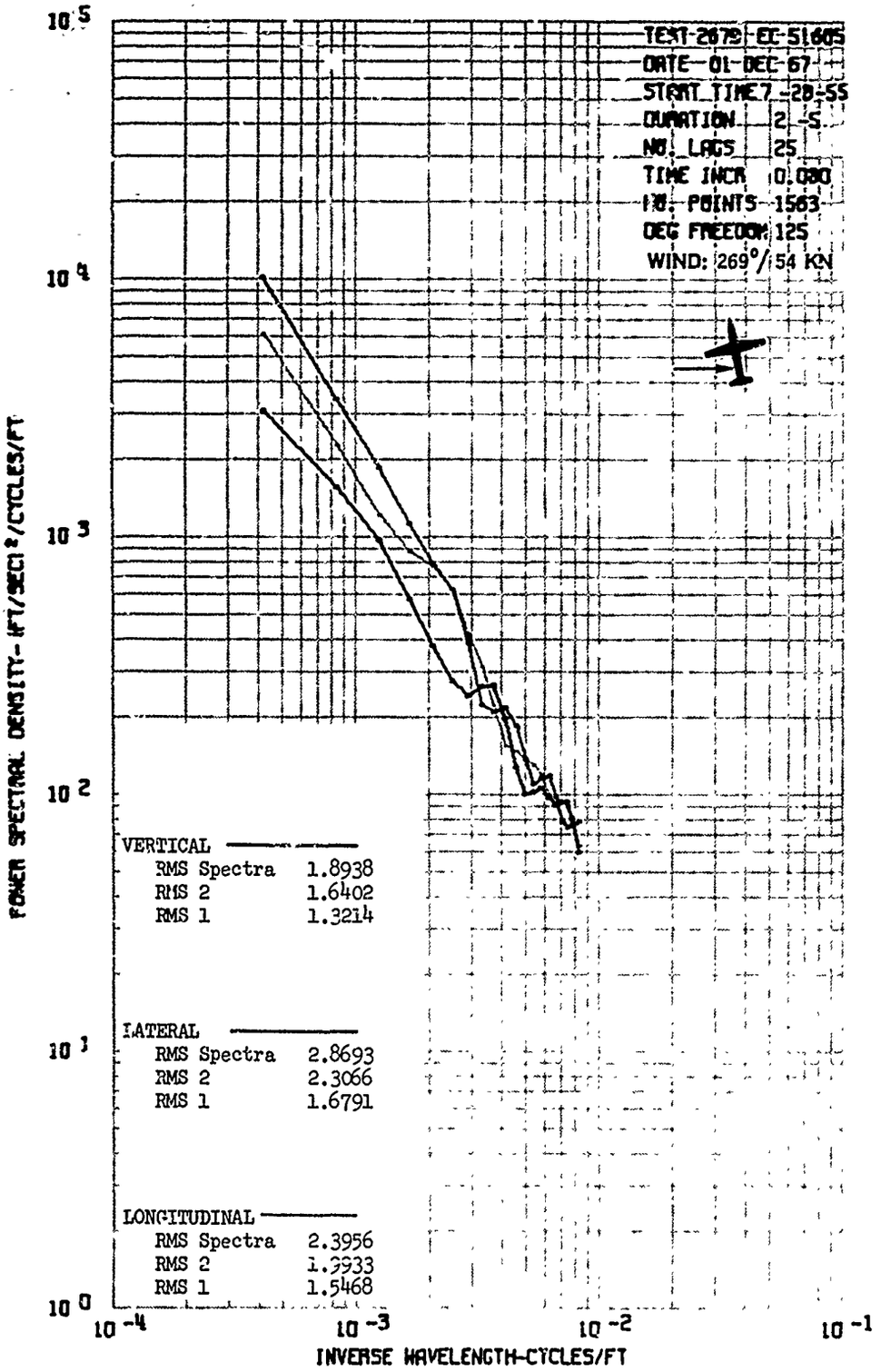


Figure 120 Gust Velocity Power Spectra for Test 267, Run 9
Maximum Standard λ = 2000 Feet

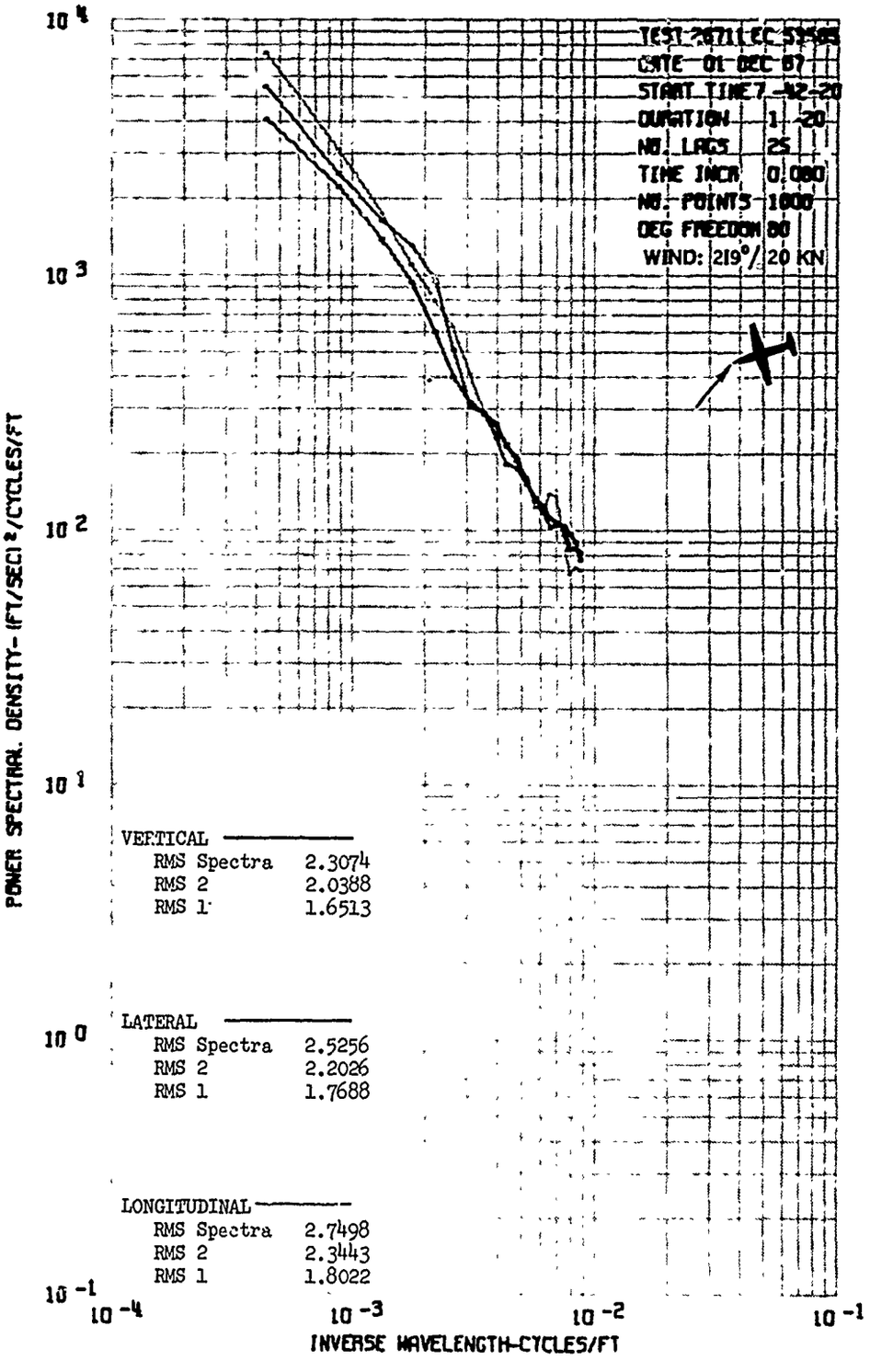


Figure 121 Gust Velocity Power Spectra for Test 267, Run 11
Maximum Standard λ = 2000 Feet

APPENDIX V

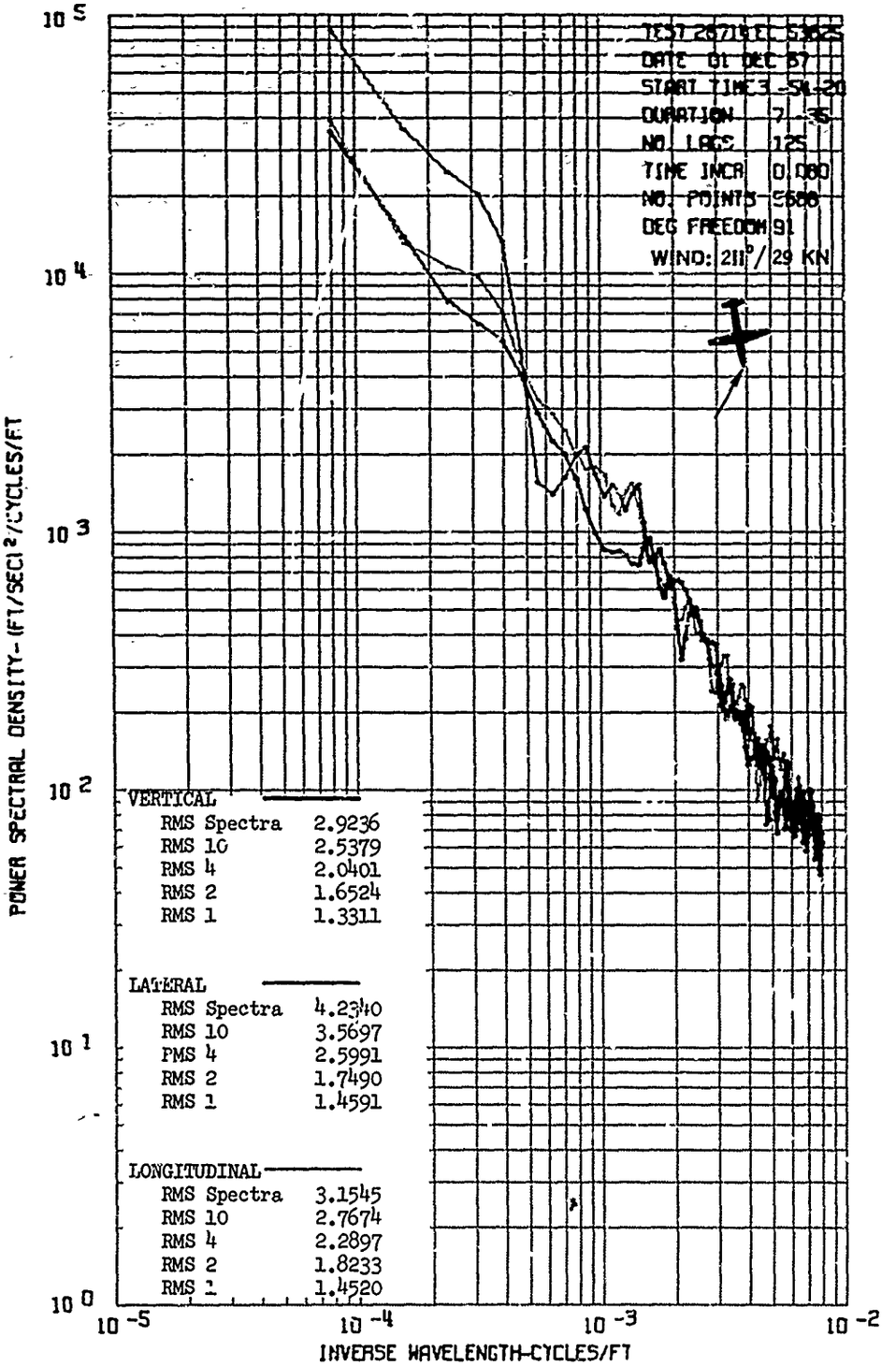


Figure 122 Gust Velocity Power Spectra for Test 267, Run 14
Maximum Standard λ = 10,000 Feet

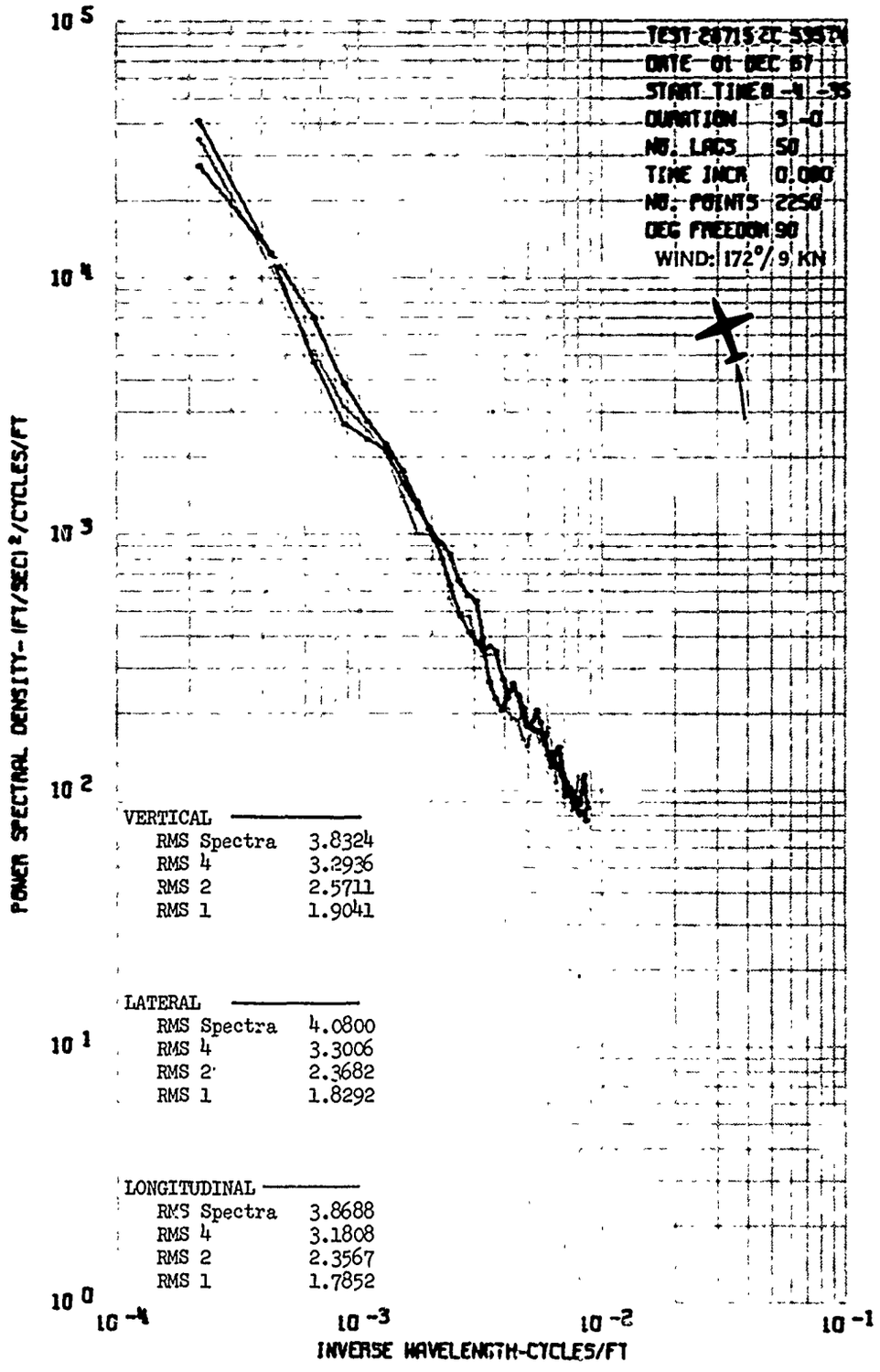


Figure 123 Gust Velocity Power Spectra for Test 267, Run 15
Maximum Standard λ = 4000 Feet

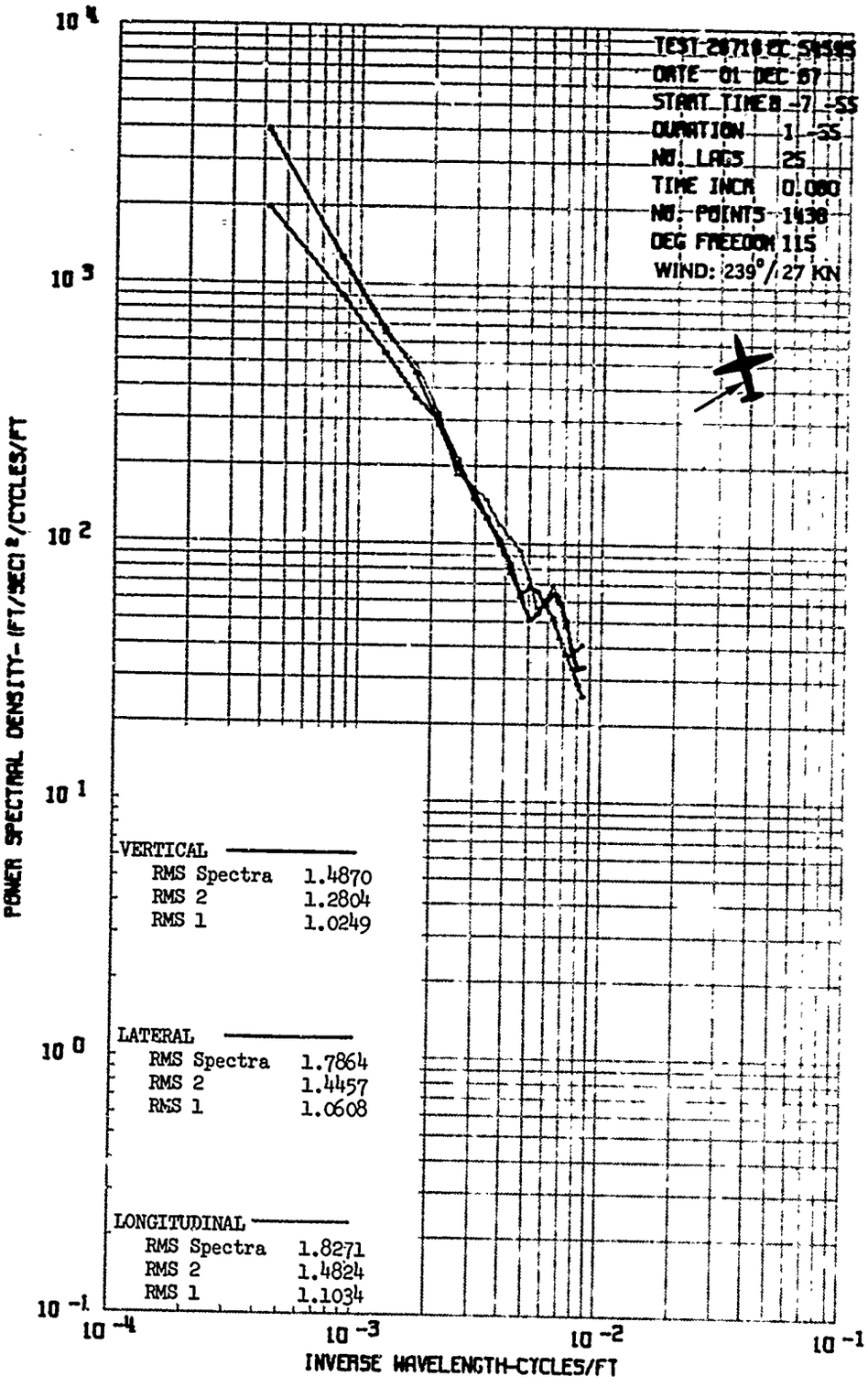


Figure 124 Gust Velocity Power Spectra for Test 267, Run 16
Maximum Standard λ = 2000 Feet

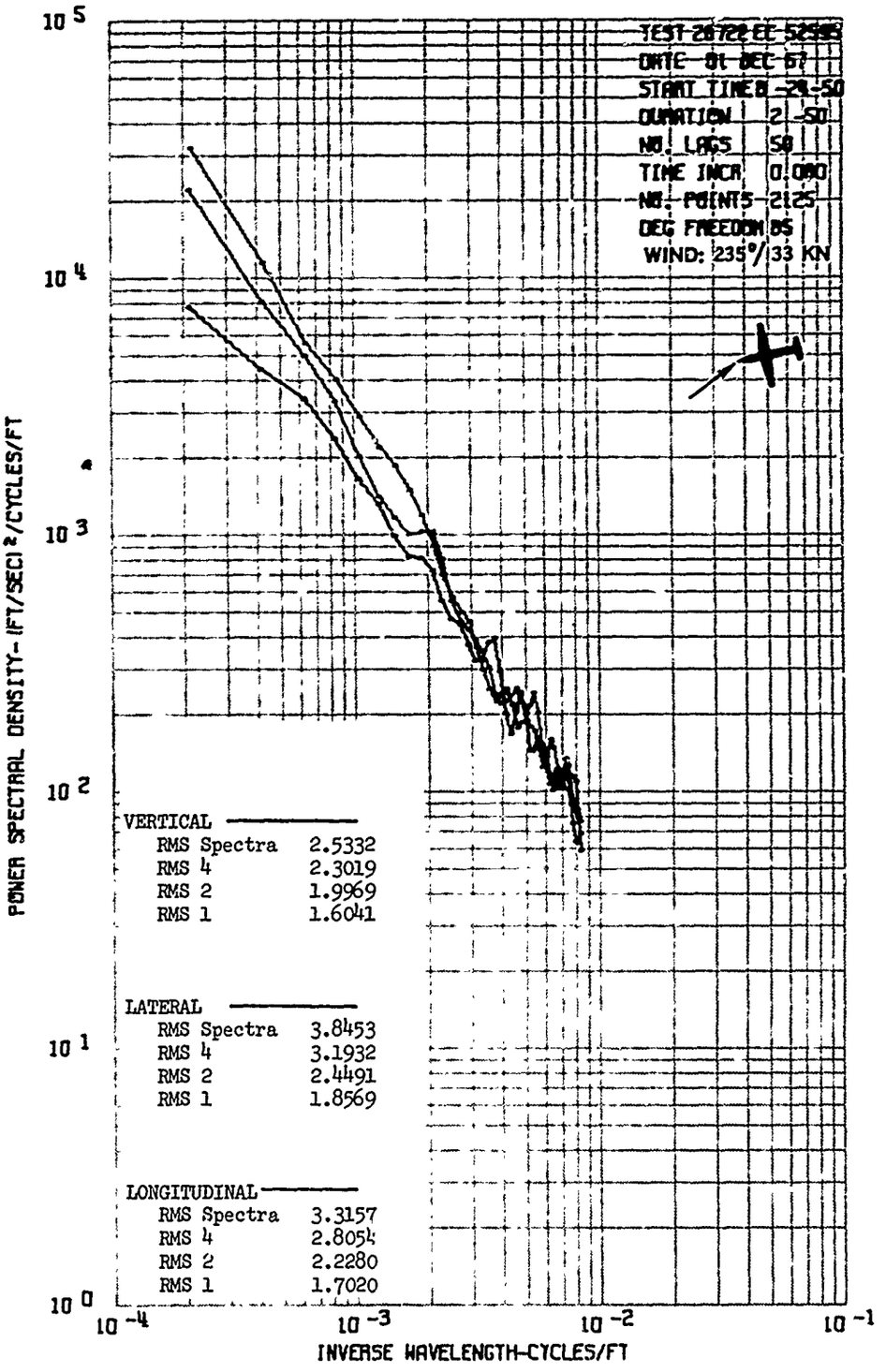


Figure 125 Gust Velocity Power Spectra for Test 267, Run 22
Maximum Standard λ = 4000 Feet

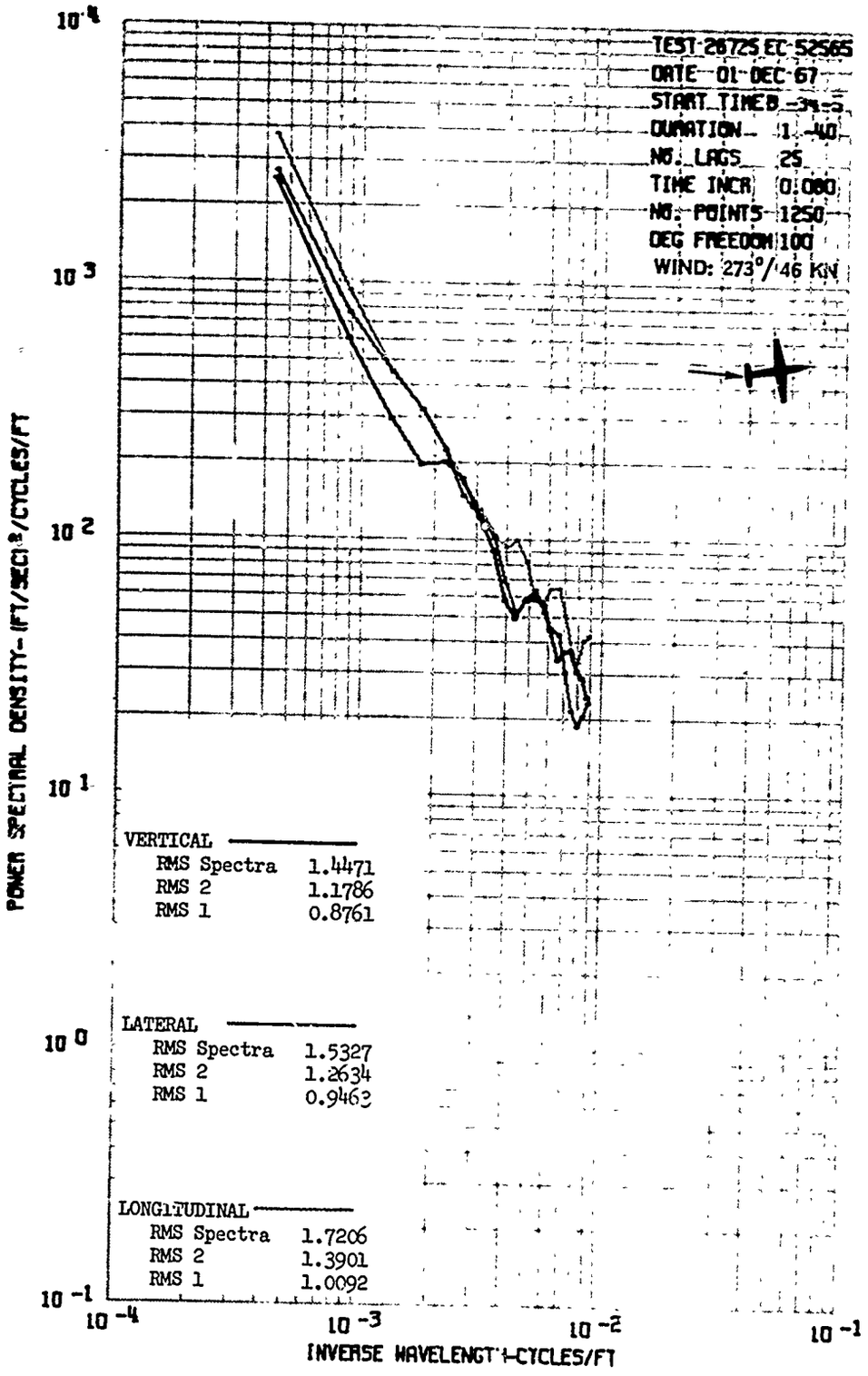


Figure 126 Gust Velocity Power Spectra for Test 267, Run 25
Maximum Standard λ = 2000 Feet

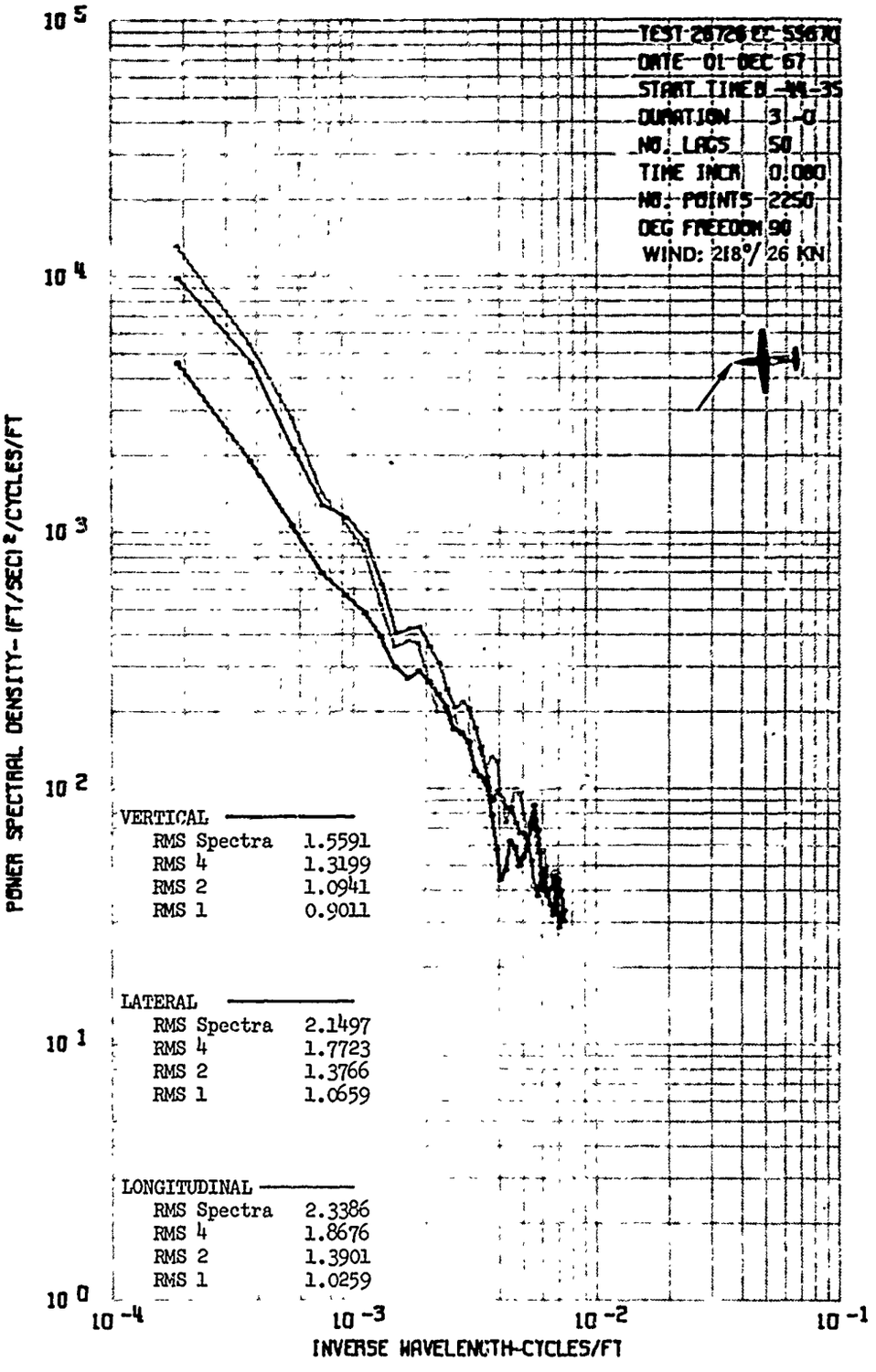


Figure 127 Gust Velocity Power Spectra for Test 267, Run 26
Maximum Standard λ = 4000 Feet

APPENDIX V

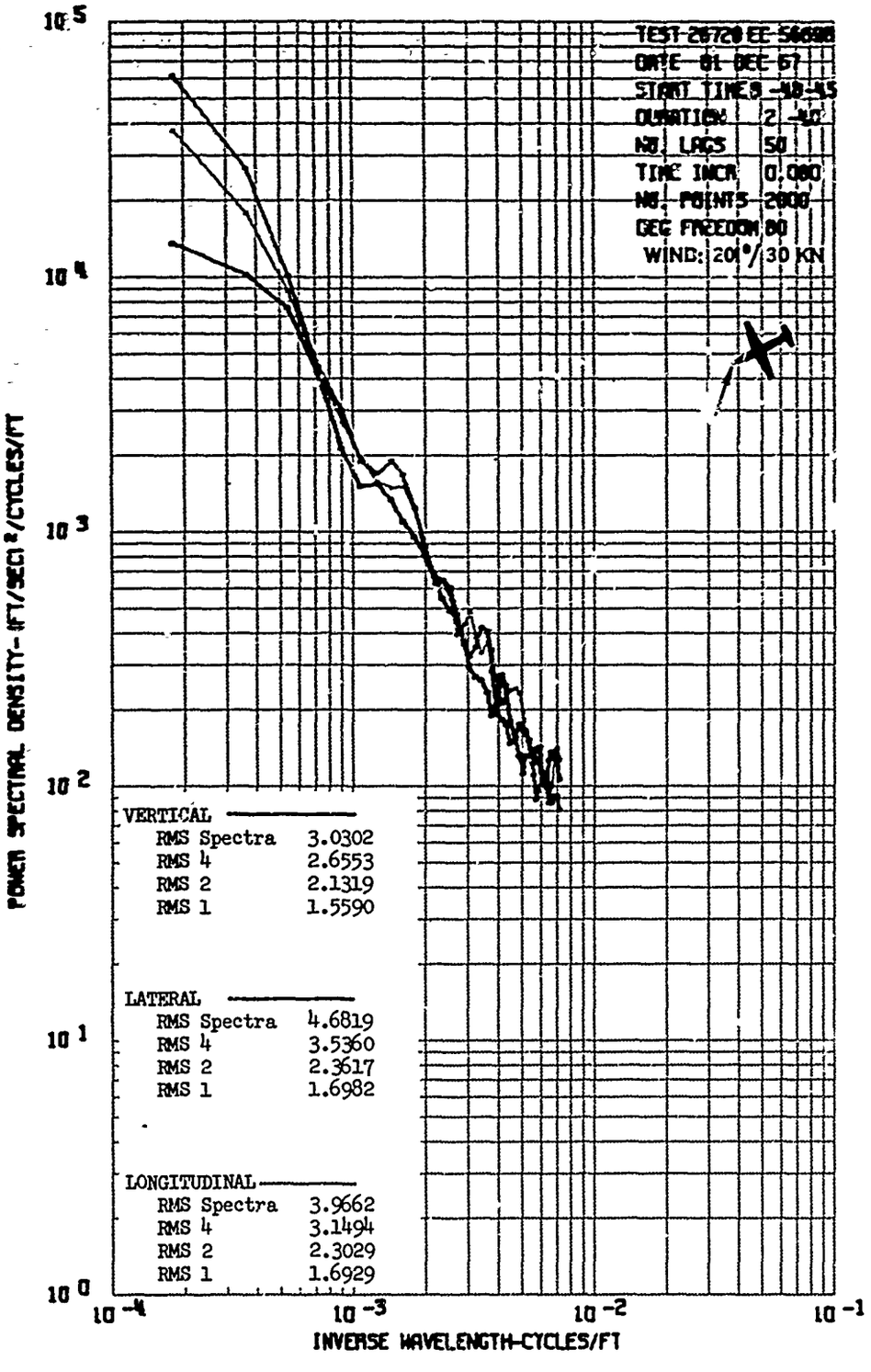


Figure 128 Gust Velocity Power Spectra for Test 267, Run 28
Maximum Standard λ = 4000 Feet

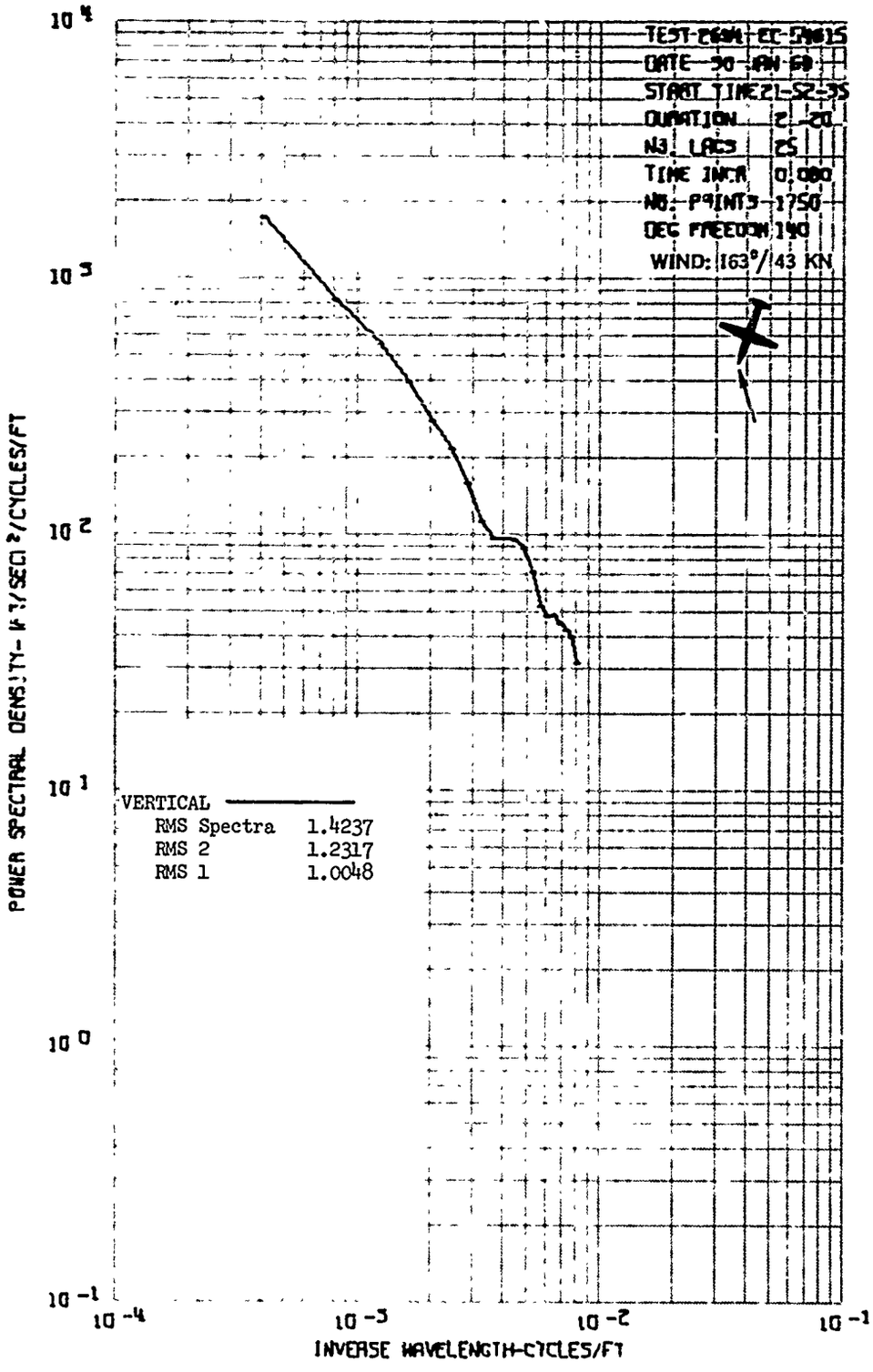


Figure 129 Gust Velocity Power Spectra for Test 269, Run 4
Maximum Standard λ = 2000 Feet

APPENDIX V

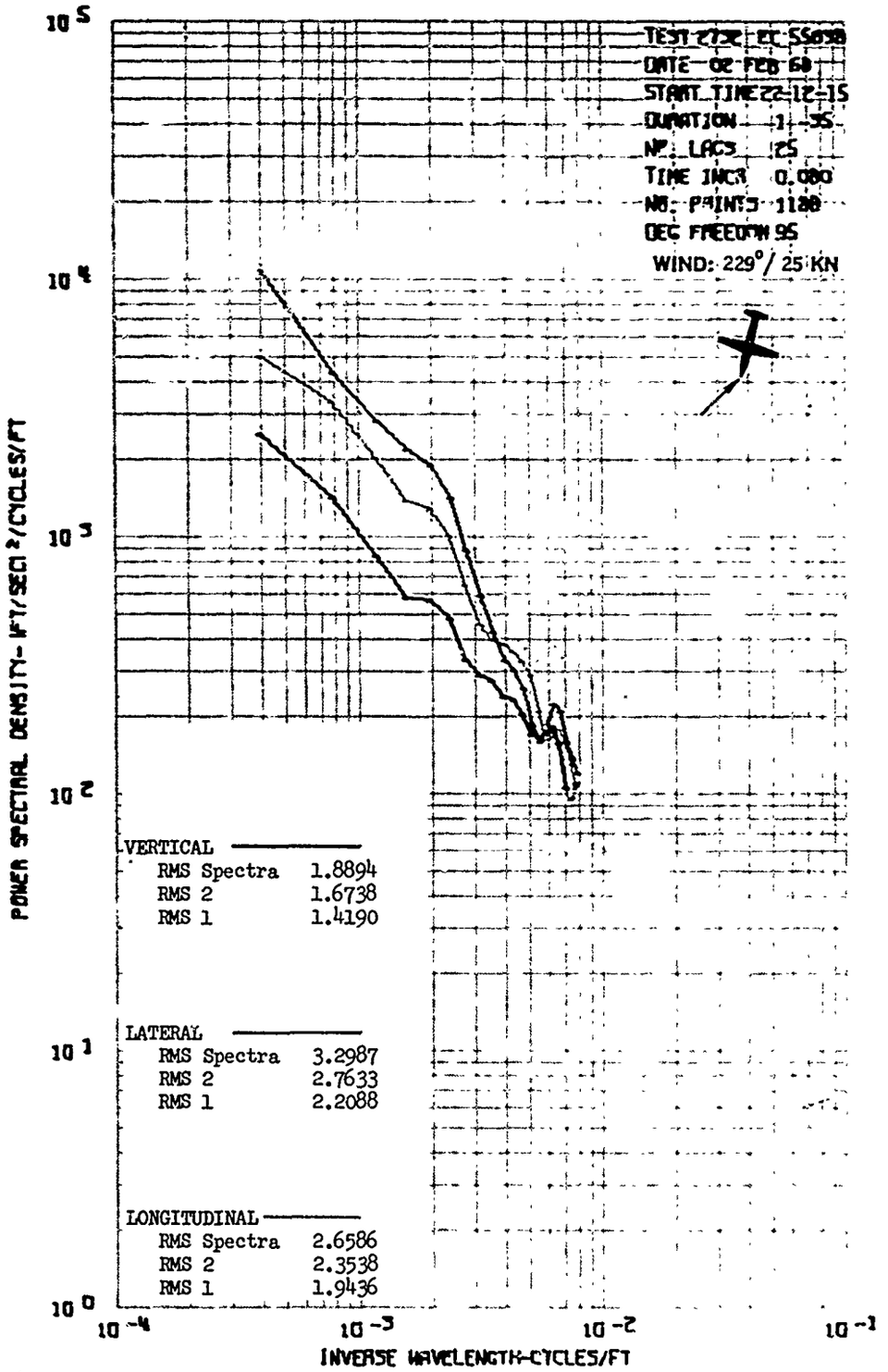


Figure 130 Gust Velocity Power Spectra for Test 273, Run 2
Maximum Standard λ = 2000 Feet

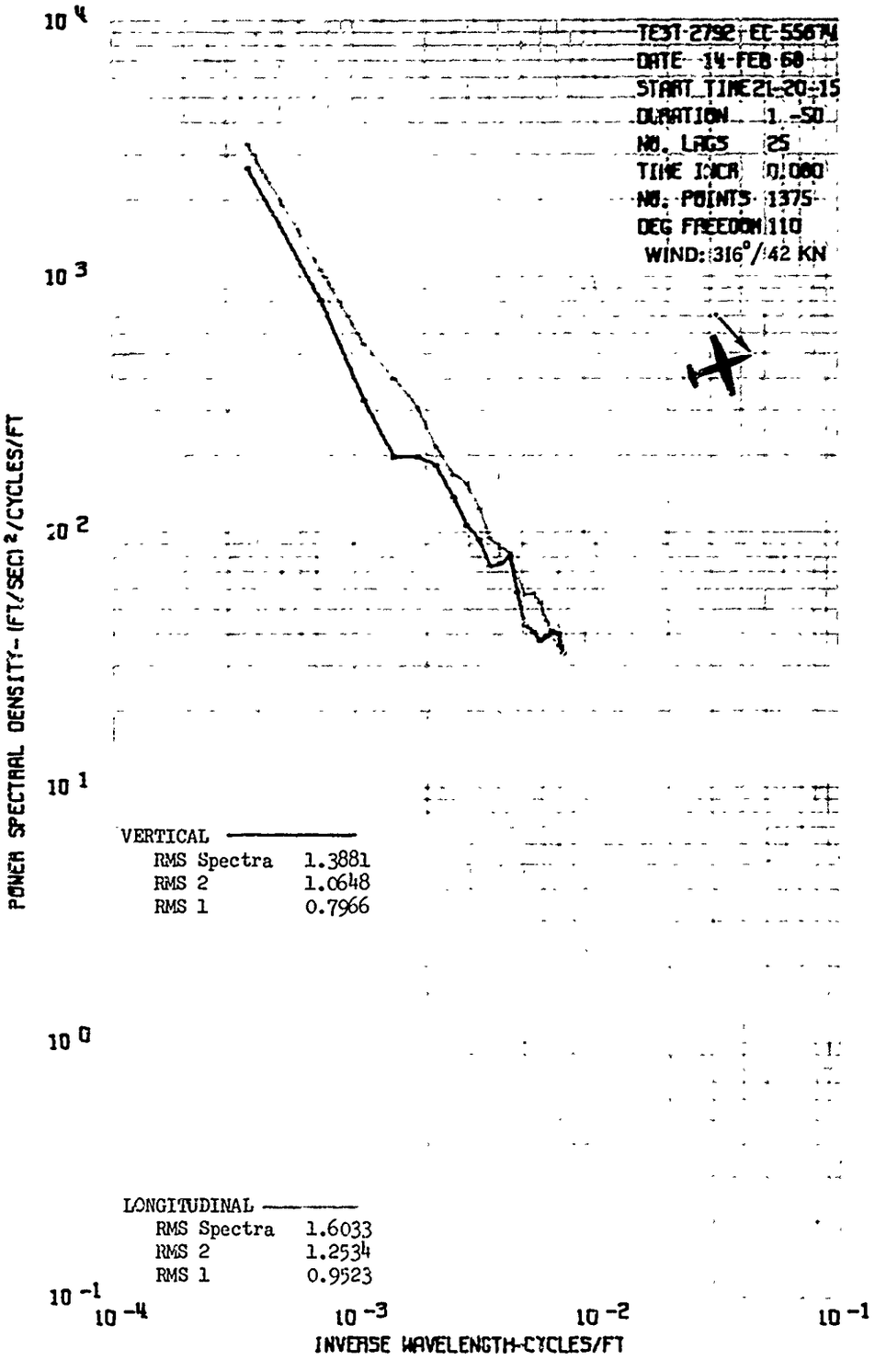


Figure 131 Gust Velocity Power Spectra for Test 279, Run 2
Maximum Standard λ = 2000 Feet

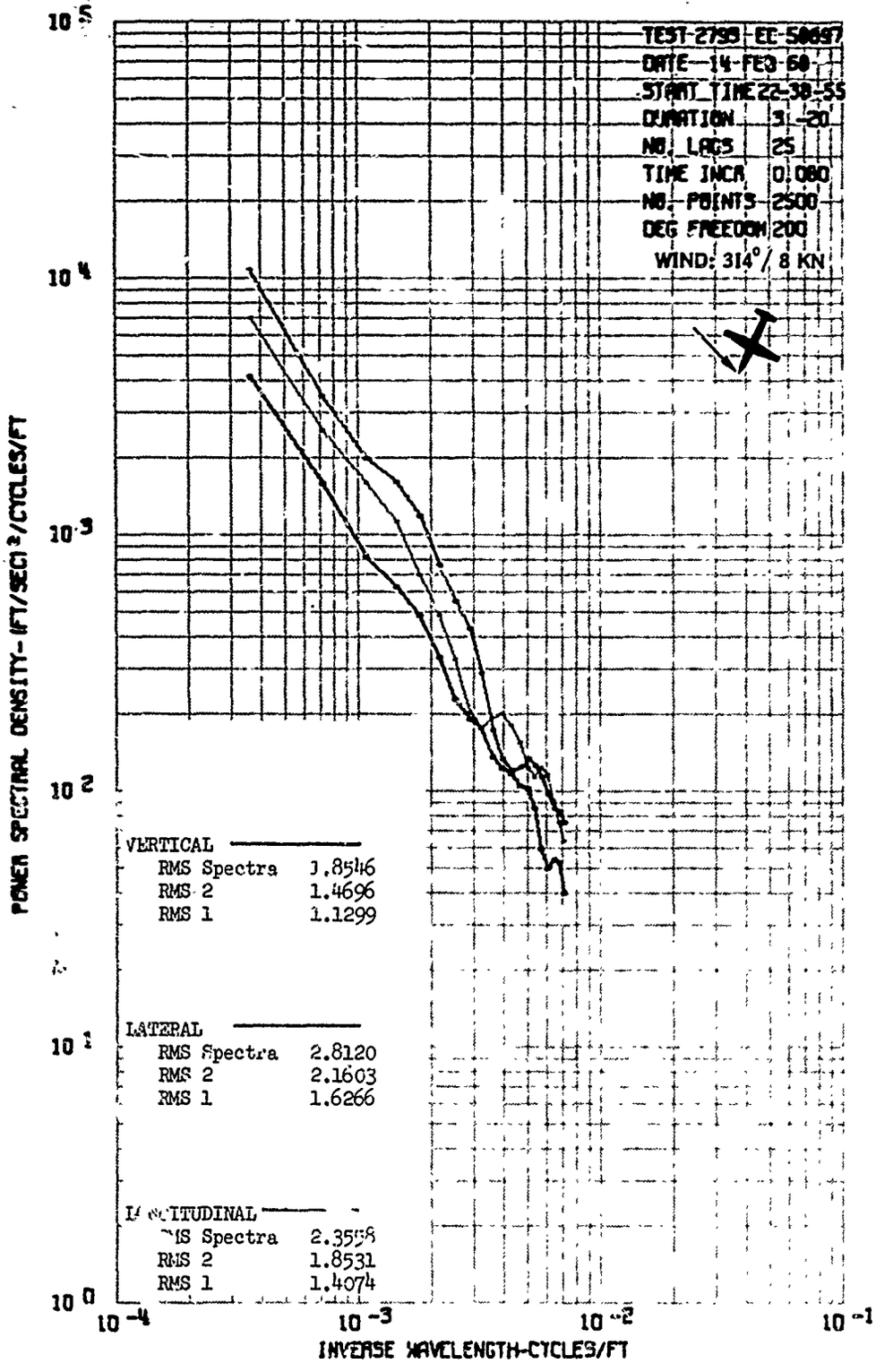


Figure 132 Gust Velocity Power Spectra for Test 279, Run 3
Maximum Standard λ = 2000 Feet

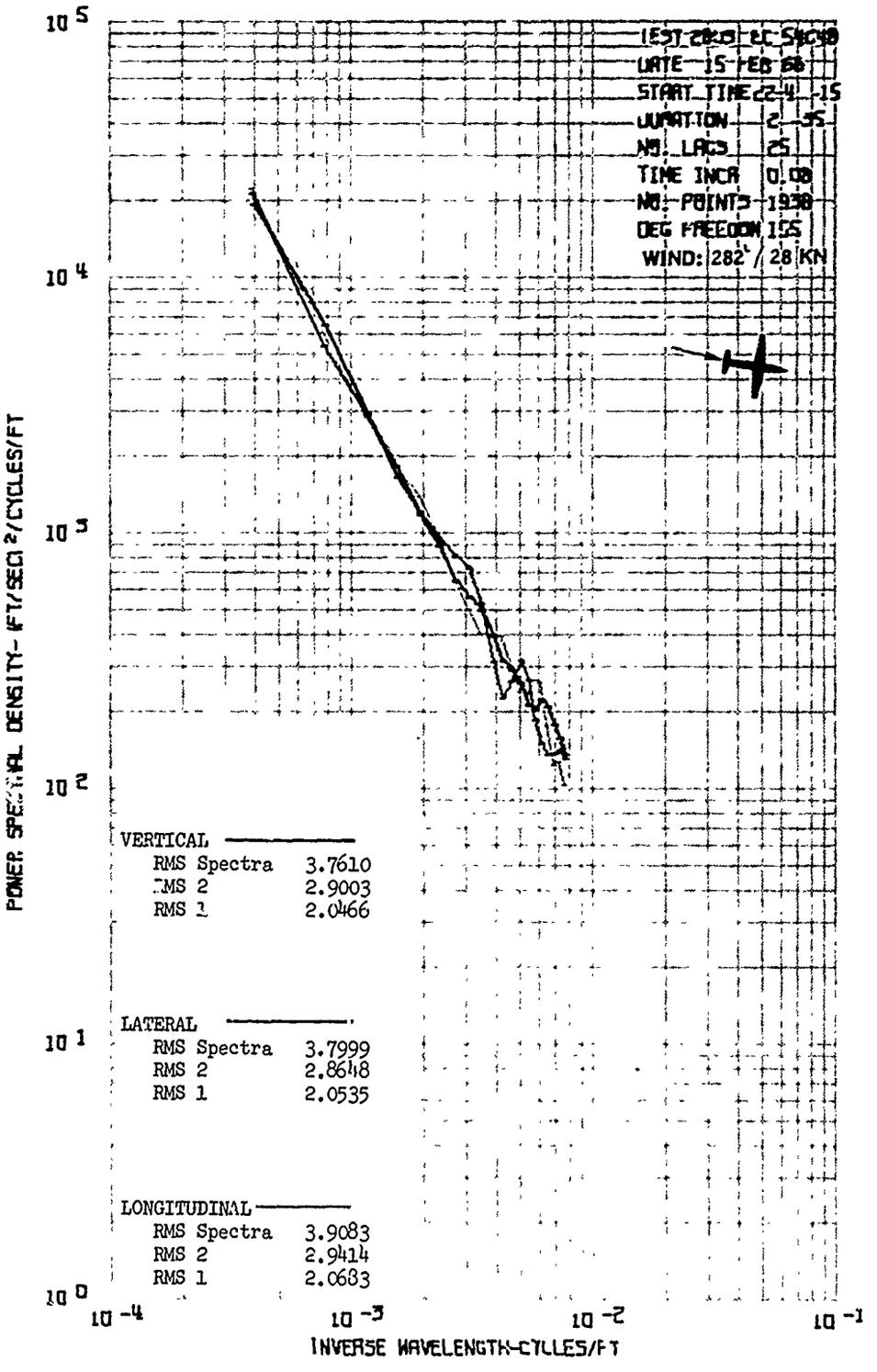


Figure 133 Gust Velocity Power Spectra for Test 280, Run 3
Maximum Standard λ = 2000 Feet

APPENDIX V

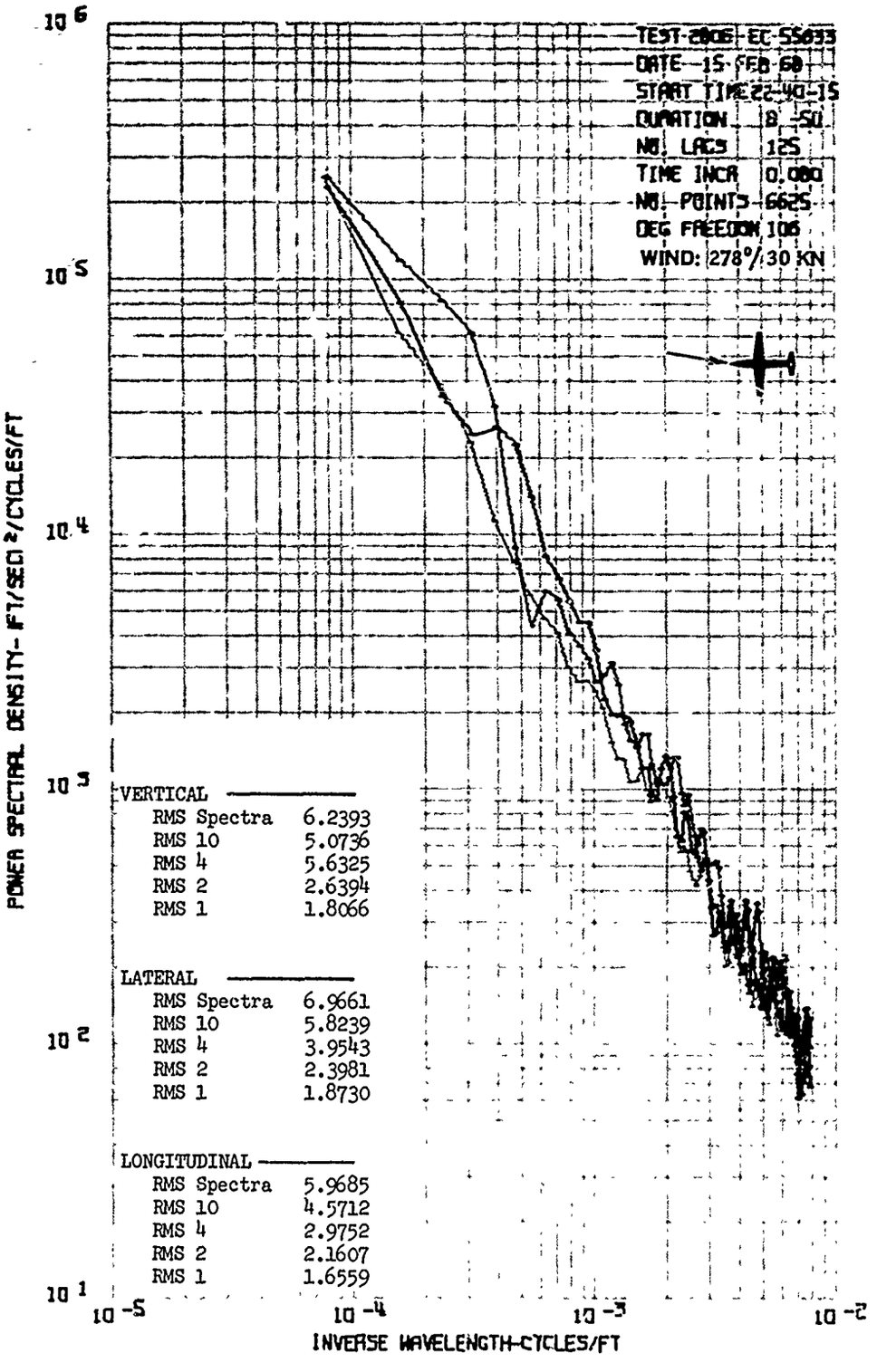


Figure 134 Gust Velocity Power Spectra for Test 280, Run 6
Maximum Standard λ = 10,000 Feet

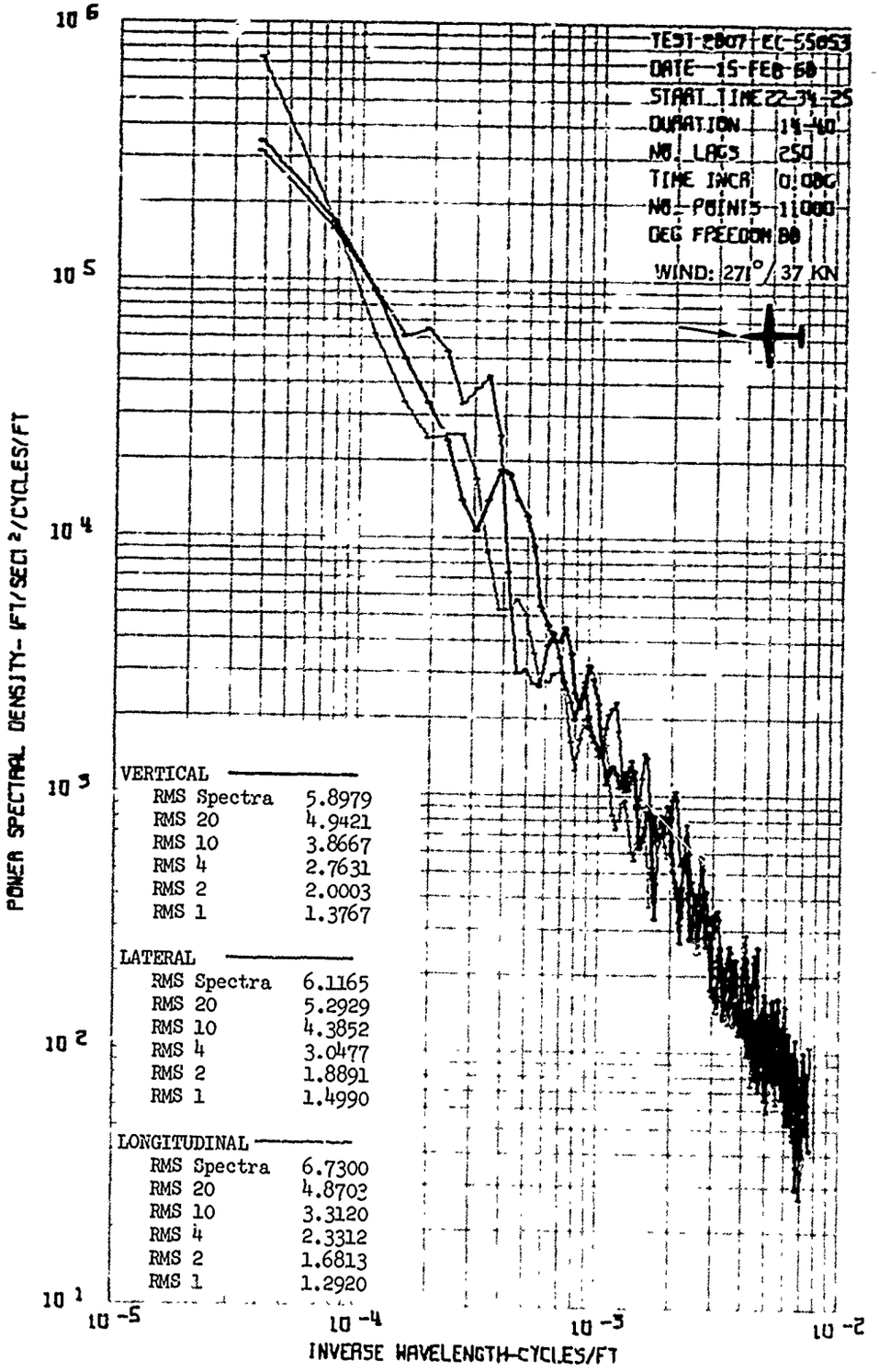


Figure 135 Gust Velocity Power Spectra for Test 280, Run 7
Maximum Standard λ = 20,000 Feet

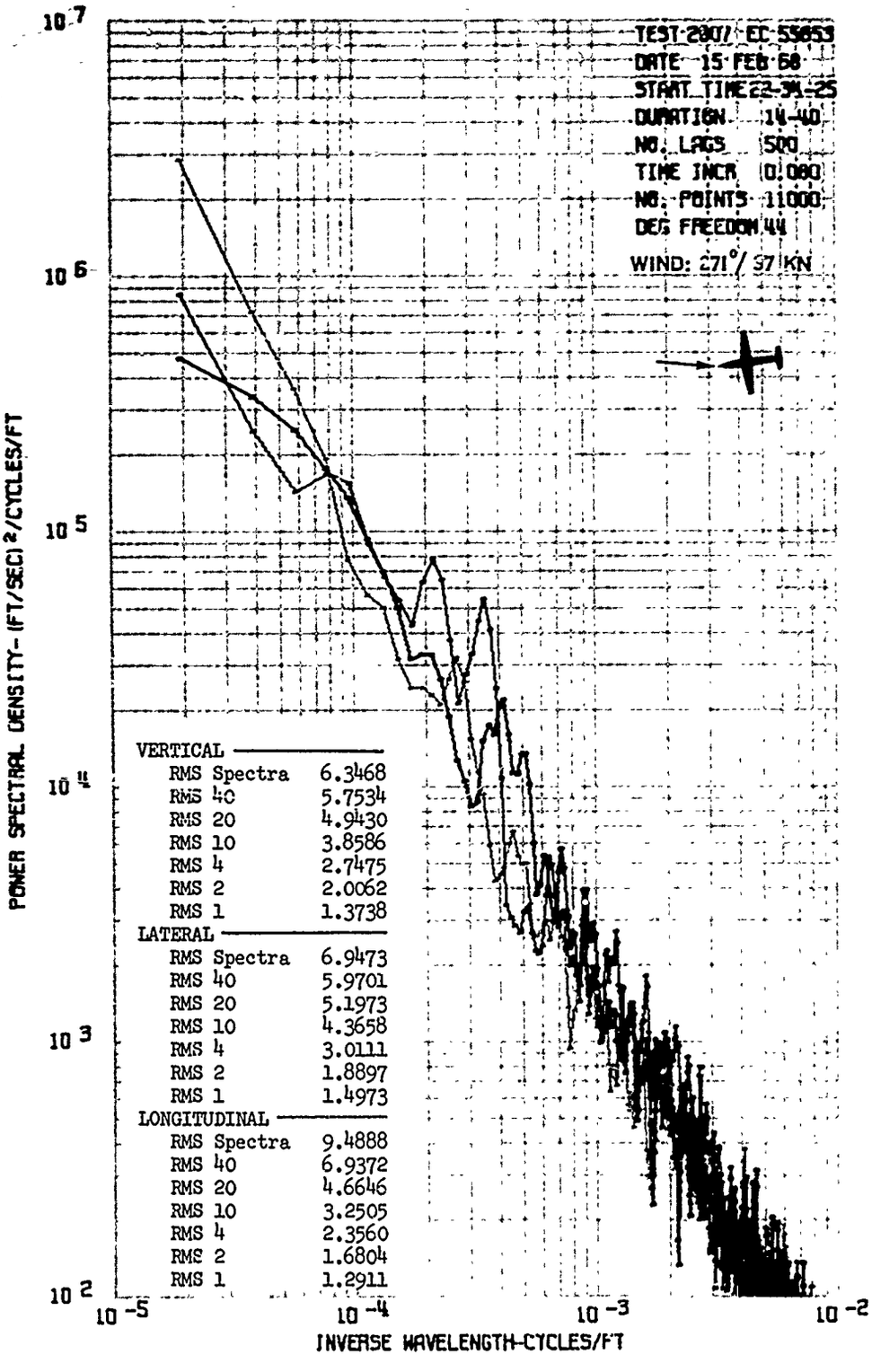


Figure 136 Gust Velocity Power Spectra for Test 280, Run 7
Maximum Standard λ = 40,000 Feet

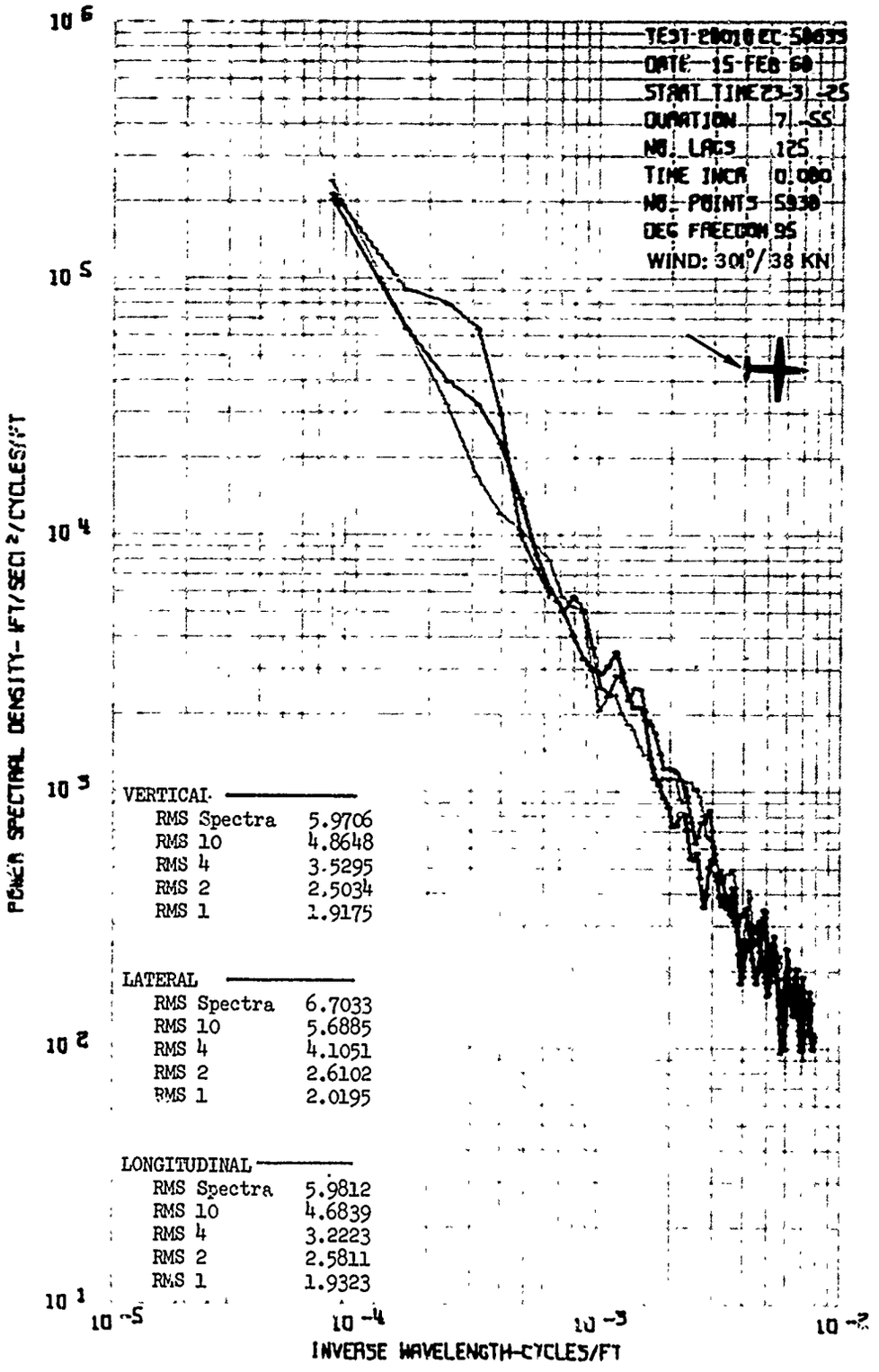


Figure 137 Gust Velocity Power Spectra for Test 280, Run 10
Maximum Standard λ = 10,000 Feet

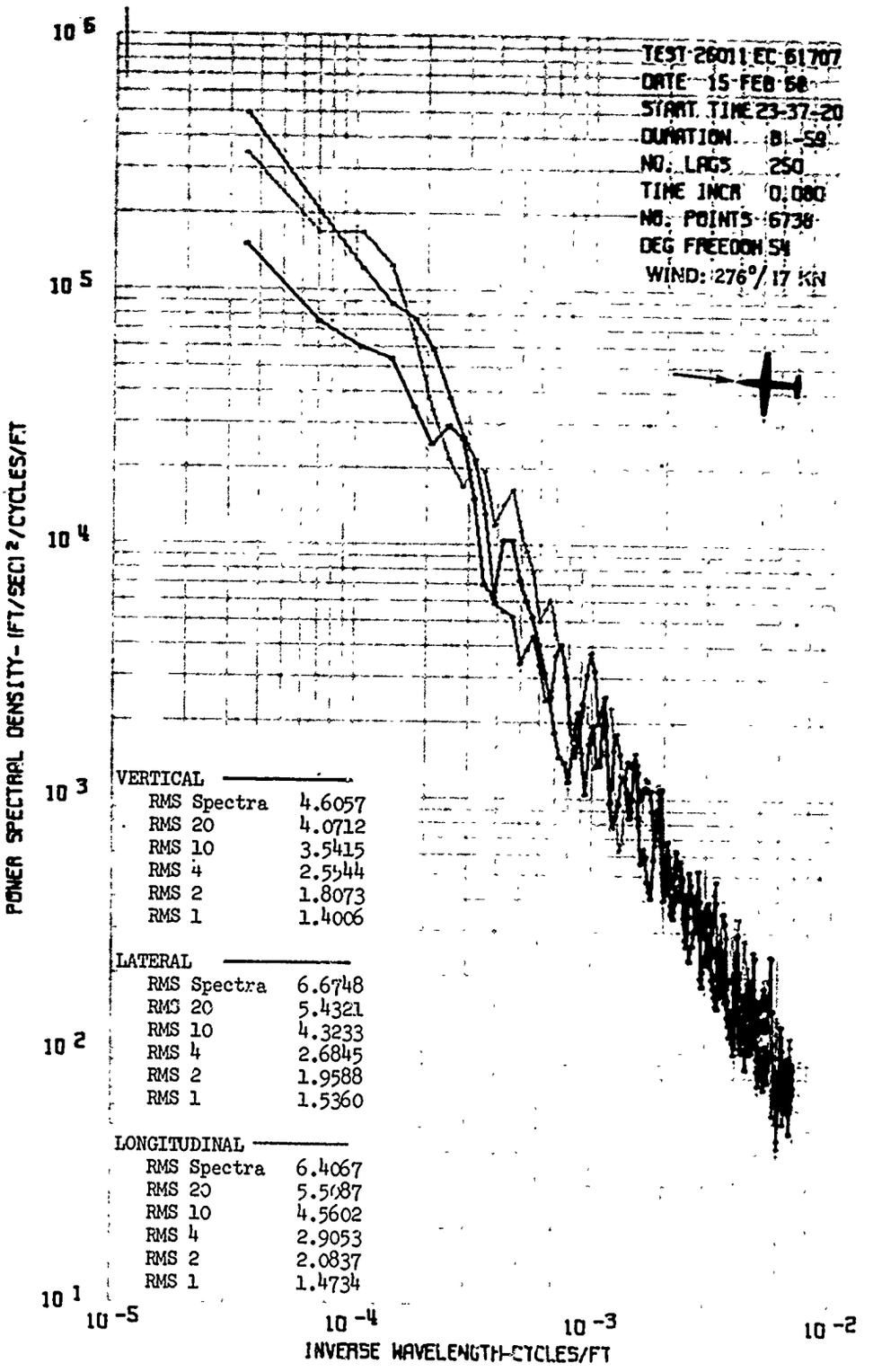


Figure 138 Gust Velocity Power Spectra for Test 280, Run 11
Maximum Standard λ = 20,000 Feet

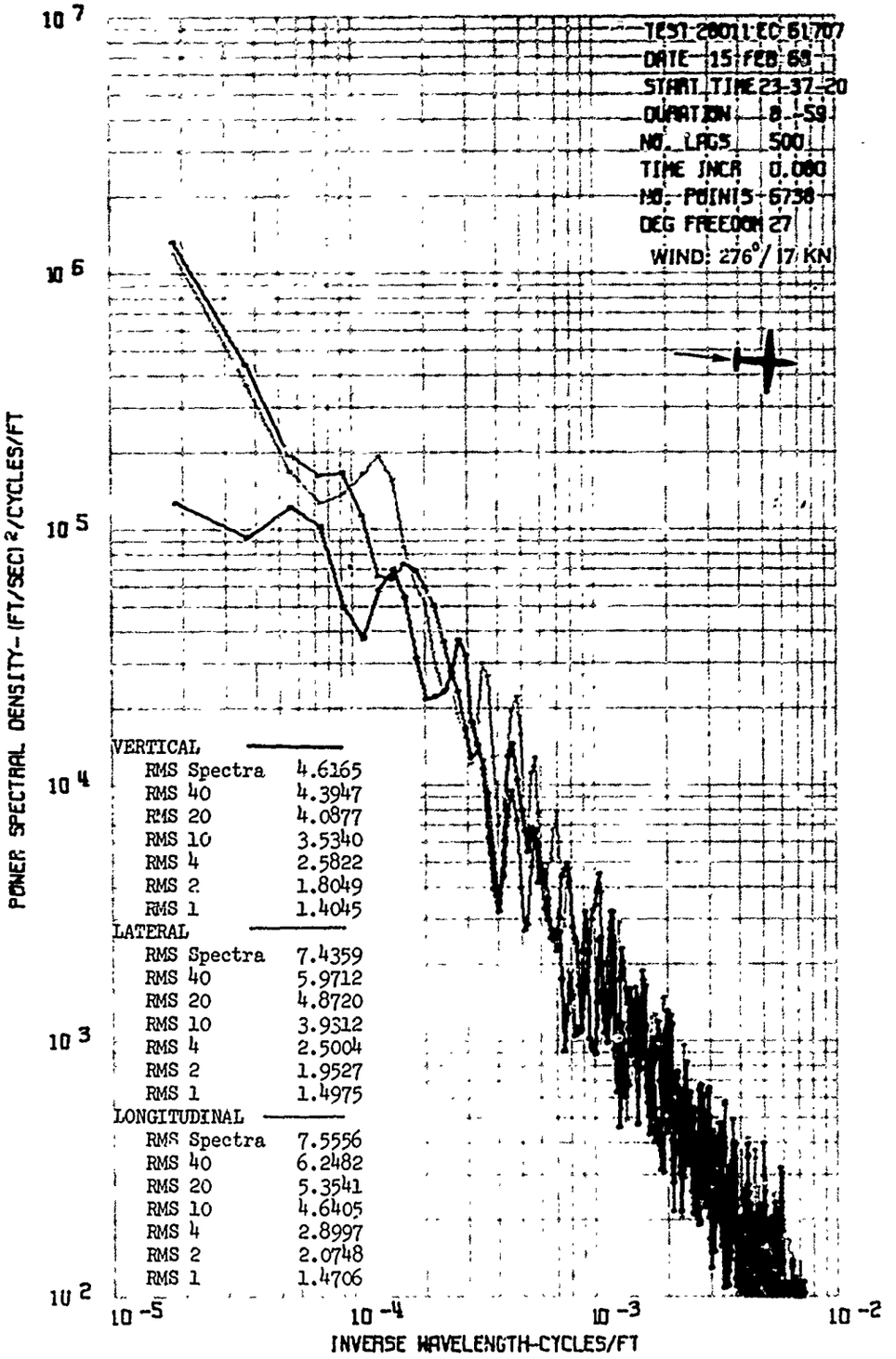


Figure 139 Gust Velocity Power Spectra for Test 280, Run 11
Maximum Standard λ = 40,000 Feet

APPENDIX V

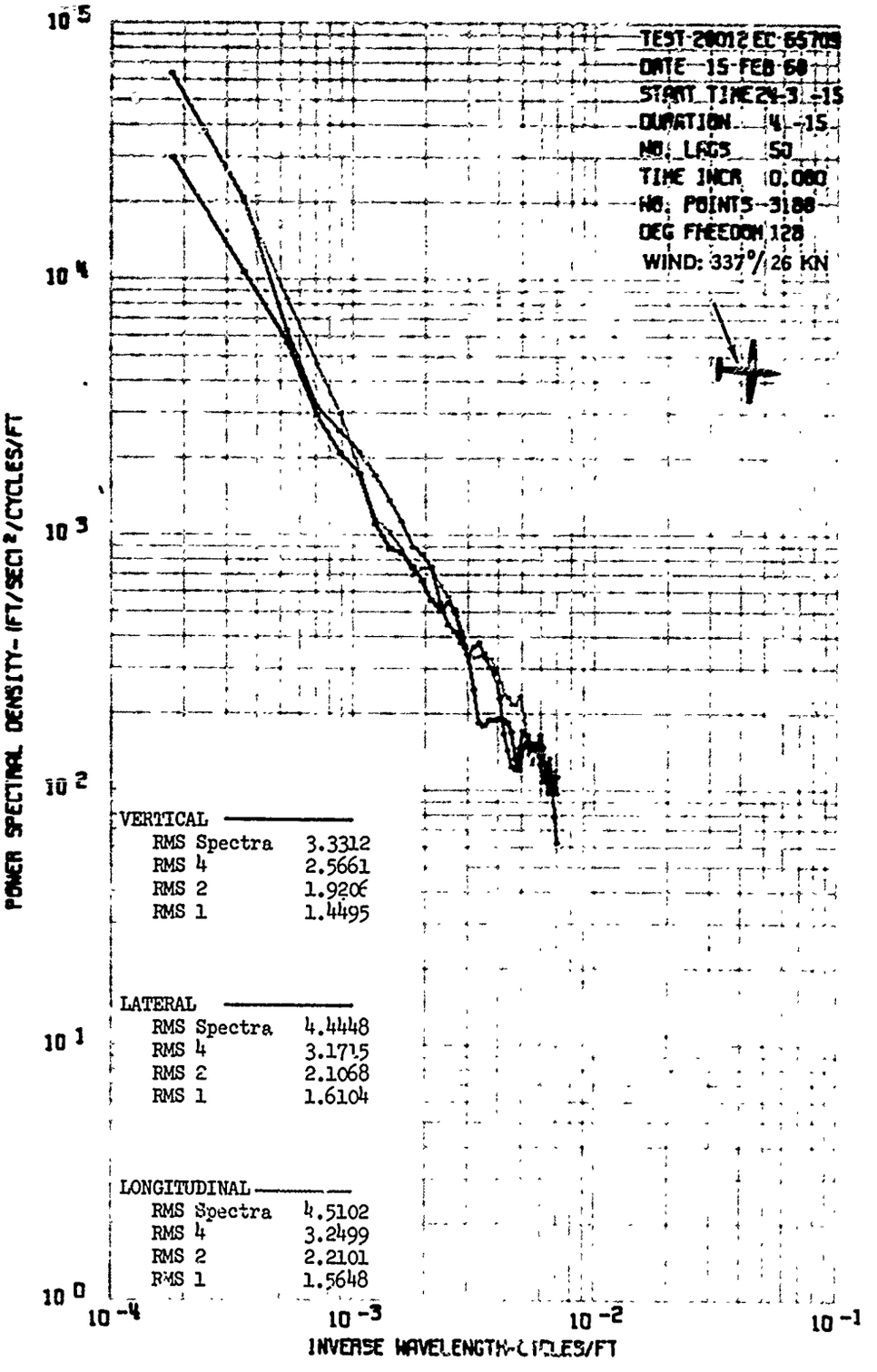


Figure 140 Gust Velocity Power Spectra for Test 280, Run 12
Maximum Standard λ = 4000 Feet

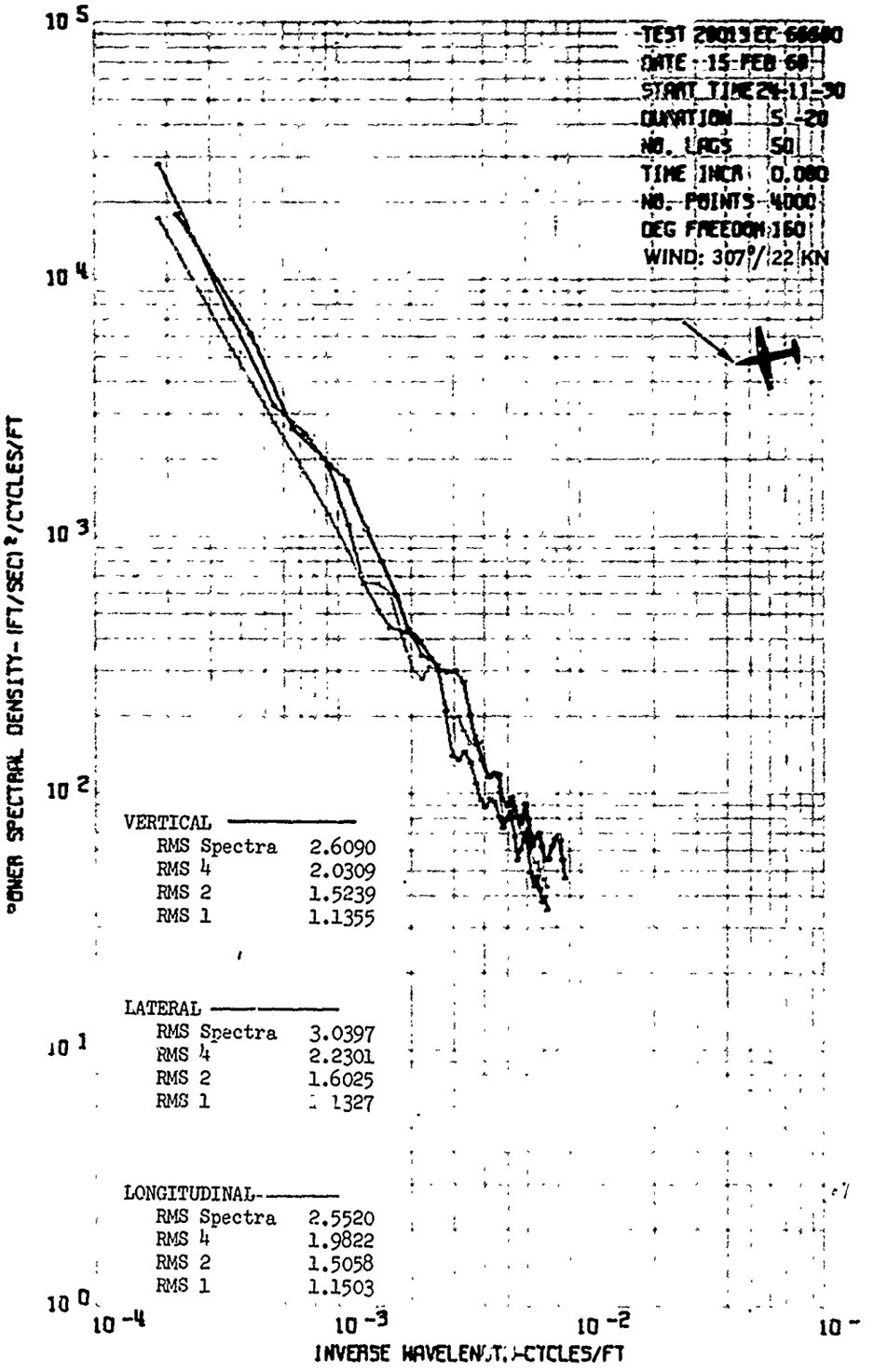


Figure 141 Gust Velocity Power Spectra for Test 280, Run 13
Maximum Standard λ = 4000 Feet

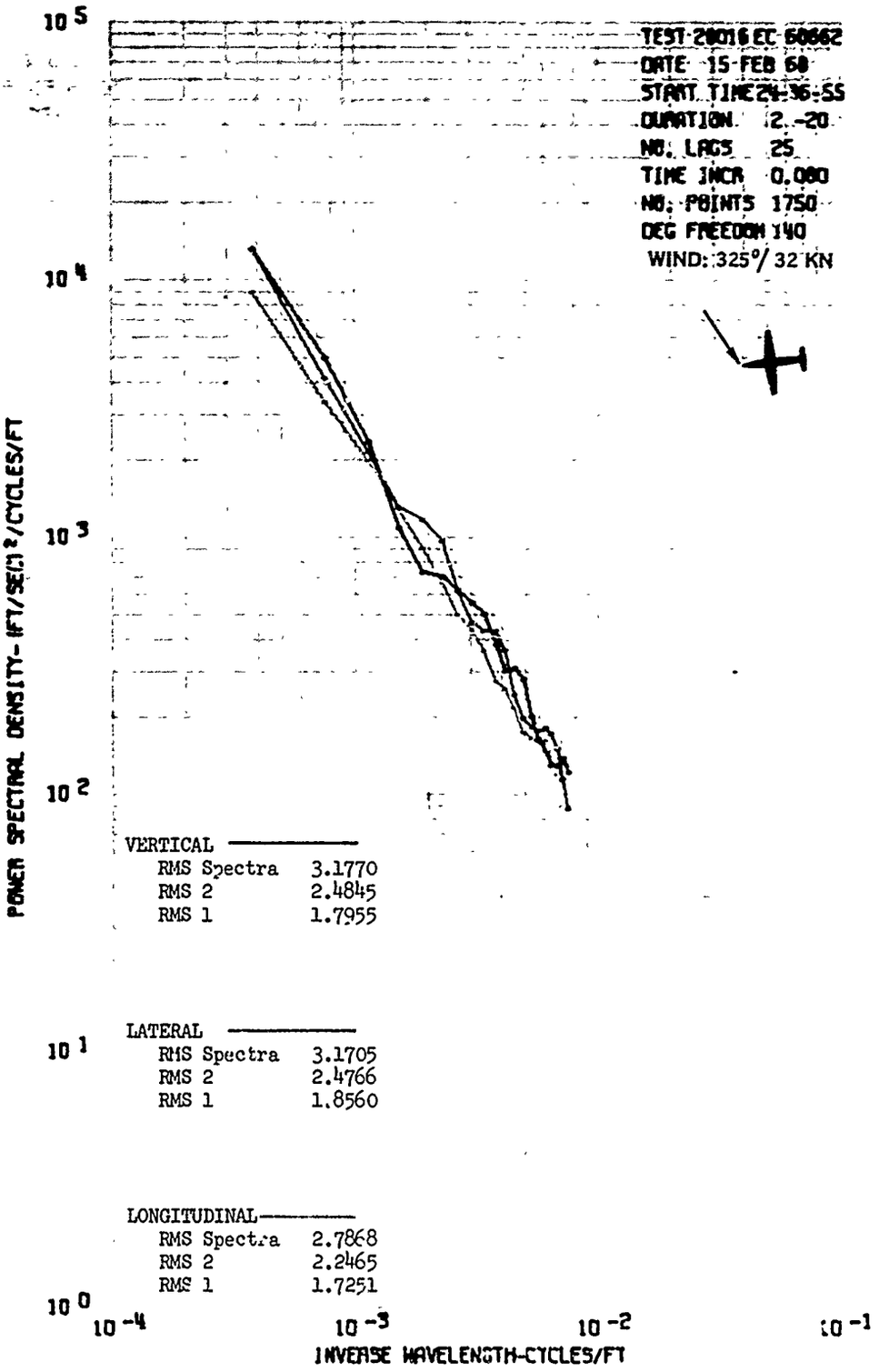


Figure 142 Gust Velocity Power Spectra for Test 280, Run 16
Maximum Standard λ = 2000 Feet

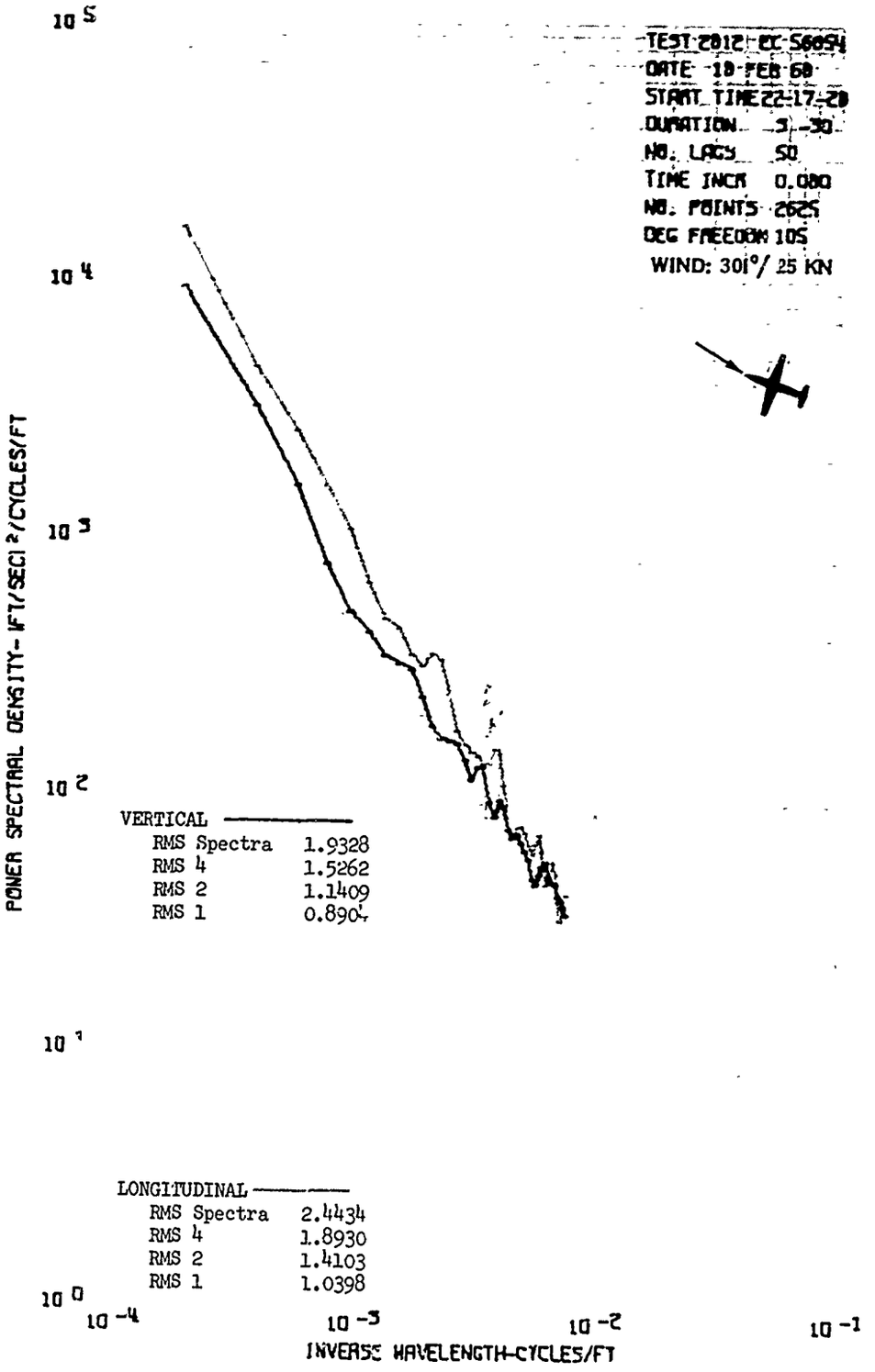


Figure 143 Gust Velocity Power Spectra for Test 281, Run 2
Maximum Standard λ = 4000 Feet

APPENDIX V

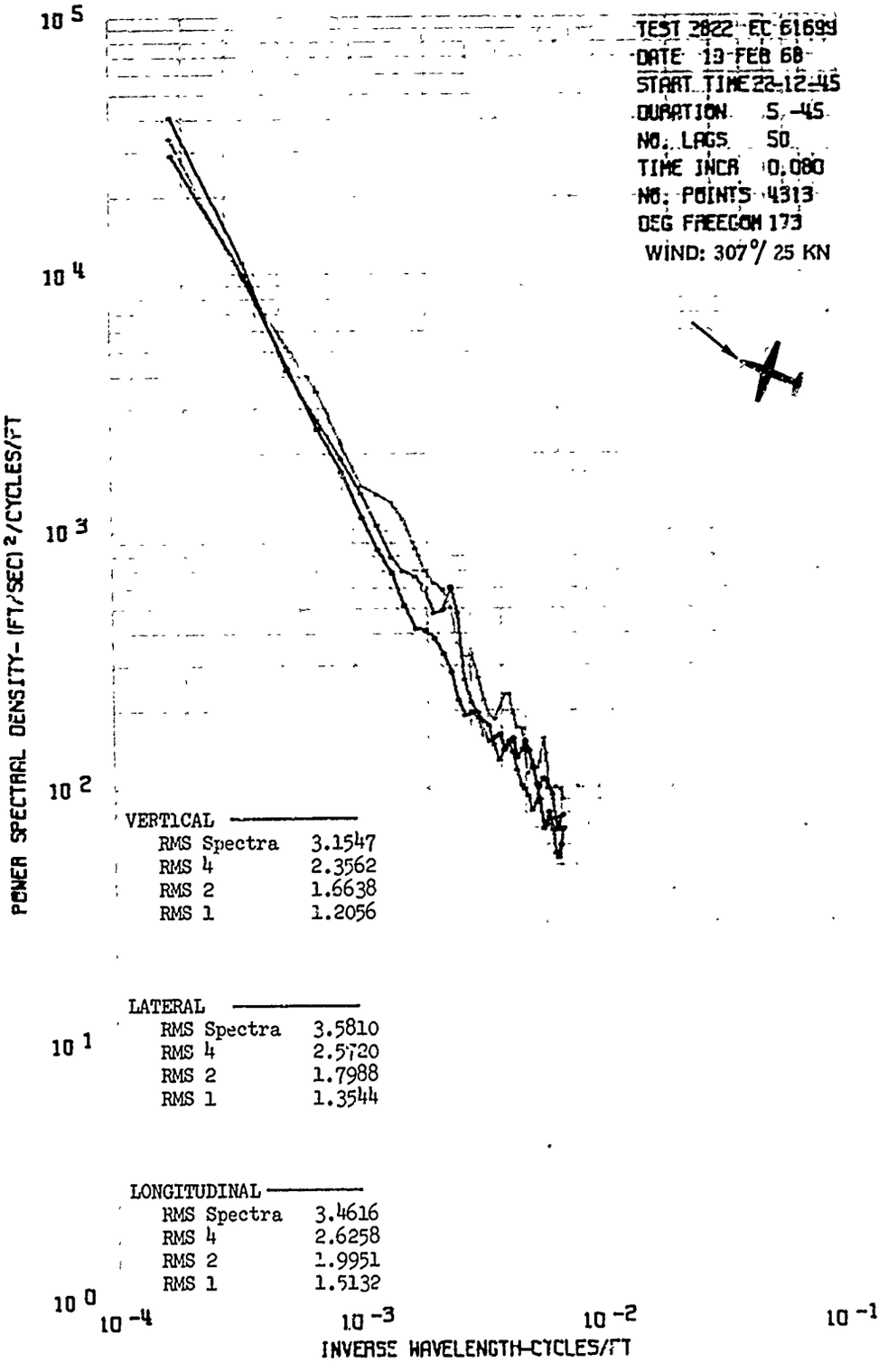


Figure 144 Gust Velocity Power Spectra for Test 282, Run 2
Maximum Standard λ = 4000 Feet

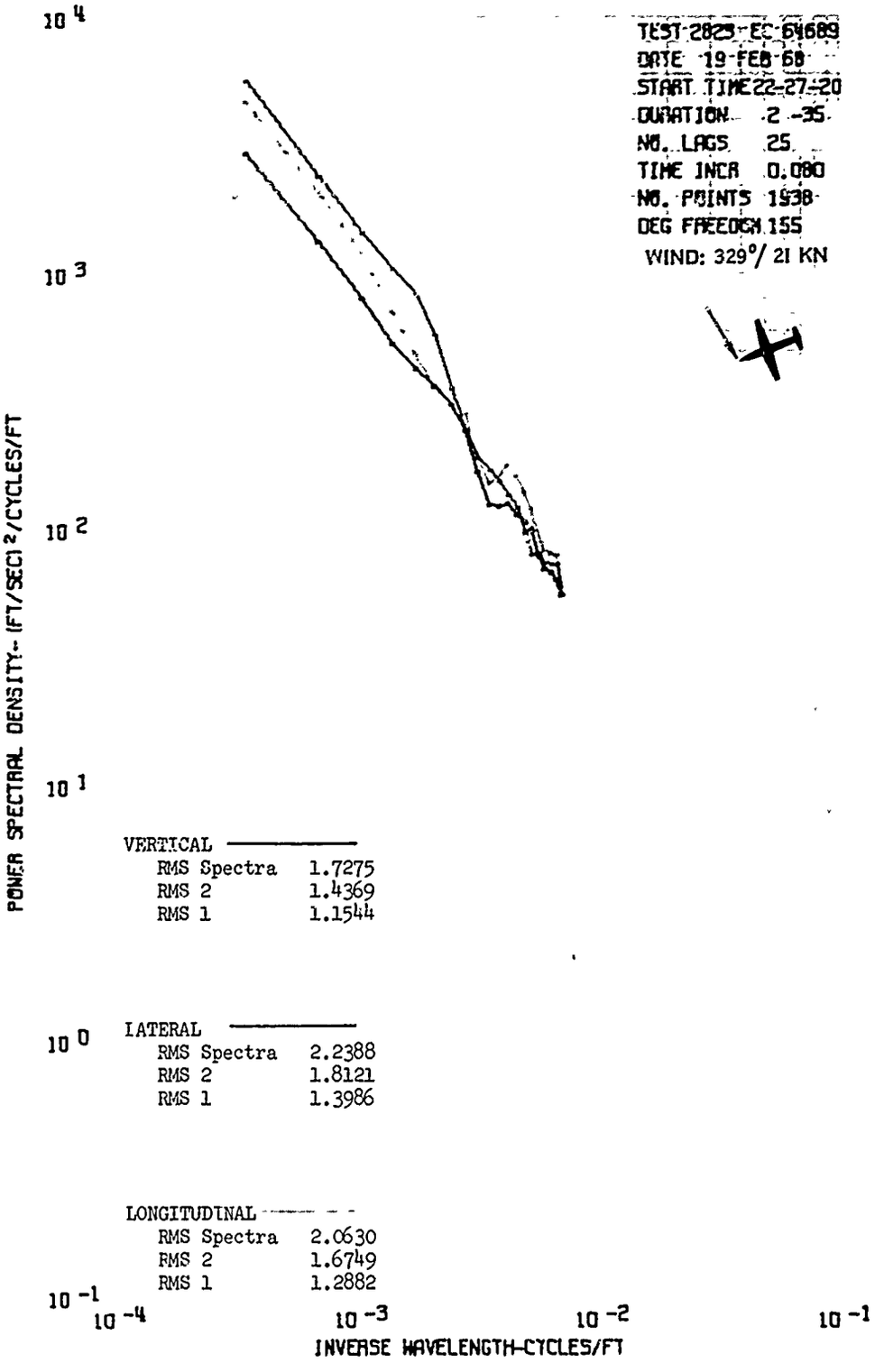


Figure 145 Gust Velocity Power Spectra for Test 282, Run 3
Maximum Standard λ = 2000 Feet

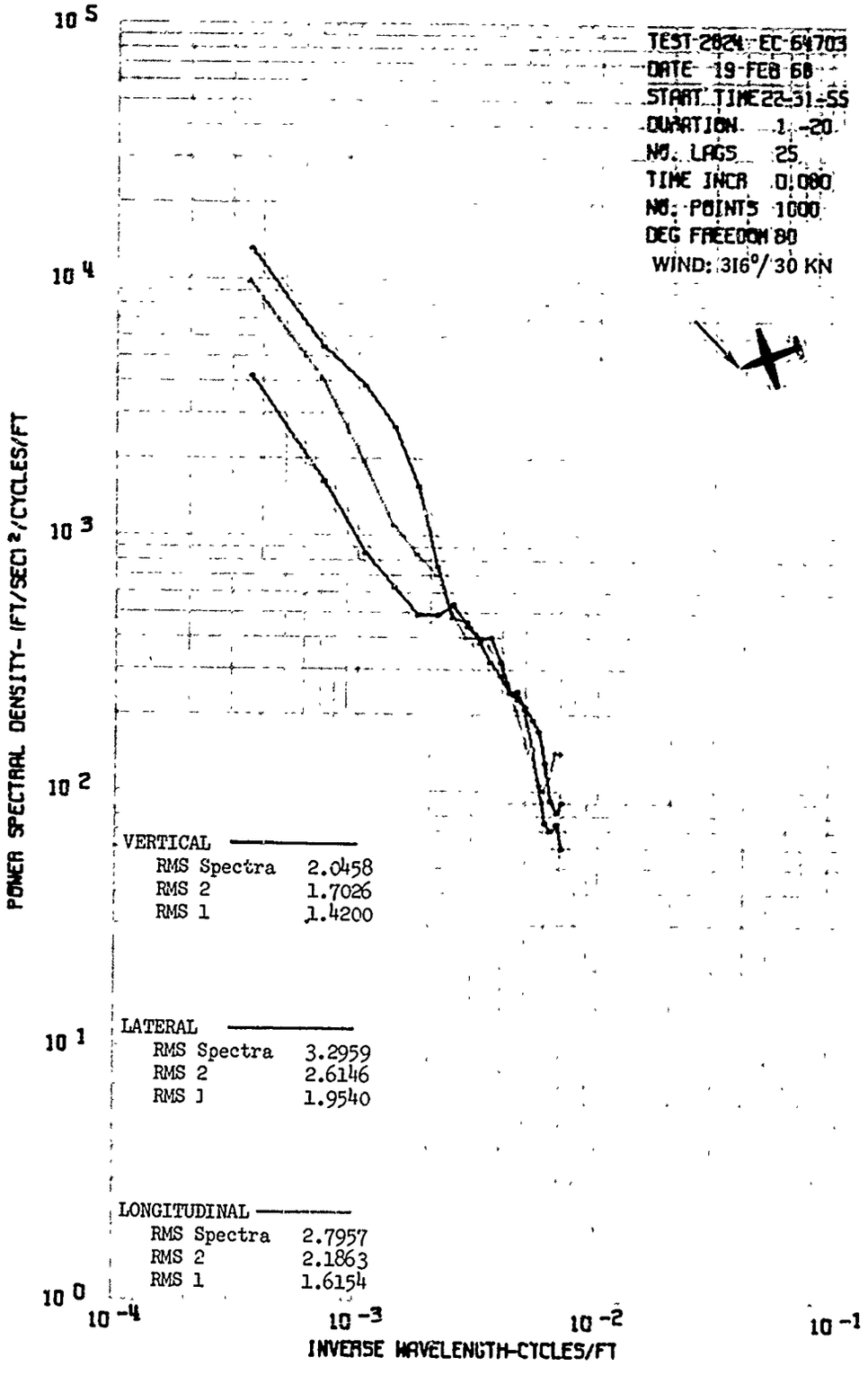


Figure 146 Gust Velocity Power Spectra for Test 282, Run 4
Maximum Standard λ = 2000 Feet

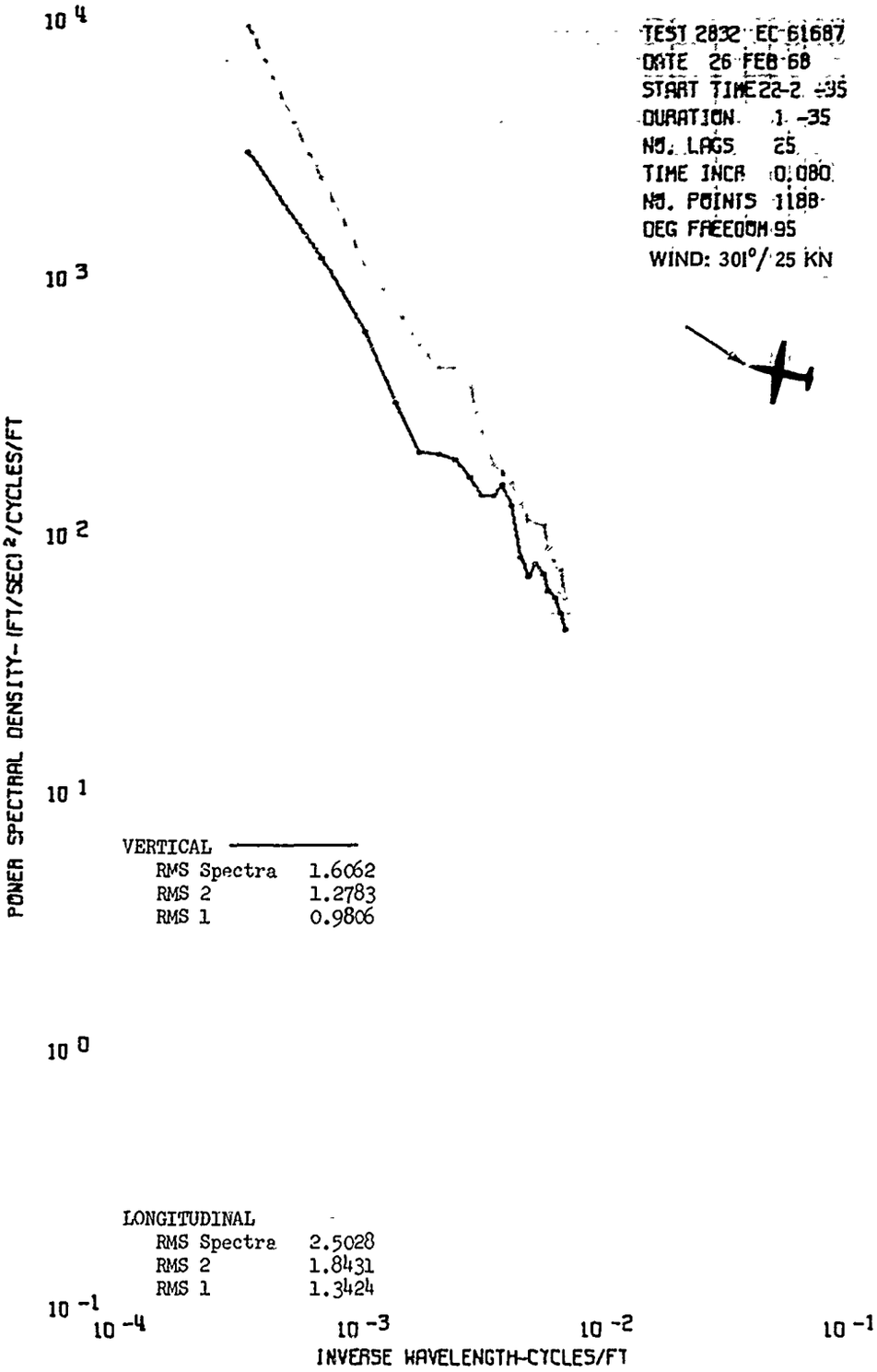


Figure 147 Gust Velocity Power Spectra for Test 283, Run 2
Maximum Standard λ = 2000 Feet

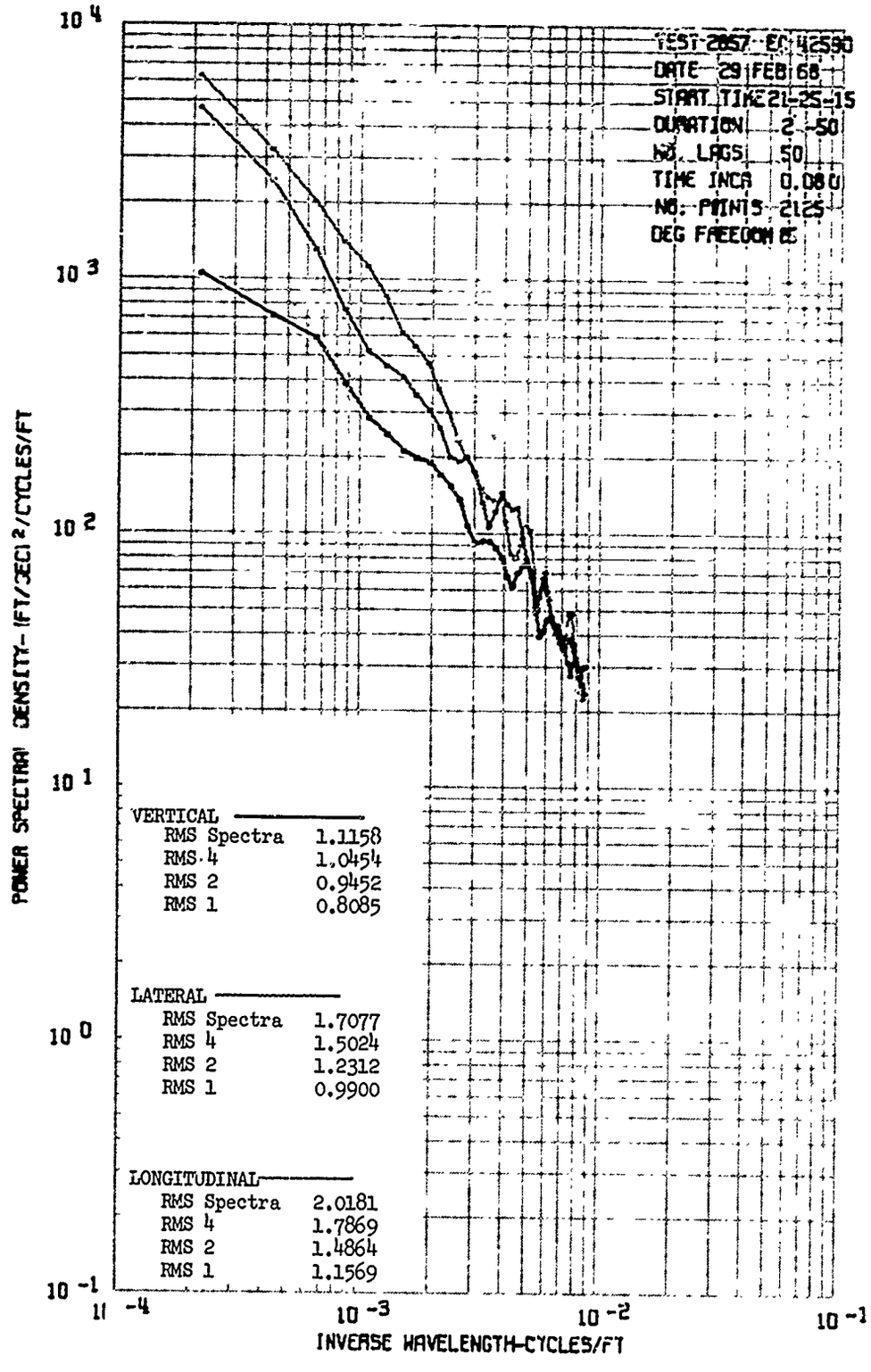


Figure 148 Gust Velocity Power Spectra for Test 285, Run 7 (Middle Altitude Flight with Canadian NAE T-33) Maximum Standard λ = 4000 Feet

APPENDIX VI

METEOROLOGICAL SUMMARIES OF TESTS

Meteorological summaries are presented herein for all the HICAT tests in the extended program beginning with Test 180, with the exception of the 10 tests* analyzed in detail in Section VI, Volume I. A complete meteorological summary is presented on two facing pages. It consists of a flight track map and the flight summary on the left hand page with RAOB charts of temperature versus pressure for 3 stations and either a 70, 100, or 200 mb chart of winds and temperatures on the right hand page. For consistency the test date and time are given in Greenwich Mean Time.

The flight track maps are derived from the tape recorded LN-3 inertial navigation data. When this information was defective or unavailable, the pilot's notes and debrief data were used to establish the flight track. A complete map shows not only the aircraft track but the location, run number, and approximate length of each high altitude CAT encounter, Turbulence intensity is indicated by the following:

- a coded subjective evaluation (VL-very light, L-light, M-moderate, S-severe)
- the root mean square deviation of the derived equivalent gust velocity, i.e., RMS U_{de}
- the RMS-2 vertical gust velocity (in all cases where the power spectral density was computed).

All the maps show test number and date together with the Greenwich time of the takeoff and landing. Since meteorological charts were used to plot the tracks and flight weather data, only place names of radiosonde observation stations are indicated and then usually in code. The code letters and the stations and/or cities designated are listed in the front of this volume.

Immediately beneath the track map is a flight summary. The summary describes the meteorological aspects of the flight together with pertinent pilot observations. A brief meteorological analysis is also provided based upon the RAOB charts and the chart of winds and temperatures.

*Tests 202, 204, 218, 220, 233, 247, 264, 265, 266, and 280.

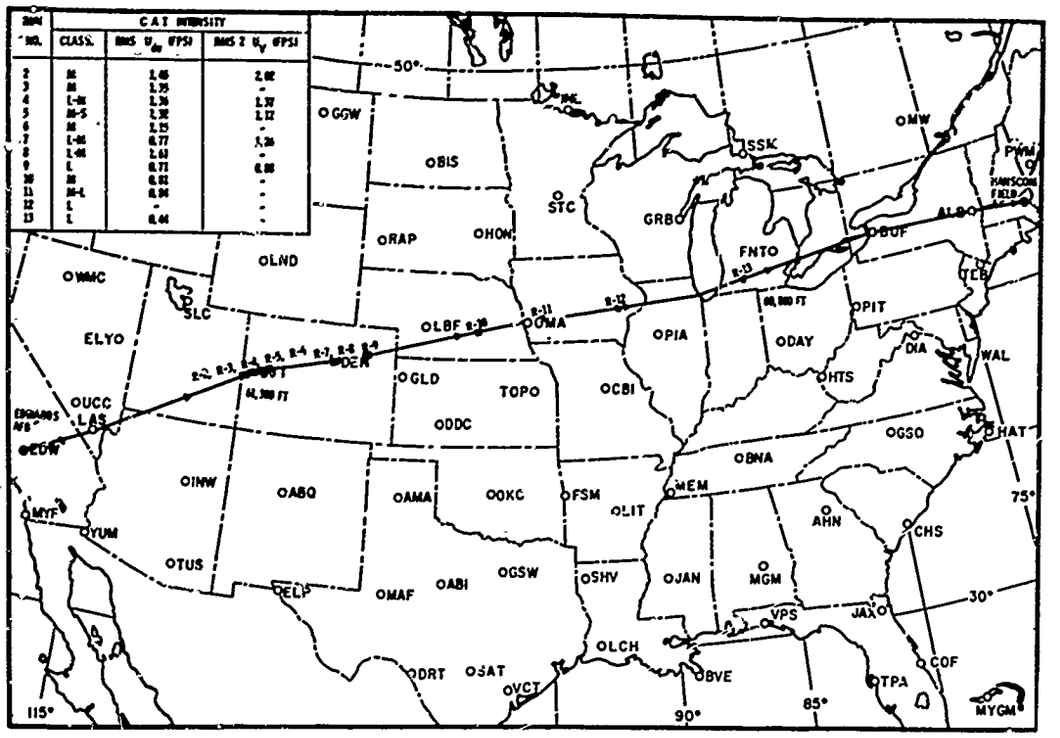
APPENDIX VI

TEST 180

13 March 1967, 1810-2350Z

Ferry Flight from Edwards AFB, California to Hanscom Field, Bedford, Massachusetts, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

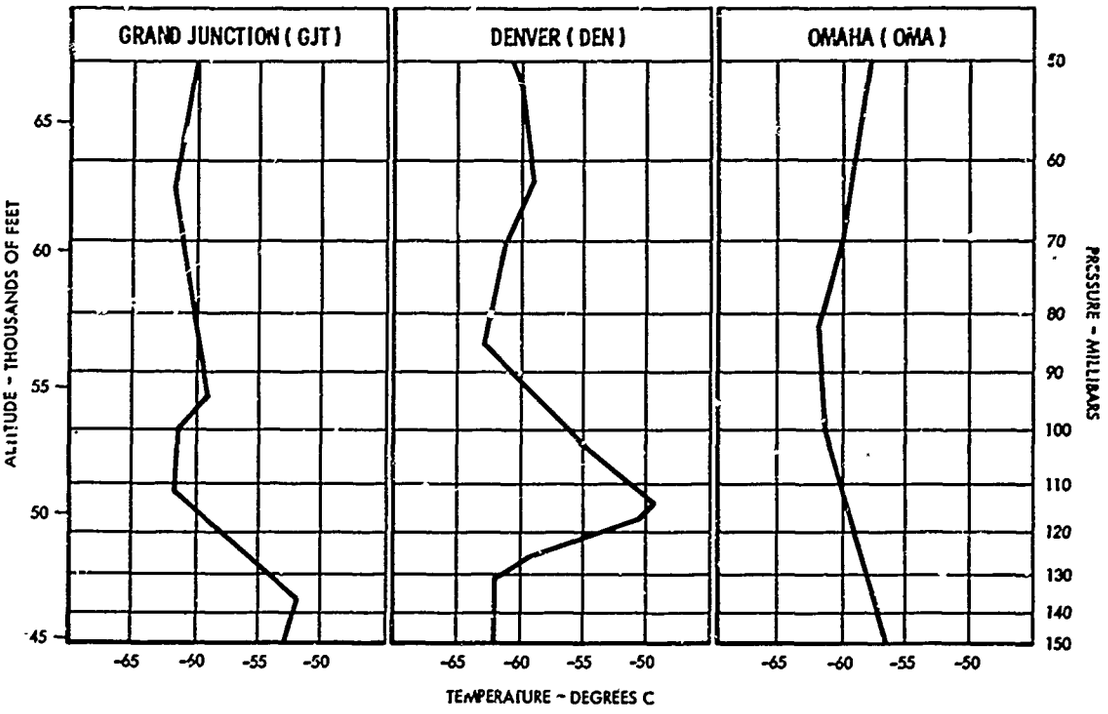
The 1800Z, 13 March 1967 surface chart, which was about one and a half hours prior to the turbulence encounters over Utah and Colorado showed a low pressure center over Wyoming with fronts extending southward to Oklahoma southwestward to California and northwestward to Washington.

There was considerable weather occurring over the Rocky Mountain region. Aloft, the 1200Z, 200 mb chart (about eight hours prior to the turbulent encounters) showed a 100 to 120 knot jetstream flowing southwest-northeast across central Nevada, Utah and southern Wyoming. Position extrapolation would place the jetstream almost directly beneath the U-2 for the entire flight from Edwards Air Force Base, California to Hanscom Field, Massachusetts.

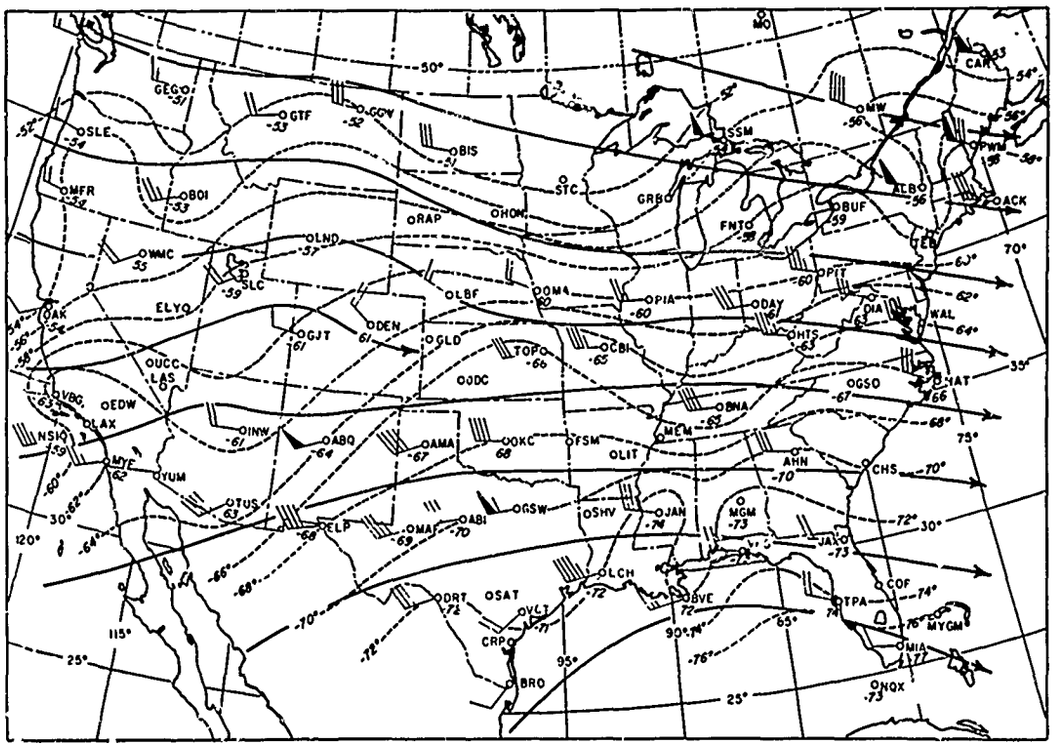
The flight track indicates that the aircraft encountered moderate to severe CAT while over the Grand Junction, Colorado area and moderate CAT near Denver, Colorado and Omaha, Nebraska. At the post-flight debriefing, the pilot stated that the top of the turbulence was about 63,000 feet. The lower boundary of the turbulent layer was not determined.

Note the 1200Z, 70 mb analysis shows a thermal trough along the INW-ELY axis with wind flow across the isotherms in the Utah-Colorado area. The 1200Z RACB analysis shows a large vertical temperature gradient (3°C/1000 feet)over Denver.

RAOB CHARTS (1200Z, 13 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 13 Mar 1967)



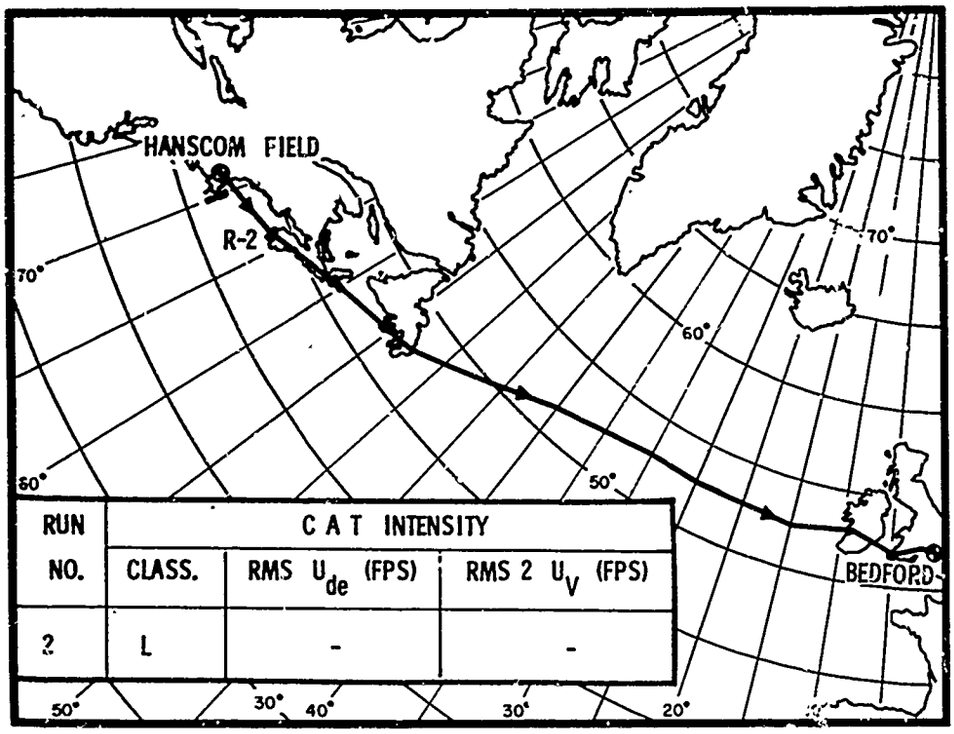
APPENDIX VI

TEST 181

15 March 1967, 0606-1306Z

Ferry flight from Hanscom Field, Bedford, Massachusetts to Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



RUN NO.	C A T INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	L	-	-

FLIGHT SUMMARY

Data not obtained.

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

APPENDIX VI

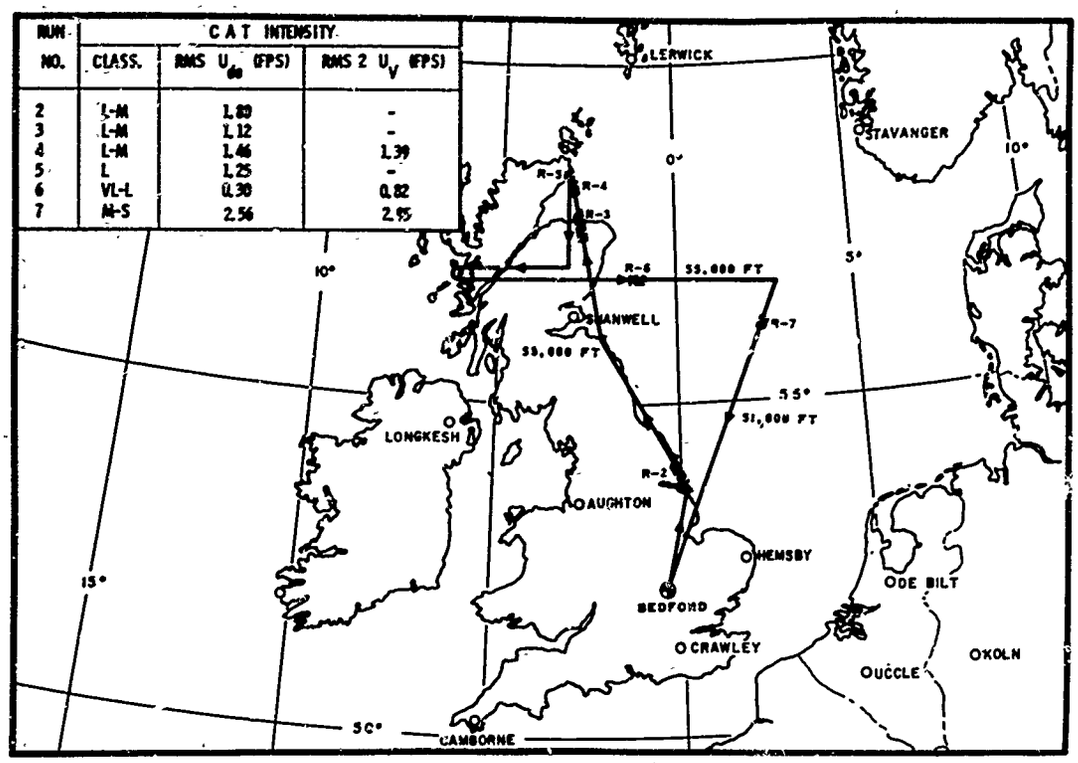
TEST 182

17 March 1967, 1000-1446Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK

RUN NO.	CAT INTENSITY CLASS.	RMS U_{ds} (FPS)	RMS 2 U_V (FPS)
2	L-M	1.89	-
3	L-M	1.12	-
4	L-M	1.46	1.39
5	L	1.25	-
6	VL-L	0.30	0.82
7	M-S	2.56	2.95



FLIGHT SUMMARY

This was the first flight out of England after arrival at Bedford from the States.

The 1200Z surface chart showed a 960 mb low pressure system centered about 300 nm north of the Scottish mountains with a cold front trailing southward and lying across southern England.

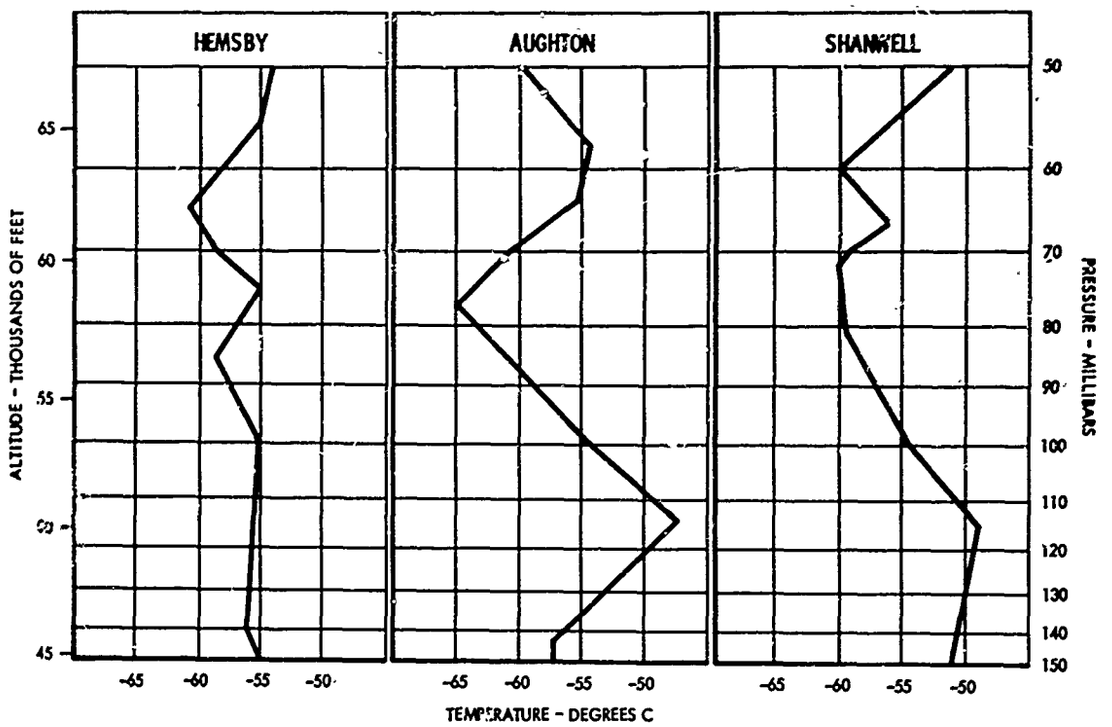
The surface front passed through Bedford shortly after the U-2 took off (~ 1000Z).

A strong westerly flow at all levels from the surface to 50,000 feet was present over northern Scotland. A 300 mb jetstream was oriented west to east directly over the highest mountains.

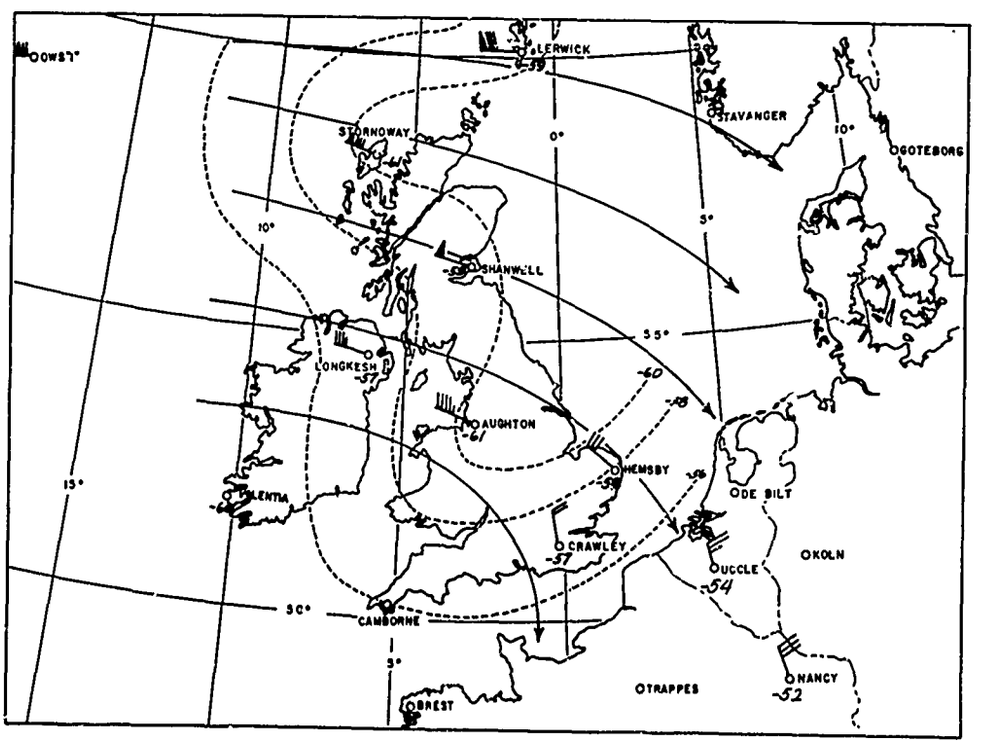
The British Canberra flew essentially the same course as that planned for the U-2 at flight levels 30,000 - 35,000 feet.

The HICAT aircraft encountered light to moderate turbulence. The Canberra pilot reported none.

RAOB CHARTS (1200Z, 17 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 17 Mar 1967)



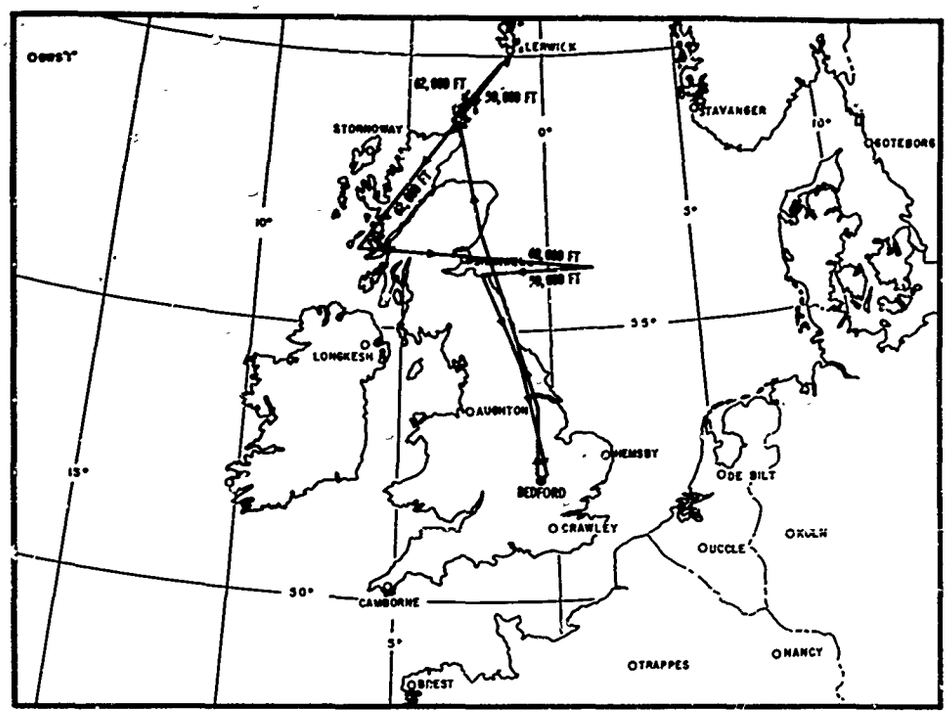
APPENDIX VI

TEST 183

20 March 1967, 0938-1431Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

On 20 March 1967, a rapidly moving surface low pressure system was positioned about 60 nm north of the northern tip of Scotland. Sky conditions were broken to overcast.

The surface flow was generally westerly becoming north-westerly at 500 mb and higher. The 1200Z 300 mb chart showed a jetstream passing over Stornoway.

The flight plan for this test was for the U-2 and the British Canberra to fly the route as indicated on the flight track. The Canberra was to search for turbulence between the altitudes 36,000-38,000 feet and the U-2 altitudes 50,000-65,000 feet.

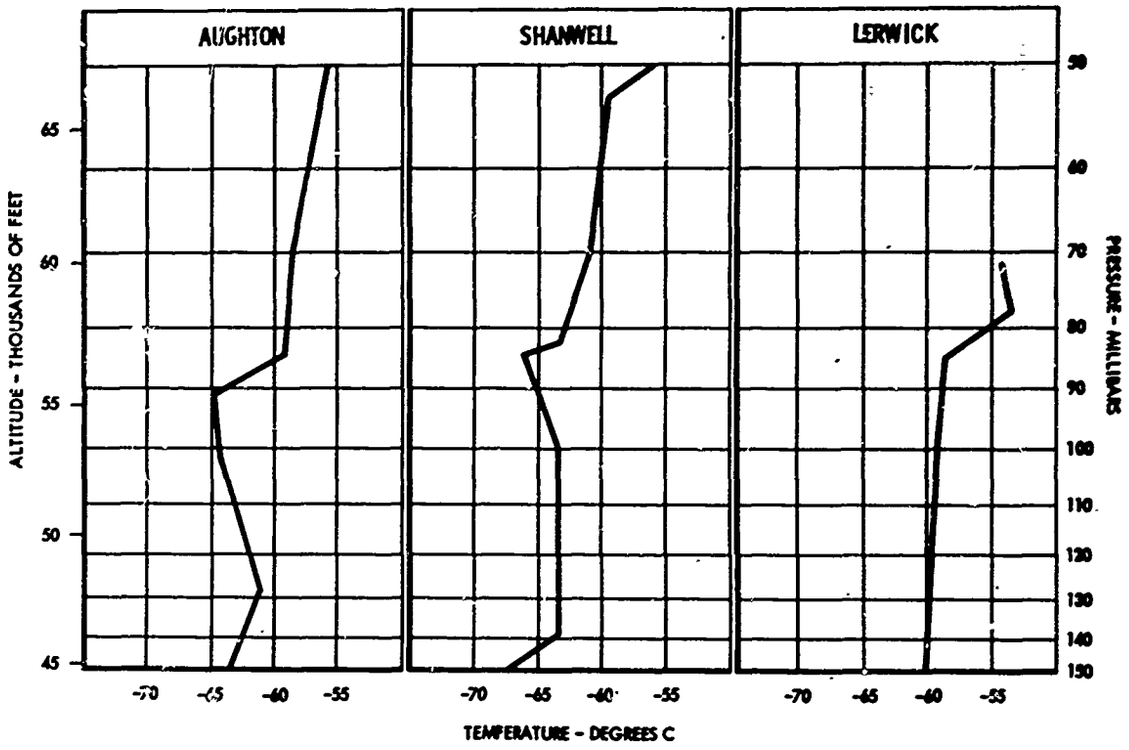
The Canberra aircraft recorded light CAT at flight level 38,000 feet over central Scotland.

The U-2 pilot reported very light CAT only, less than 0.1g at 55,000 feet. This was verified by the aircraft oscillograph record and no runs were processed.

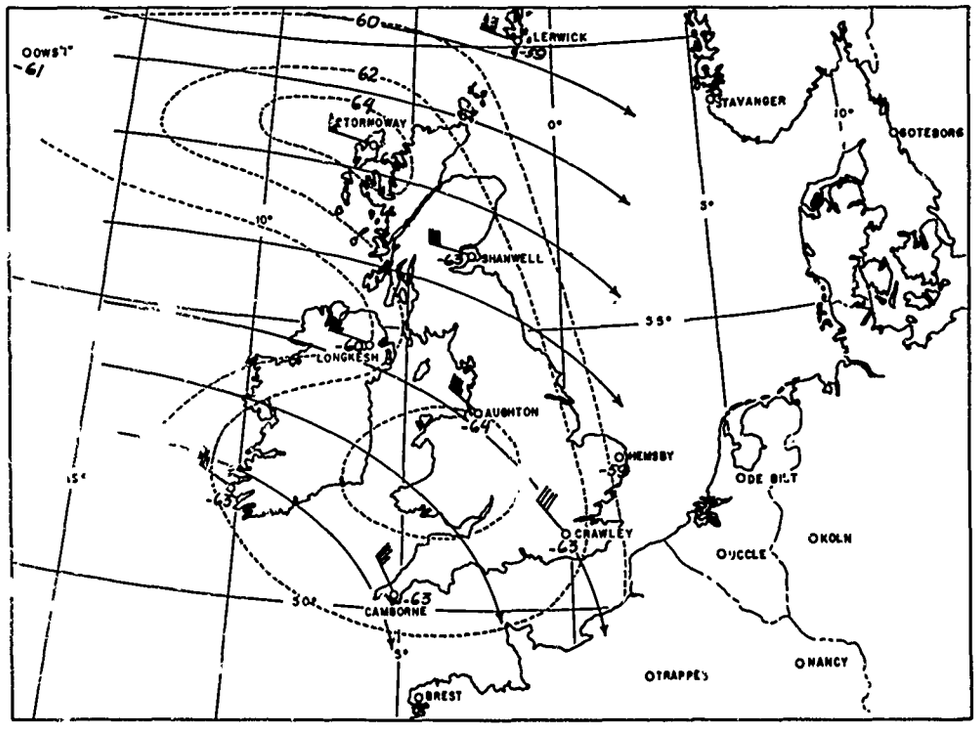
The RAOB chart shows the vertical temperature gradients between 55,000-58,000 feet over Aughton, Shanwell, and Lerwick.

Note the weak horizontal temperature gradient and the anticyclonic wind flow at the 100 mb level.

RAOB CHARTS (1200Z, 20 Mar 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 20 Mar 1967)



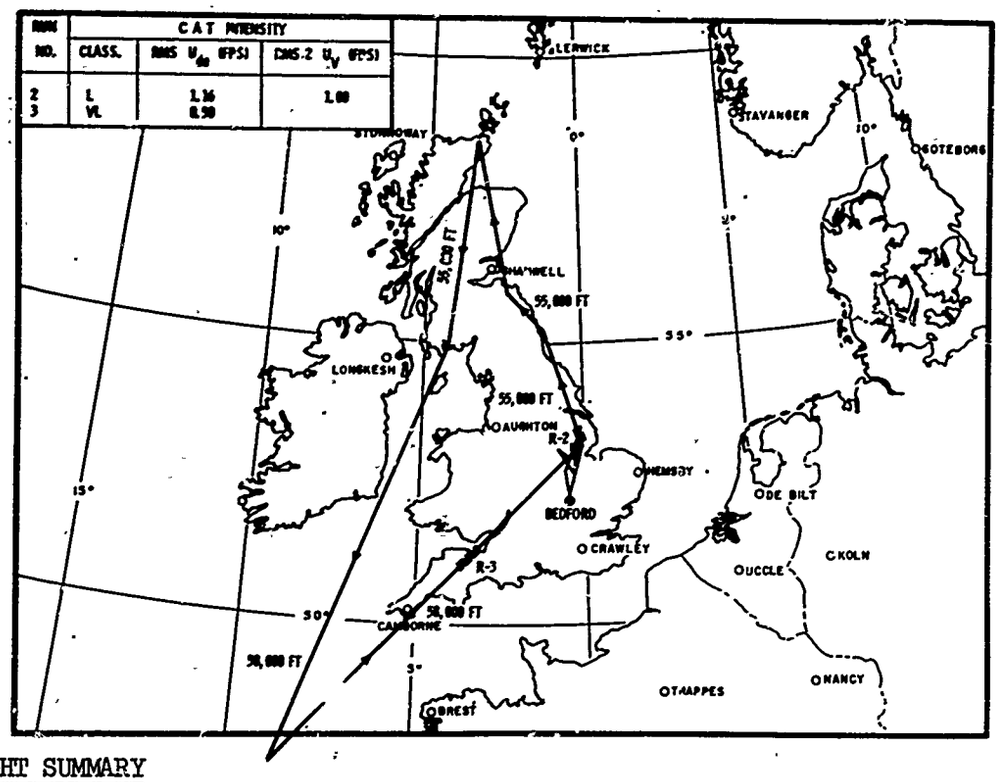
APPENDIX VI

TEST 184

21 March 1967, 0926-1437Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

At 1200Z, 21 March 1967, a weak surface cold front was moving rapidly into northern Ireland. A surface high pressure system was centered about 100 miles east of Brest, France and most of England was experiencing a south-southwest wind flow in the lower levels. Sky condition was scattered-to-broken cumulus.

Aloft (500 mb- 50mb), winds were west becoming northwest over the British Isles. Wind velocities (averaging 65 knots) were unusually high at the 70 mb level from Shanwell to the north.

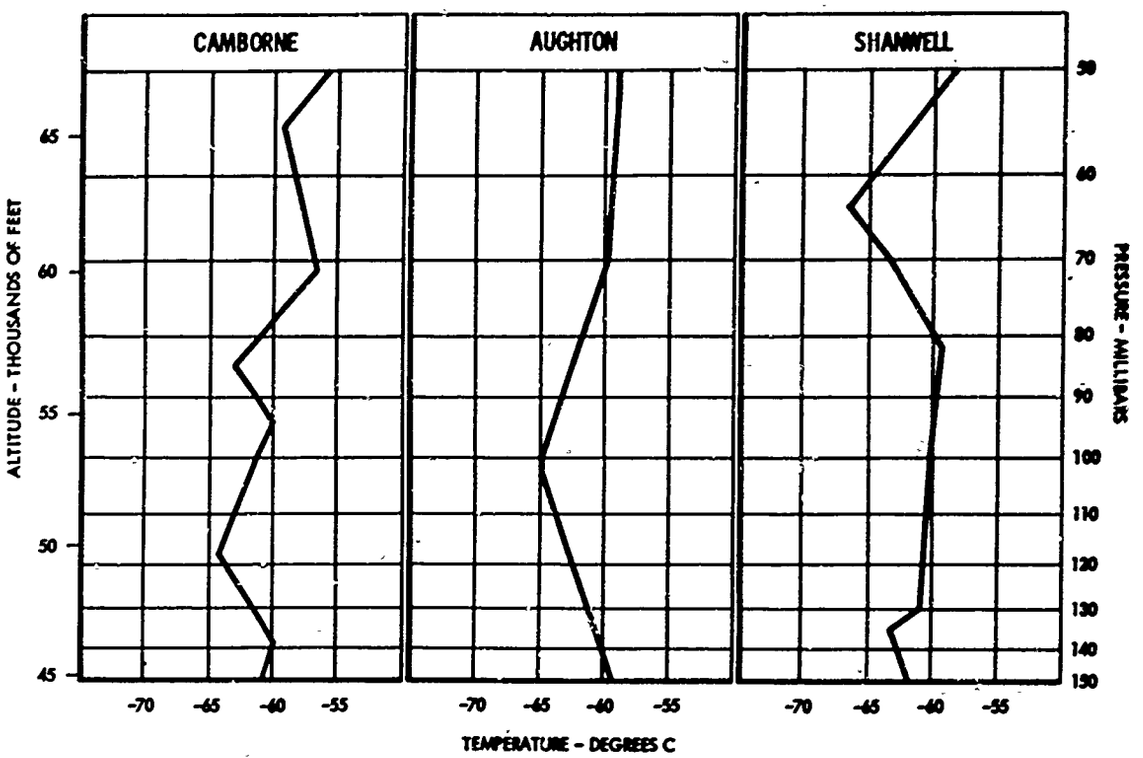
Tropopause analysis showed the surface to have little slope.

The U-2 and Canberra both flew the route as indicated on the flight track. Both aircraft reported light turbulence about 50 miles north of Bedford; the Canberra at flight level 38,000 feet and the U-2 at 55,000 feet.

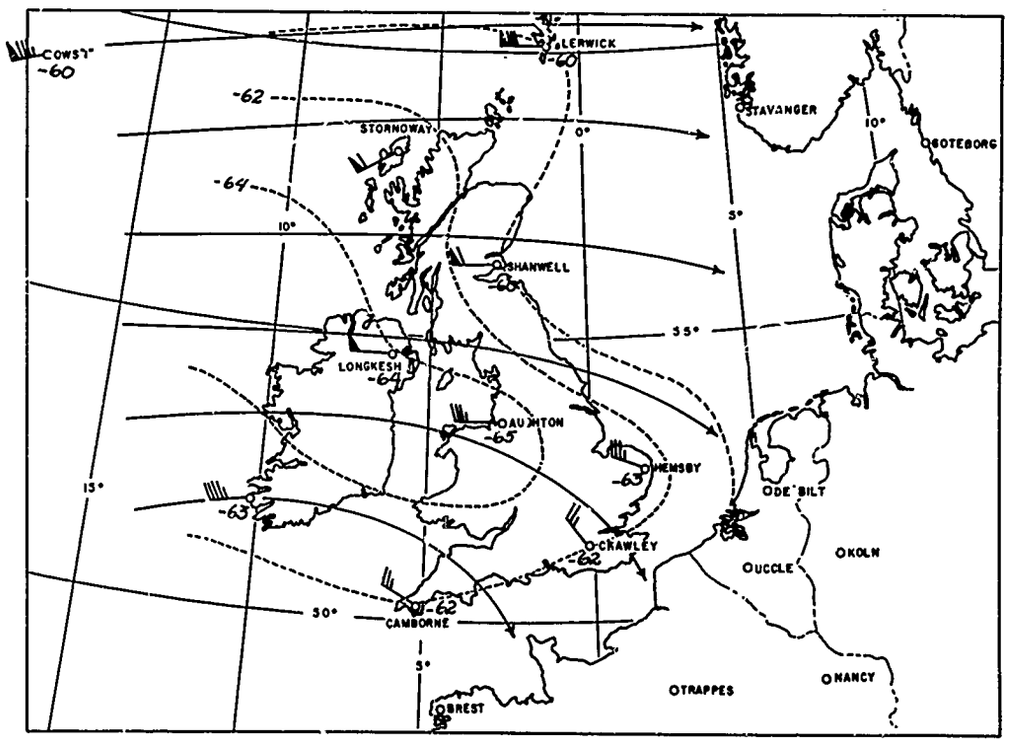
The U-2 also reported some very light CAT at 55,000 feet over Shanwell. This run was not processed. The portion of the route south of Bedford was reported completely smooth by the pilots of both aircraft.

APPENDIX VI

RAOB CHARTS (1200Z, 21 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 21 Mar 1967)



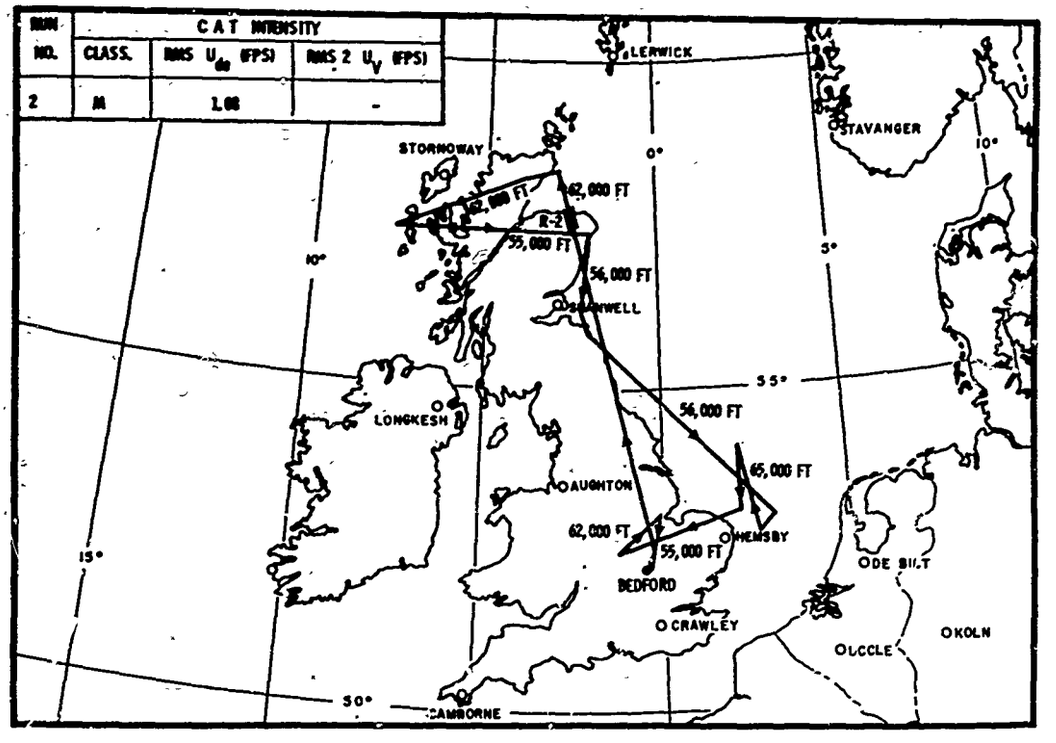
APPENDIX VI

TEST 185

22 March 1967, 0858-1325Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

At 1200Z, 22 March 1967, a surface cold front was oriented west-east across central England with a jetstream at the 300 mb level paralleling the surface front and located over the Prestwick, Scotland area. Winds at the upper levels were generally 95 - 100 knots from 270°.

The tropopause height chart showed a relatively steep slope from a 200 mb high over central England to a 360 mb low 600 miles to the north. The horizontal temperature gradient at the tropopause for this same region was from -66°C over southern England to -48°C at the center of the low.

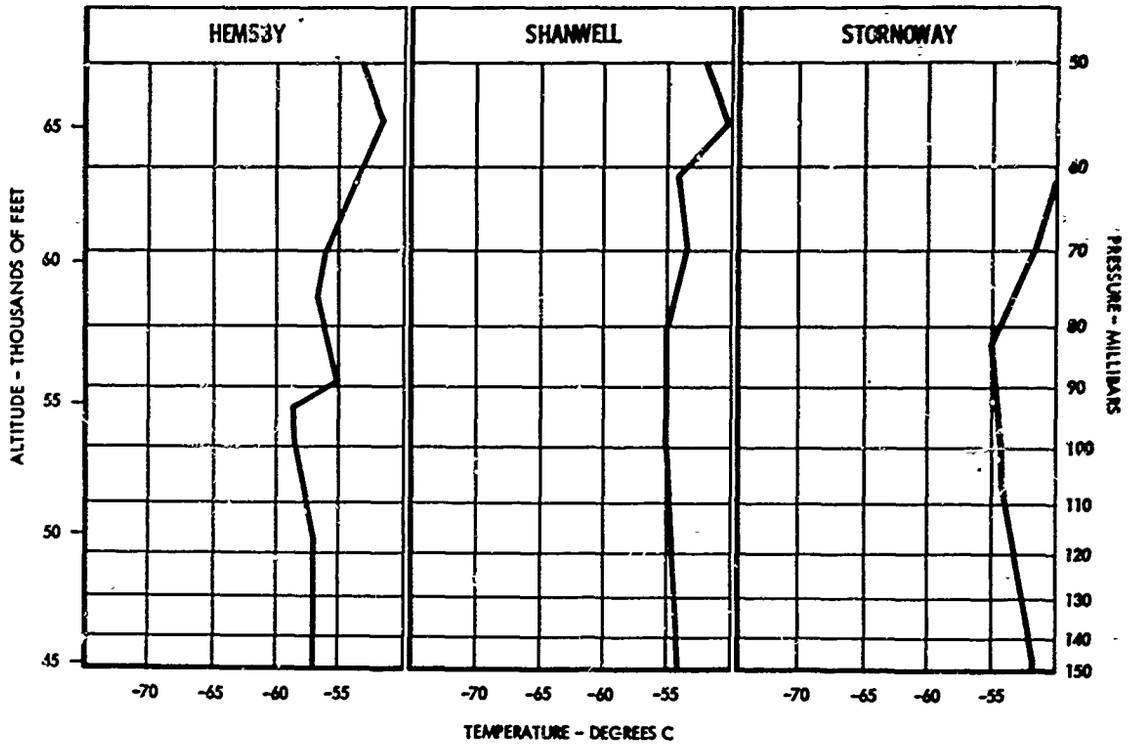
The Canberra and U-2 flew the route as shown on the flight track. The pilot of the Canberra reported very light CAT 100 nm north of Shanwell at 38,000 feet; also, that he was in and out of the turbulence for approximately one hour. The U-2 pilot reported very light to light CAT almost the entire route with "a few good bumps" over the channel. Only one run was processed from the record.

The vertical temperature gradient is small although ΔT's at 55,000 feet (Hemsby) and 65,000 feet (Shanwell) show some evidence of wave motion.

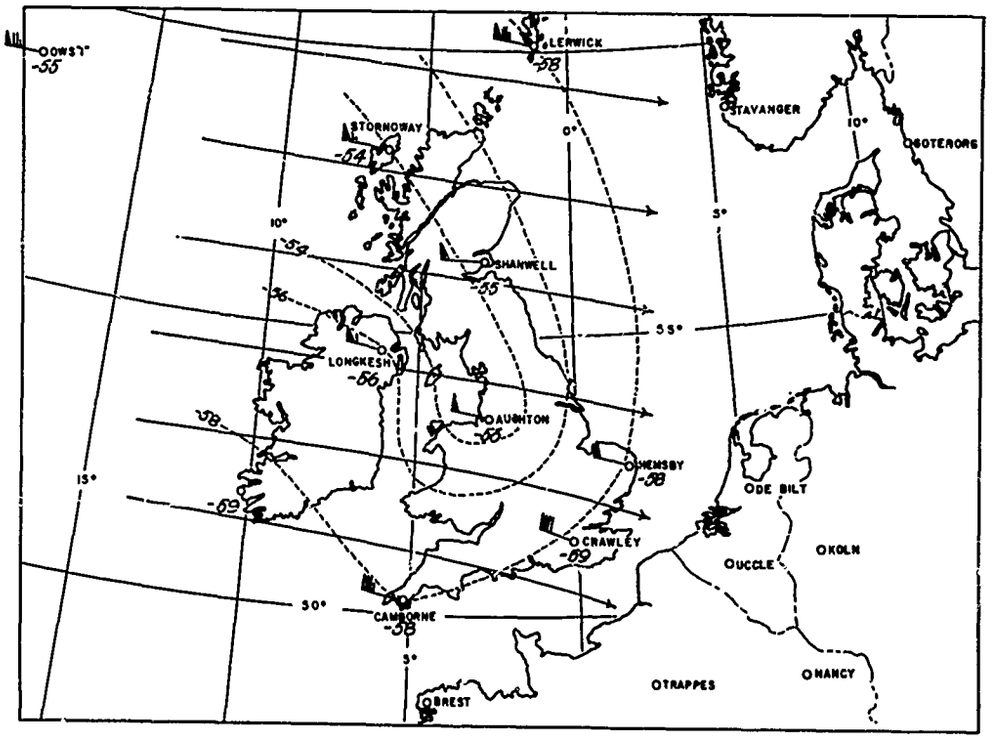
The 70 mb analysis shows a thermal trough over the northern region of the British Isles with the wind flow almost normal to the isotherms. The horizontal temperature gradient is generally less than 5°C per 120 nautical miles.

APPENDIX VI

RAOB CHARTS (1200Z, 22 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 22 Mar 1967)



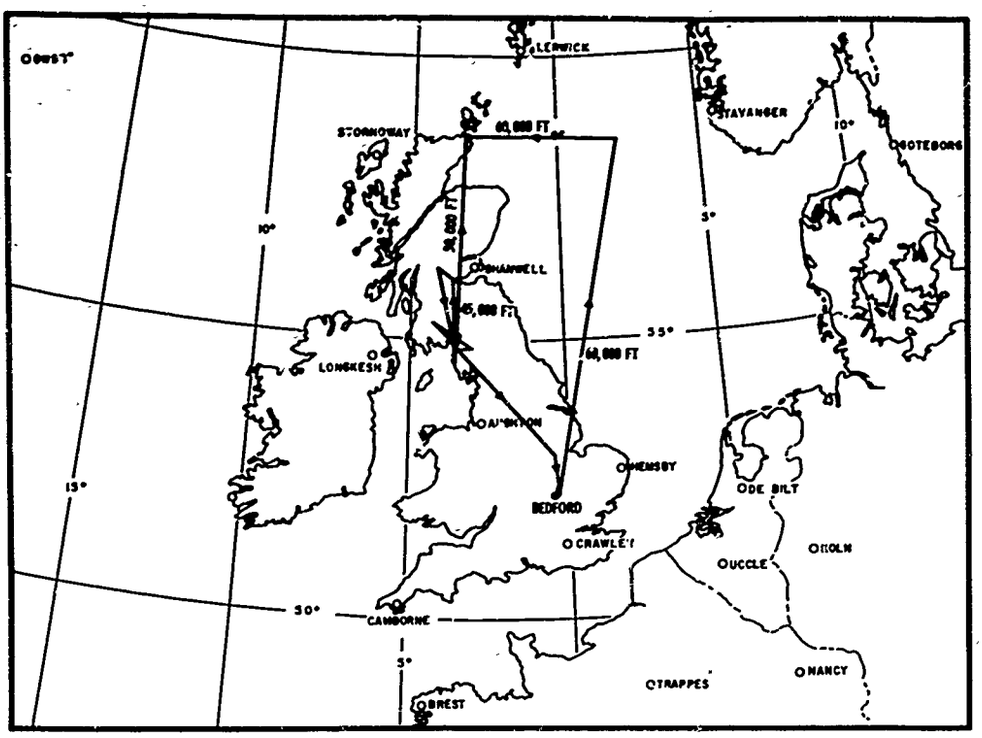
APPENDIX VI

TEST 186

28 March 1967, 0903-1256Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

On 28 March 1967, a 978 mb surface low pressure system was centered over the North Sea. The low extended well up past the 300 mb level with the vertical axis of the system showing little slope.

A double jetstream was flowing around the southern periphery of the upper low to the south of England and into central France.

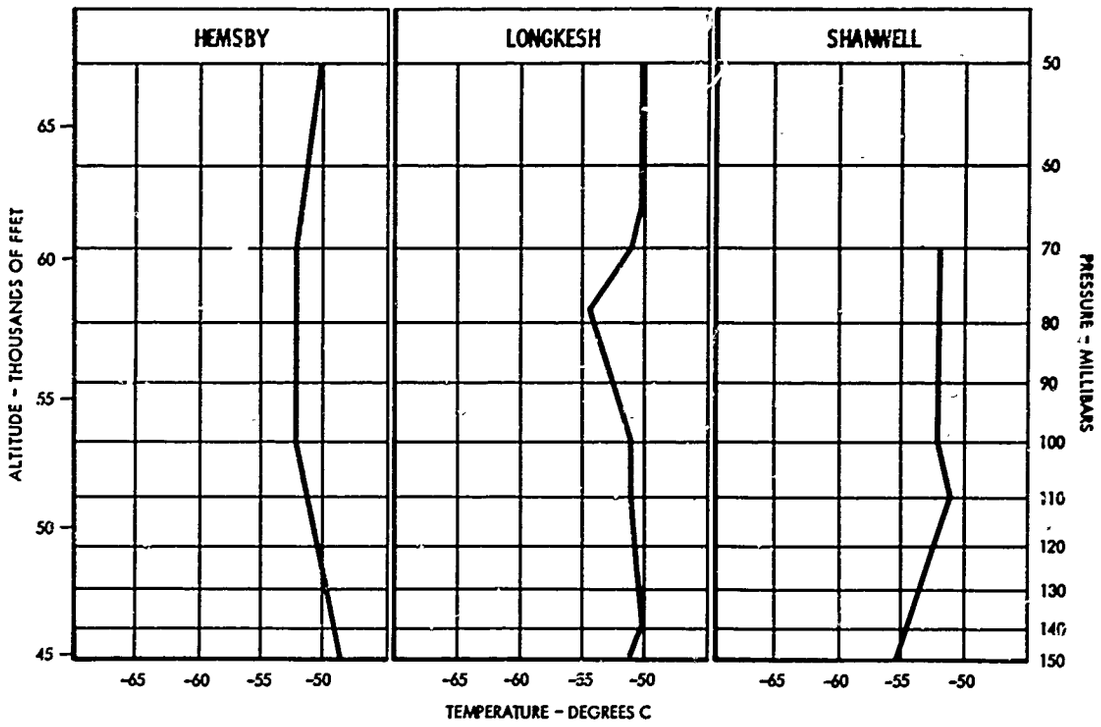
A first choice of area to sample for turbulence was over the jetstream south of England. However, due to a malfunctioning generator, the U-2 could not fly over water past the glide back point.

The selected flight route was over central and northern England and in the area of a thermal trough with weak horizontal temperature gradient as indicated on the flight track.

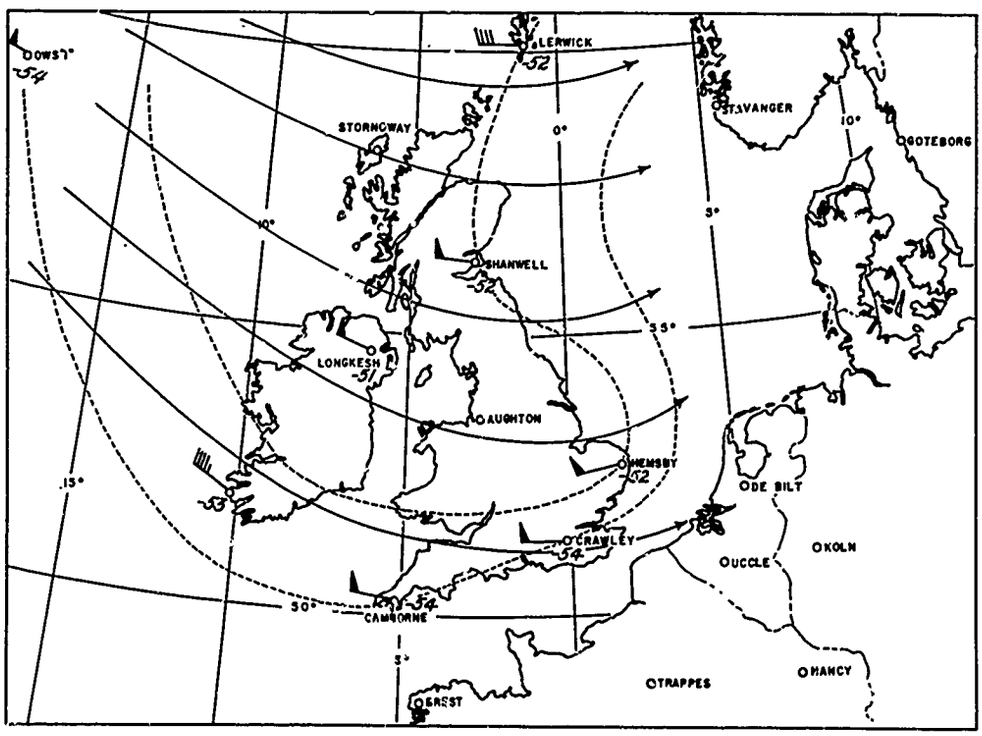
The pilot of the U-2 reported intermittent very light CAT along the eastern leg of his route, no CAT along the northern leg and almost continuous very light CAT between 50,000 - 65,000 feet along the western leg of the route. The RAOB chart shows a small vertical temperature gradient between 53,000 feet to 62,000 feet over Longkesh.

No runs were processed from the record.

RAOB CHARTS (1200Z, 28 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 28 Mar 1967)



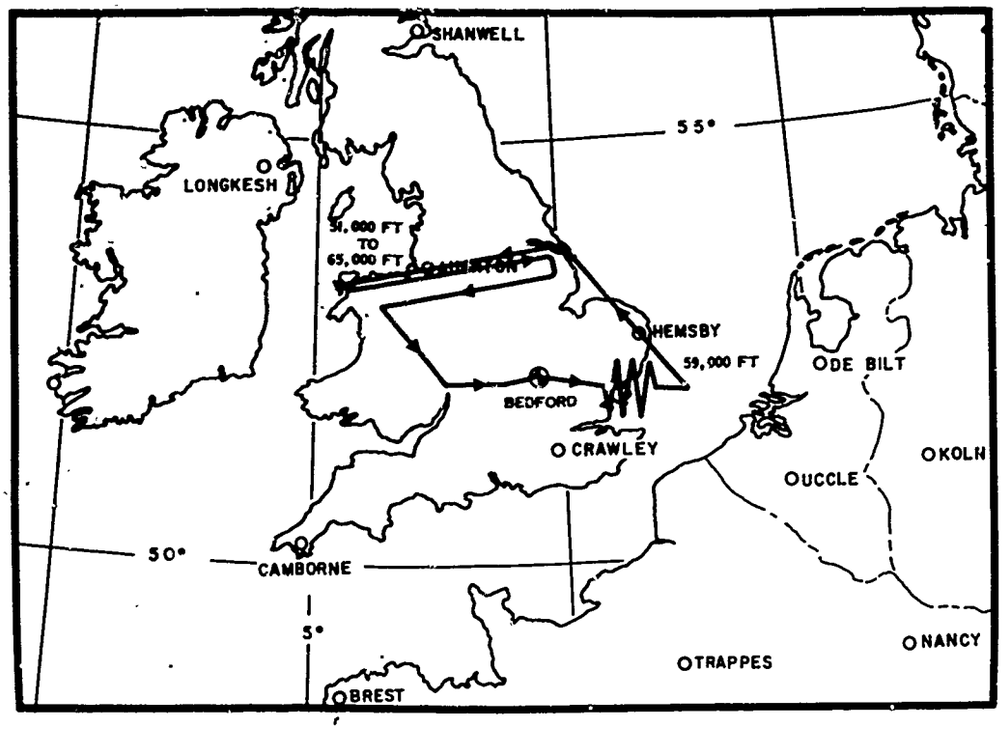
APPENDIX VI

TEST 187

30 March 1967, 1155-1436Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

This flight was scheduled as a combination test flight, after generator change, and HICAT test.

Conditions did not appear favorable for the production of CAT this date. A weak northwesterly flow from the surface through the 70 mb level prevailed over the British Isles. Weak troughs were moving northwest-southeast across the British Isles. Aloft, the jetstream was approximately 800 nautical miles southwest of the area of interest.

The flight track was selected primarily to accommodate test flight requirements.

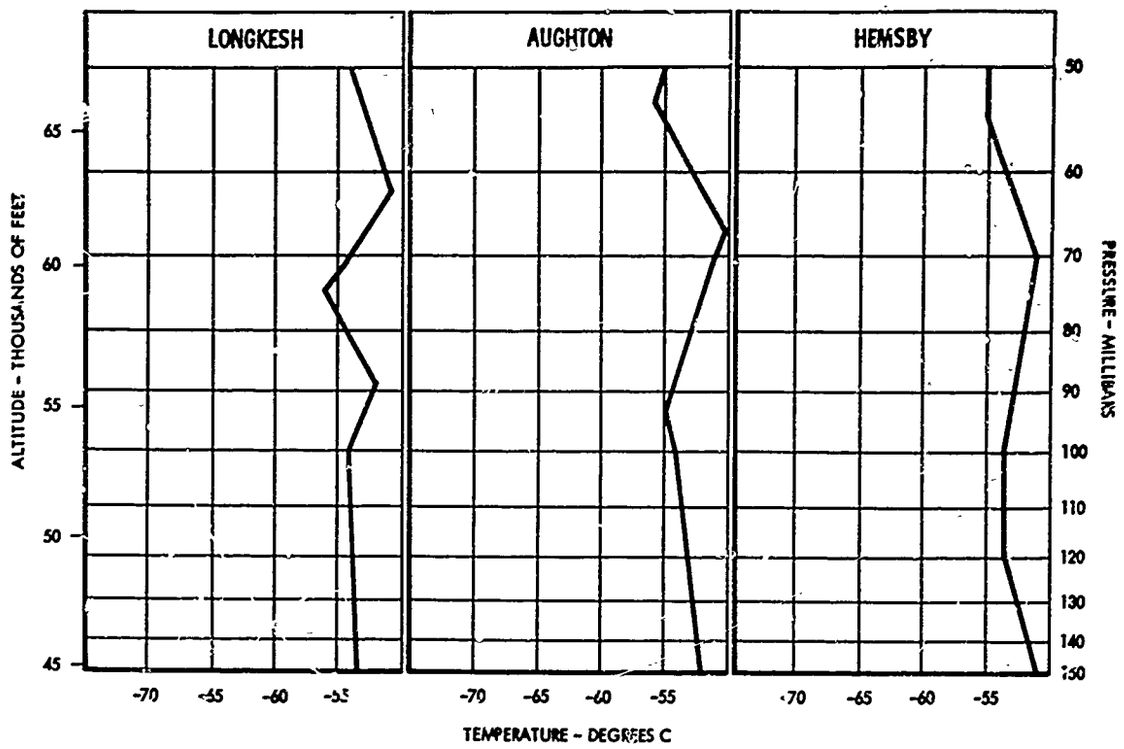
No significant CAT was reported by the U-2 pilot.

The vertical temperature gradient between 56,000 feet and 63,000 feet over Longkesh is similar to soundings that have been associated with light to very light CAT but this could not be verified for this test.

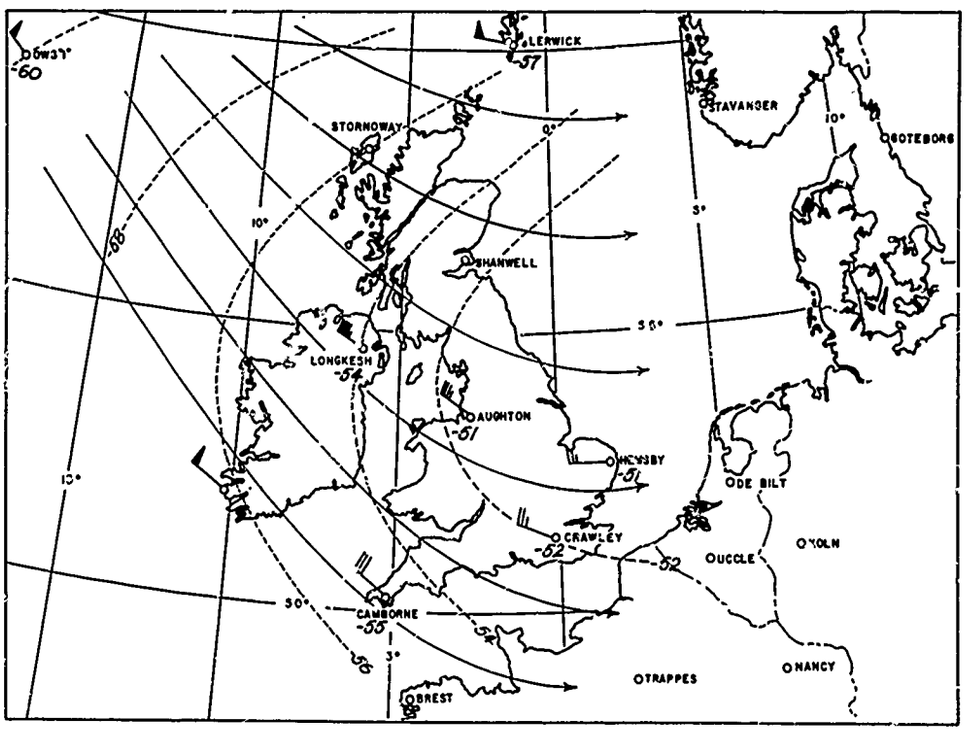
The 70 mb analysis shows a predominantly northwest flow and weak horizontal temperature gradient. ($\Delta T/\Delta N$ = ~4°C/600 nm.)

APPENDIX VI

RAOB CHARTS (1200Z, 30 Mar 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 30 Mar 1967)



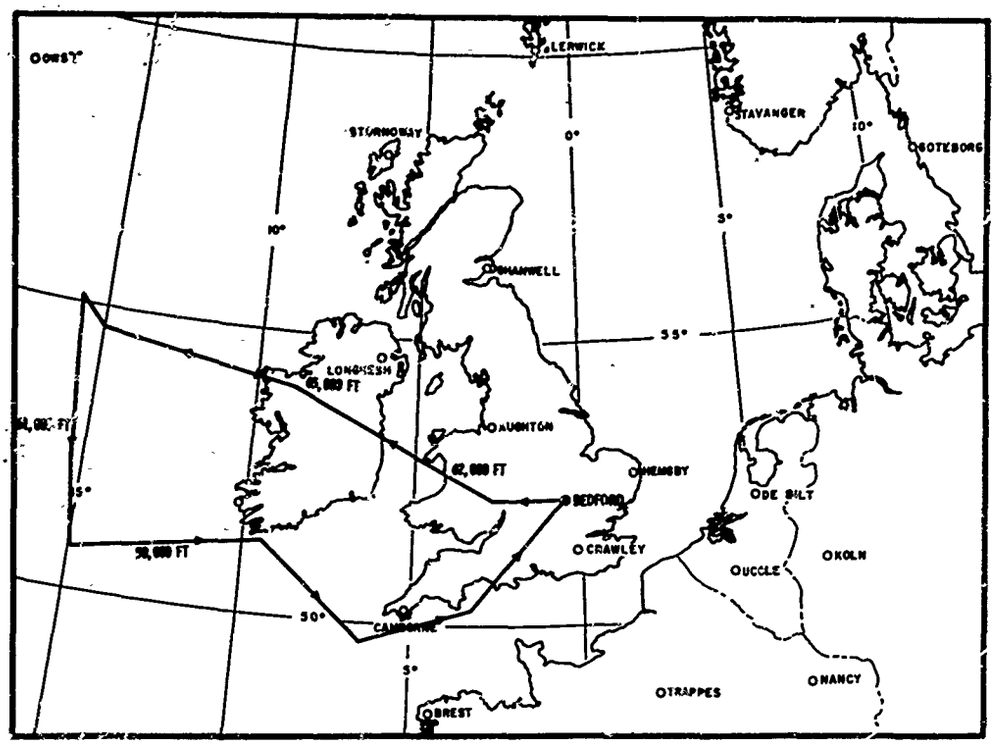
APPENDIX VI

TEST 188

31 March 1967, 0901-1329Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

The meteorological condition that prevailed on 31 March 1967 over the HICAT operating region was that of little activity. In the lower levels a weak high pressure ridge was oriented north-south and centered over Ireland. Aloft, a weak, northwest-southeast wind flow prevailed over the British Isles.

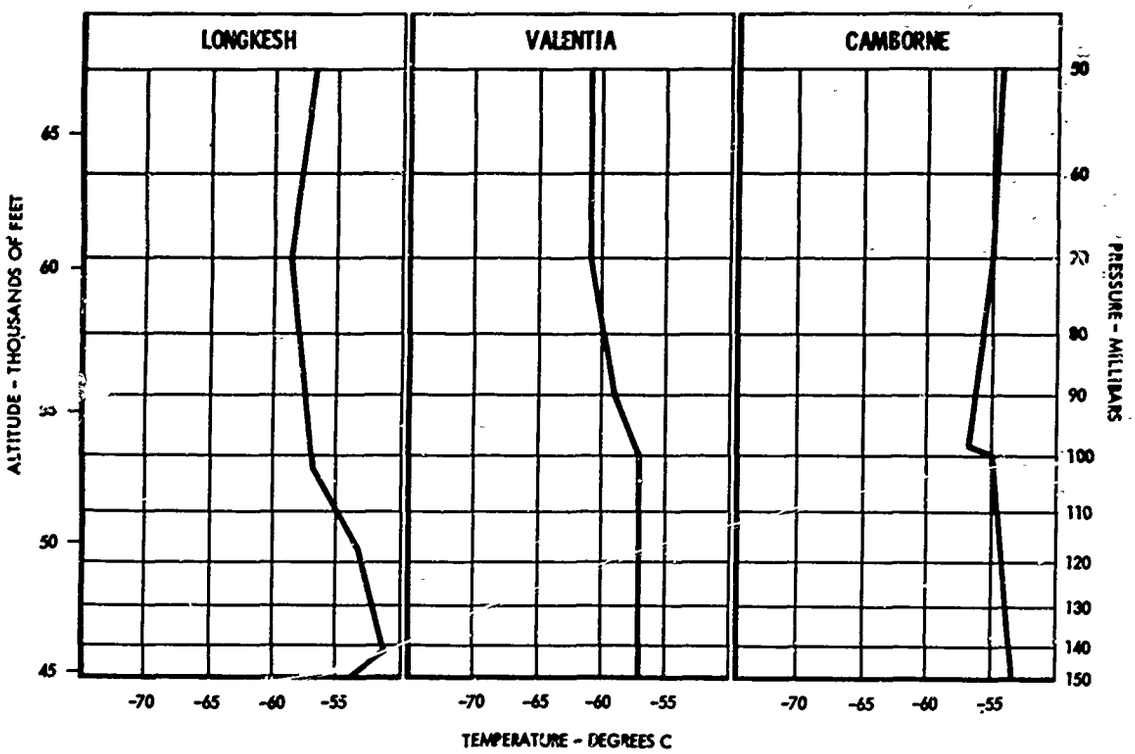
A band of maximum velocity winds, although not particularly strong (85-90 knots), was positioned just to the west of the Irish coast passing from that point southeastward toward Lands End, England. The flight track was planned to cross this band of winds.

The U-2 pilot reported no turbulence except a "couple of ripples" over the band of maximum winds mentioned above. No turbulence runs were processed.

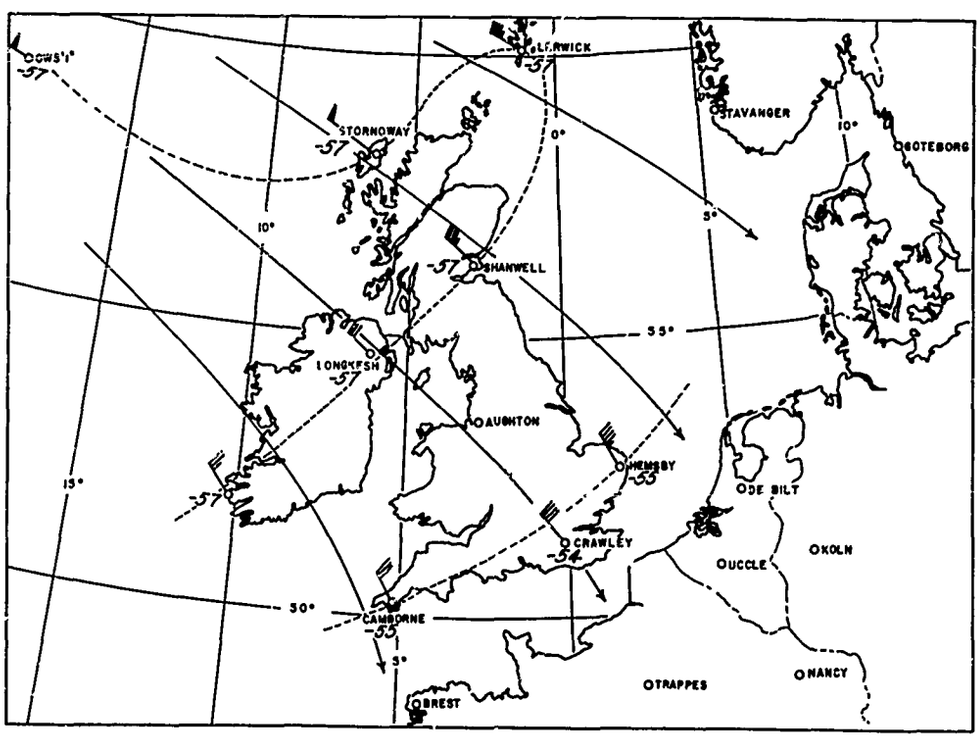
No large vertical temperature gradients are shown on the RAOB chart.

The 70 mb analysis shows an almost straight line northwest-southeast wind flow and a very weak horizontal temperature gradient.

RAOB CHARTS (1200Z, 31 Mar 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 31 Mar 1967)



APPENDIX VI

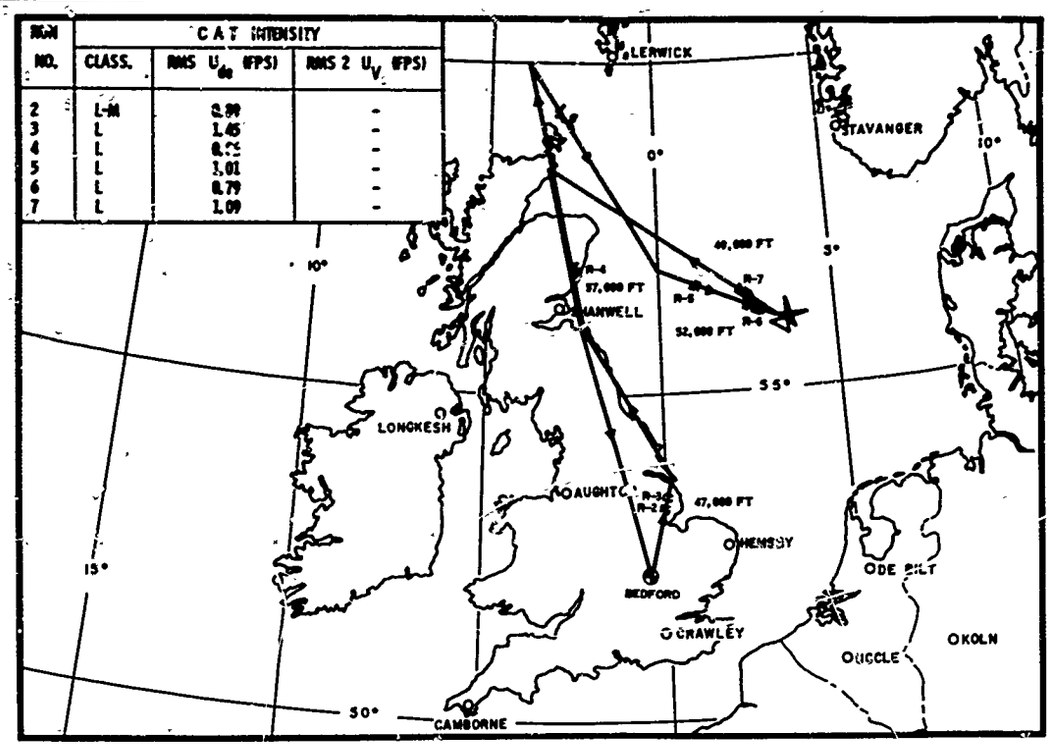
TEST 189

3 April 1967, 0854-1420Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK

RUN NO.	CAT INTENSITY CLASS.	RMS U_{ds} (FPS)	RMS 2 U_V (FPS)
2	L-M	2.89	-
3	L	1.45	-
4	L	0.75	-
5	L	1.01	-
6	L	0.79	-
7	L	1.09	-



FLIGHT SUMMARY

On 3 April 1967, a surface low pressure system was centered over Iceland with an occlusion extending southeast. The point of the occlusion was approximately 180 miles west of the Scottish mountains with the associated warm front lying north-south along the Irish coast.

The main axis of the jetstream curved anticyclonically across the point of the occlusion thence southeast over the northern tip of the British Isles and into central France.

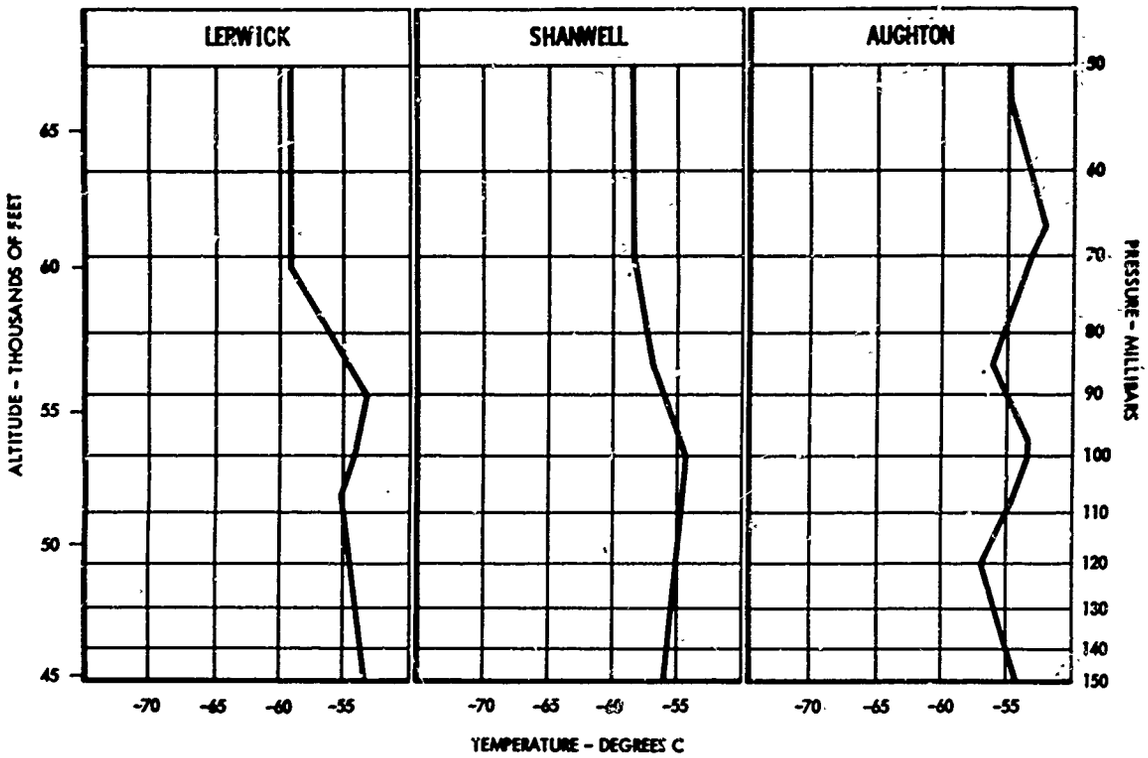
The primary objective of this flight was to sample for turbulence above the section of the jetstream from Wick to 56°N - 4°E.

The flight track shows the pilot did not encounter turbulence until north of Shanwell. From that point to 56°N - 4°E and return he encountered several patches of light to very light CAT. The best turbulence (±0.15g) was located near 56°N - 4°E.

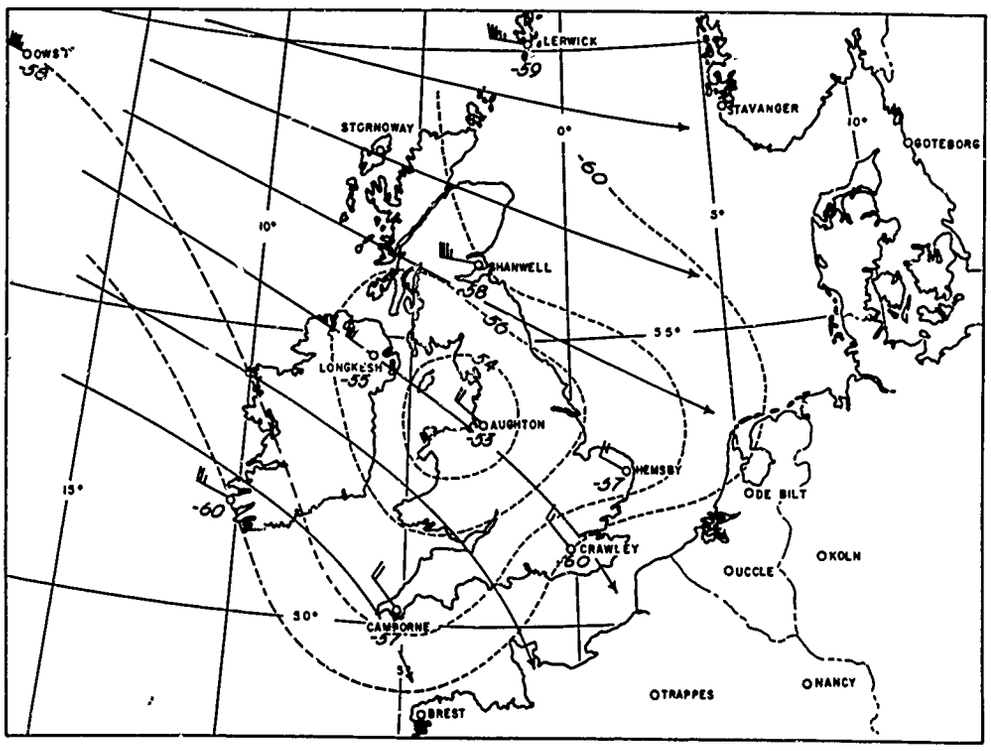
The RAOB chart shows weak vertical gradients at Lerwick and Shanwell with a well defined wave pattern and larger gradient at Aughton. The turbulence was sampled at 56°N - 4°E, about 180 nm from the nearest RAOB.

Note that Aughton which has the largest vertical gradient is located in the center of the thermal trough, as shown on the winds and temperature chart.

RAOB CHARTS (1200Z, 3 Apr 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 3 Apr 1967)



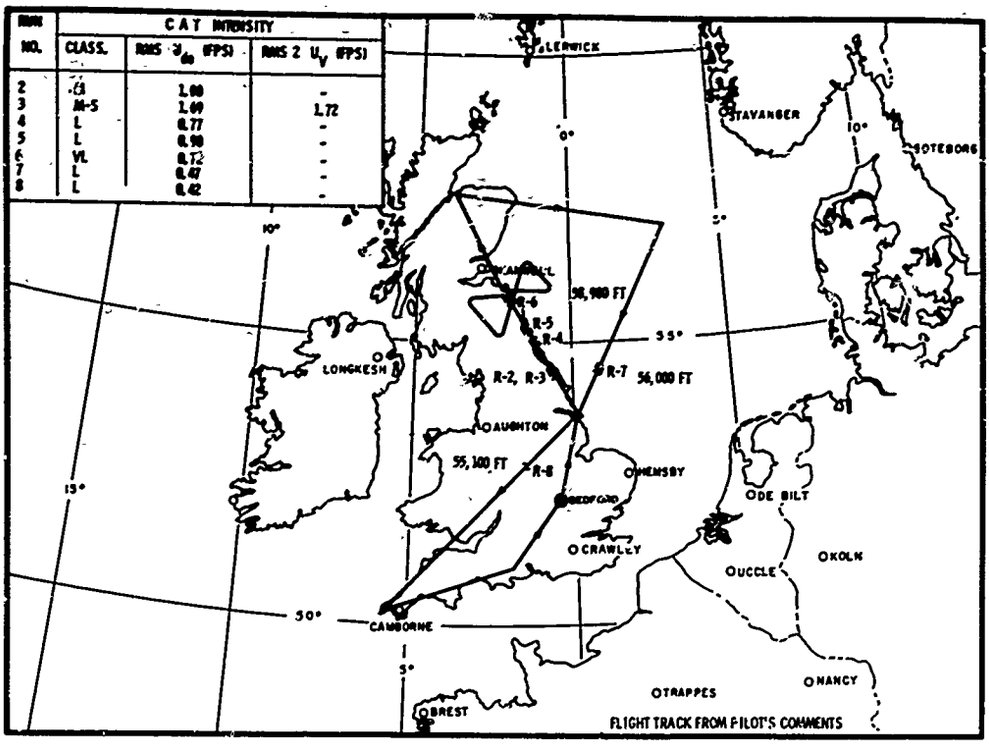
APPENDIX VI

TEST 190

4 April 1967, 0910-1450Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

On 4 April 1967, a surface warm front was moving slowly across central England. A high pressure system was centered to the southwest and near 46°N - 15°W. Most of the British Isles were in the warm sector of an occlusion and under the influence of rather mild westerly winds in the lower levels. Aloft, winds became more northwesterly to northerly with a jetstream of 120 knots at the 300 mb level flowing from Stornoway in the north to Hawley in the south.

The flight track for the mission was planned to fly along and across the band of strong winds.

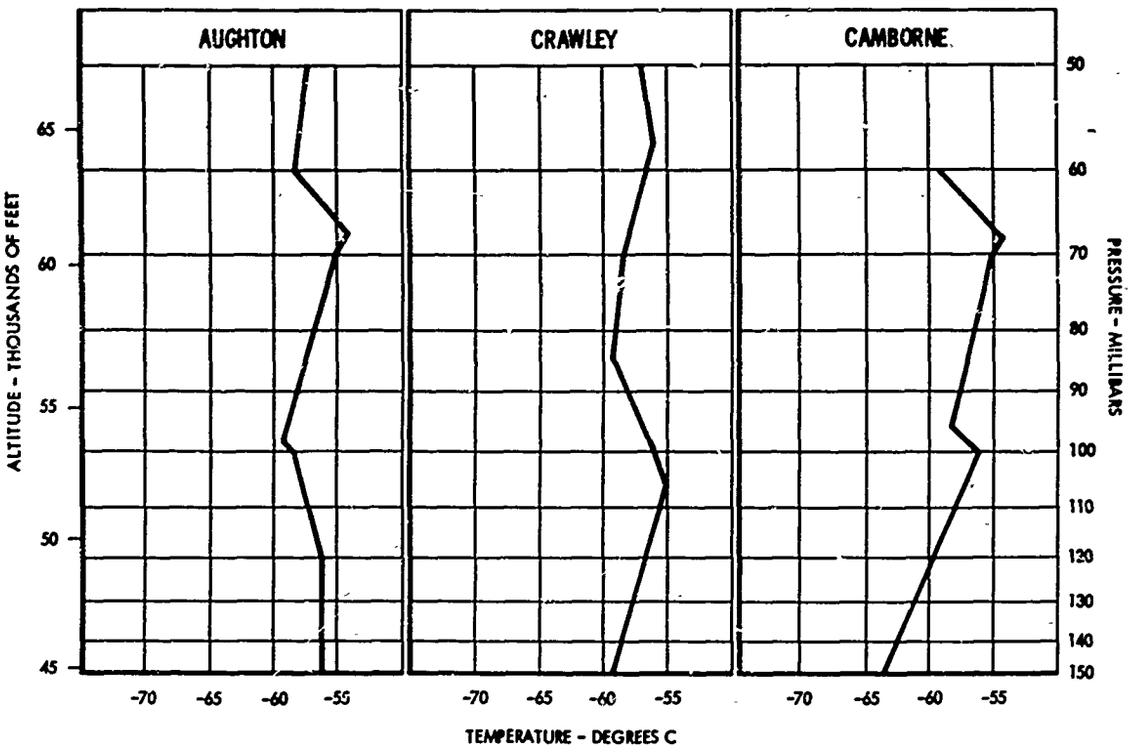
The U-2 encountered very light to light CAT over six areas and one brief period of light to moderate CAT near Shanwell.

A pilot report from the British metro teletype net reported severe turbulence at 5,000 - 7,000 feet about 50 miles south of Shanwell.

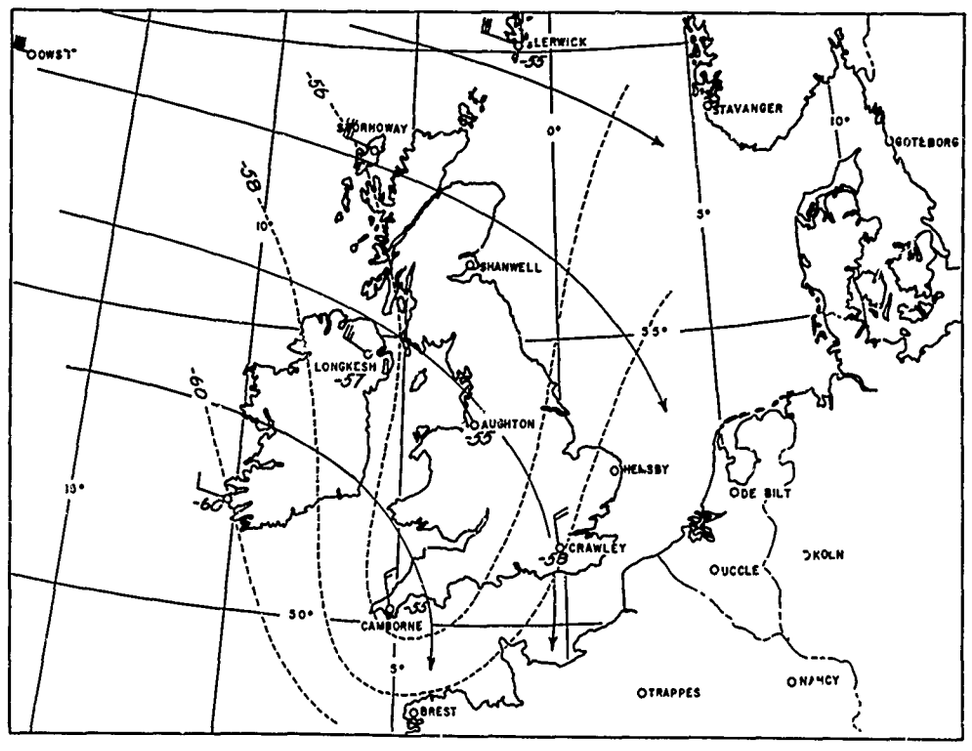
The RAOB chart indicates vertical gradients somewhat greater than small (< 1.5°C/1000 feet being small) near 62,000 feet over Aughton and 53,000 and 63,000 feet over Camborne.

Note that a deep warm thermal trough at the 70 mb level (winds and temperature chart) is positioned almost directly over the band of strong winds at 300 mb.

RAOB CHARTS (1200Z, 4 Apr 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 4 Apr 1967)



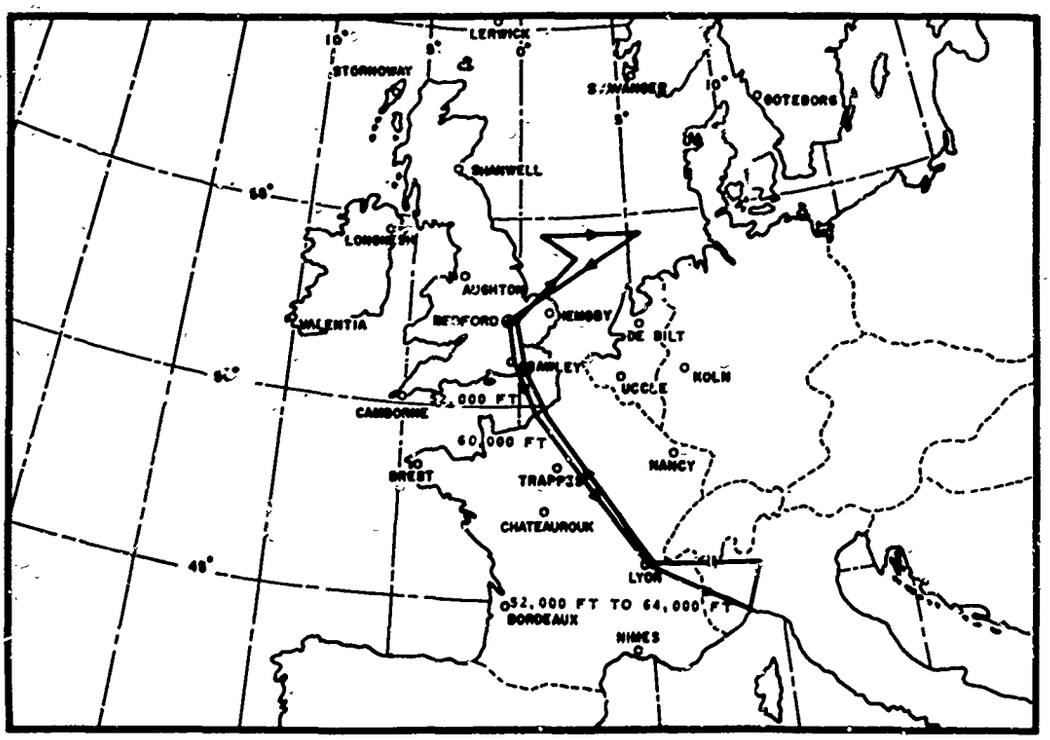
APPENDIX VI

TEST 191

12 April 1967, 0825-1442Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

The surface chart for 1200Z, 12 April 1967, showed a low pressure center of 1016 mb centered near Paris, France. A surface cold front extended southward from the center to near the French-Spanish border. Overcast conditions prevailed over France north of the French Alps. South of the Alps, skies were scattered to broken.

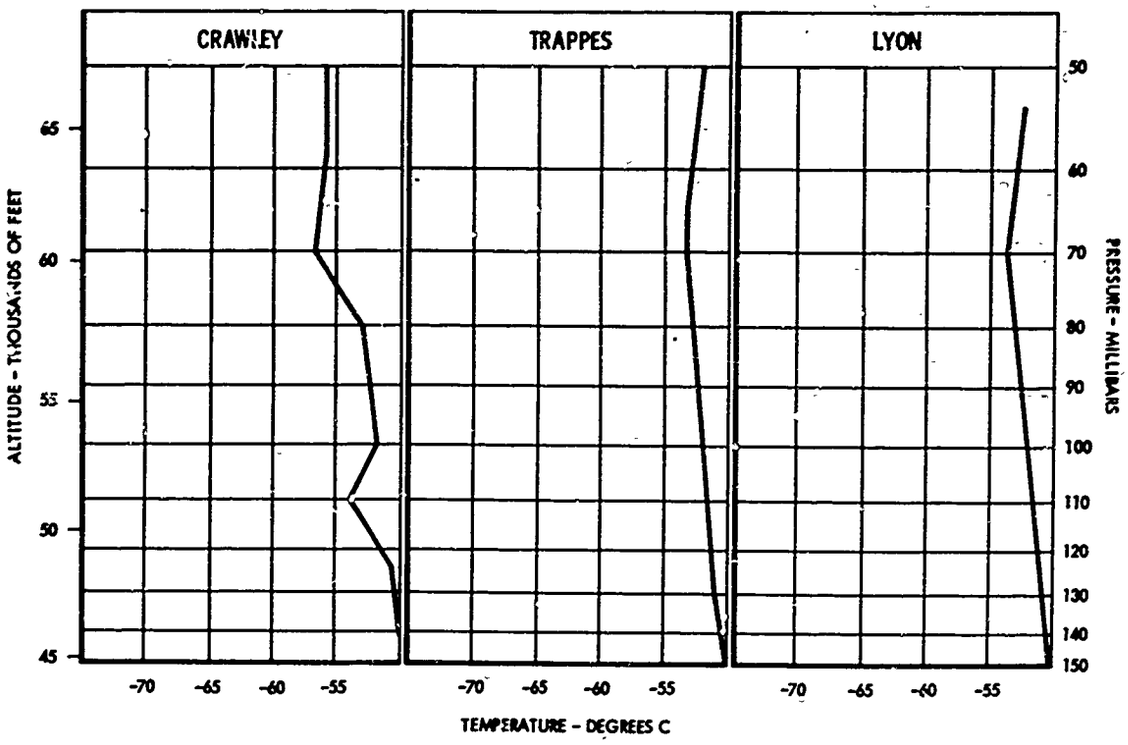
At the 200 mb level a trough was positioned over the English Channel and oriented in a southwest-northeast direction. Winds at 200 mb over the sampled area were about 210° at 20 knots. At other levels, winds were comparatively light.

The pilot reported very light patchy turbulence from 42,000 to 54,000 feet over the English Channel and into western France. No runs were processed.

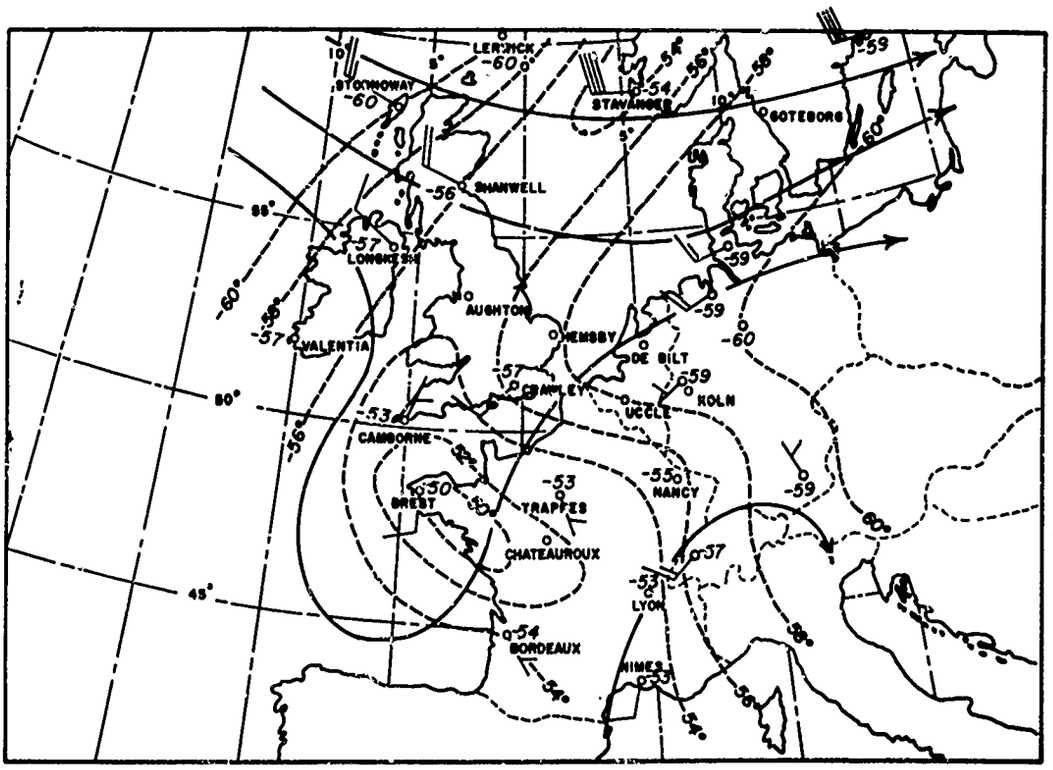
The RAOB chart shows changes in the vertical temperature gradient at 1200Z from 48,000 to 53,000 feet over Crawley. This corresponds well to the levels of very light CAT reported by the pilot. The RAOBs for Trappes and Lyon are quite smooth appearing and show very little gradient.

The temperature and winds chart shows a wind shift line and warm thermal trough at 70 mb and over the English Channel and western France. This corresponds to the area the pilot reported very light patchy CAT.

RAOB CHARTS (1200Z, 12 Apr 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 12 Apr 1967)



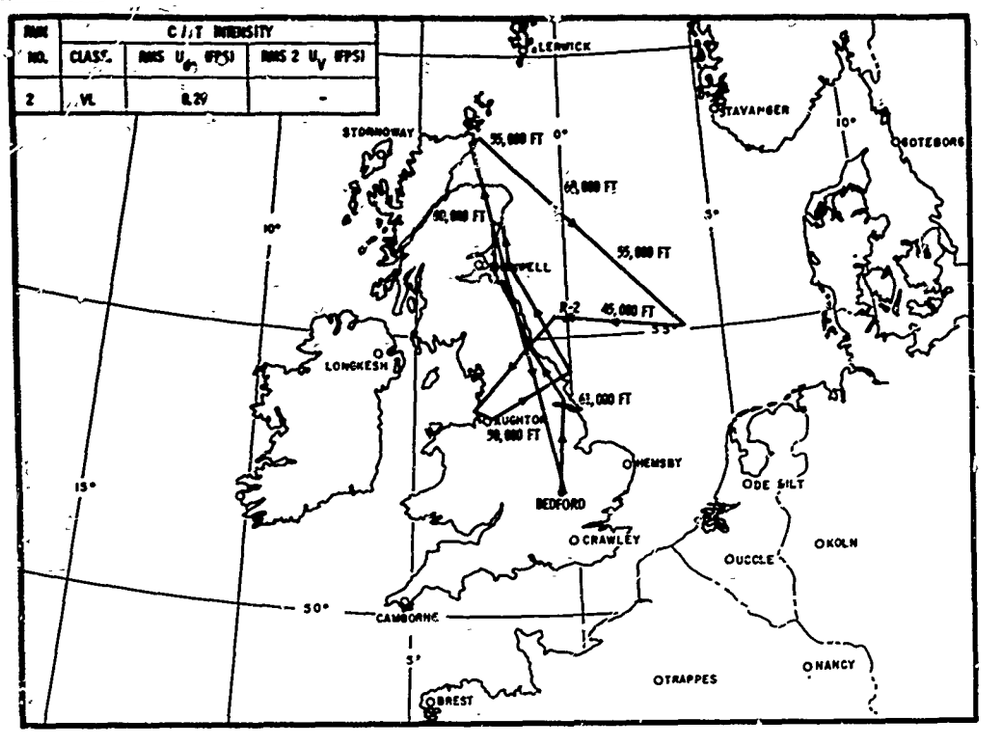
APPENDIX VI

TEST 192

13 April 1967, 0905-1409Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

A well defined ridge at both the surface and aloft through all observed levels was centered over Ireland. Below the tropopause, the prevailing winds were northeasterly. Above the tropopause and at the 70 mb level, winds were north to northwest over the sampled area.

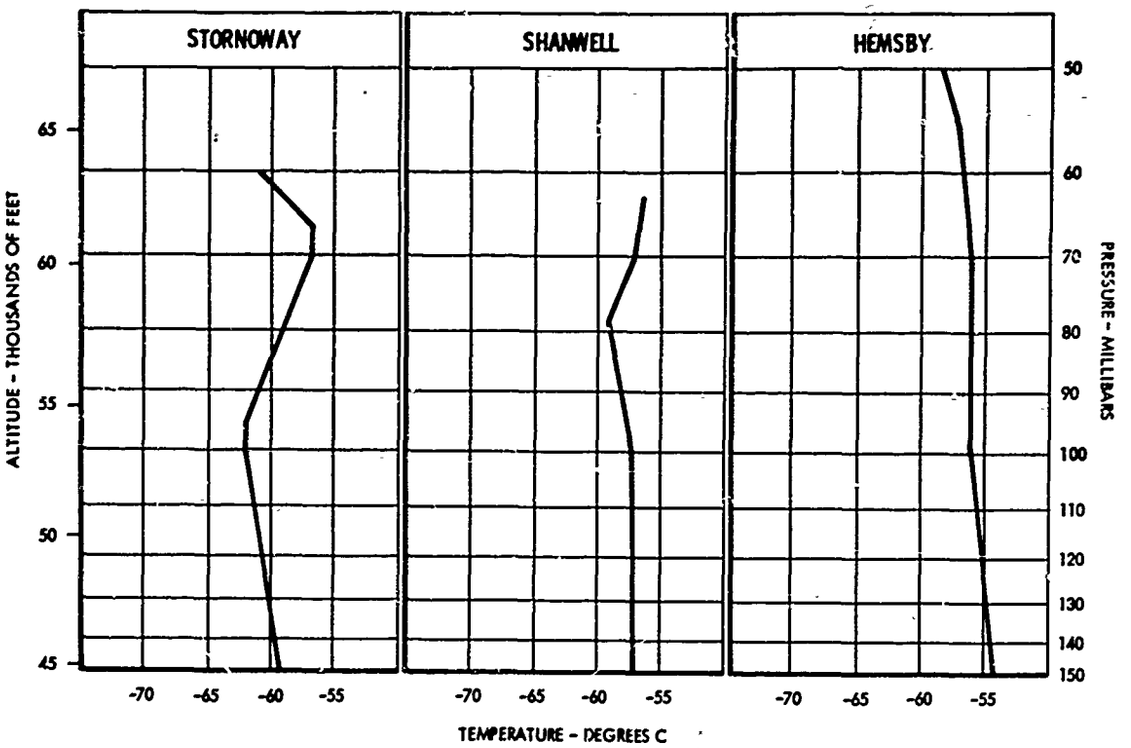
The flight track was flown over a steeply sloping area of the tropopause that existed along the northeast coast of the British Isles.

Although only one run was processed (Run 2), the pilot reported numerous patches of very light CAT over the area.

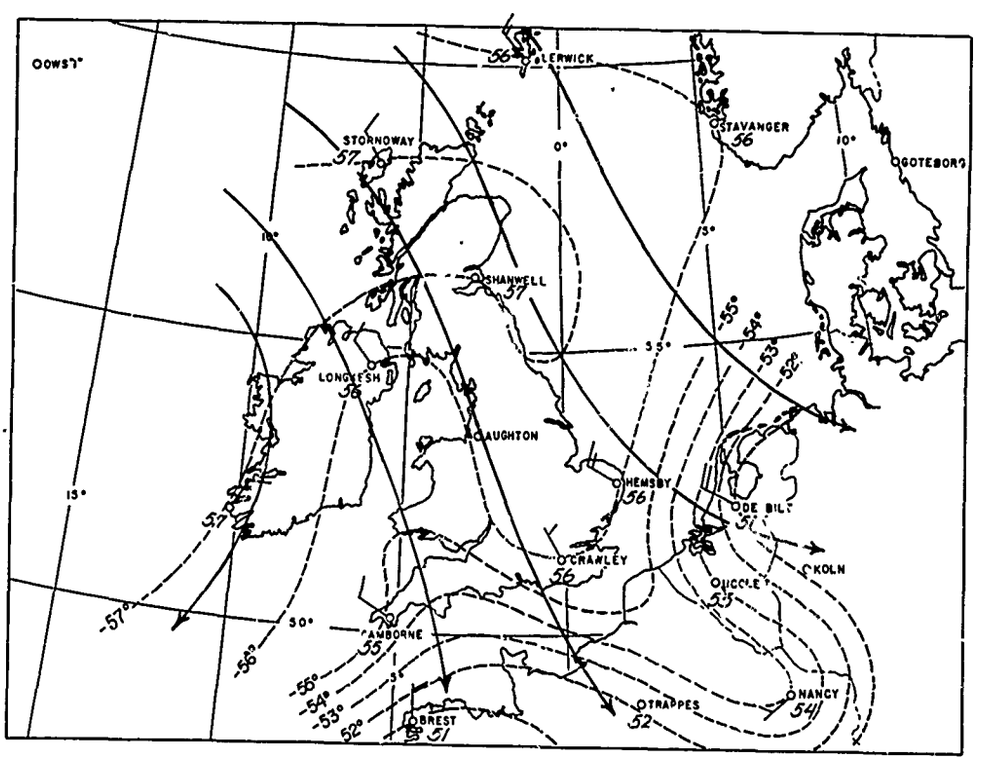
An interesting comment by the pilot was that a solid undercast was present east of a line from Shanwell and Longkesh with clear skies to the west. The very light CAT occurred over the undercast and ended abruptly over the clear area. During the time of the flight, Prestwick control issued an air advisory of moderate to severe CAT over the southeast of the Scottish mountains at 18,000 - 40,000 feet.

Stornoway and Shanwell show small vertical gradients (RAOB chart). The winds and temperature chart shows the very light winds present at 70 mb (compare with Test 182). Also note cold thermal ridge over Irish Sea and warm thermal trough along northeast coast of British Isles.

RAOB CHARTS (1200Z 13 Apr 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 13 Apr 1967)



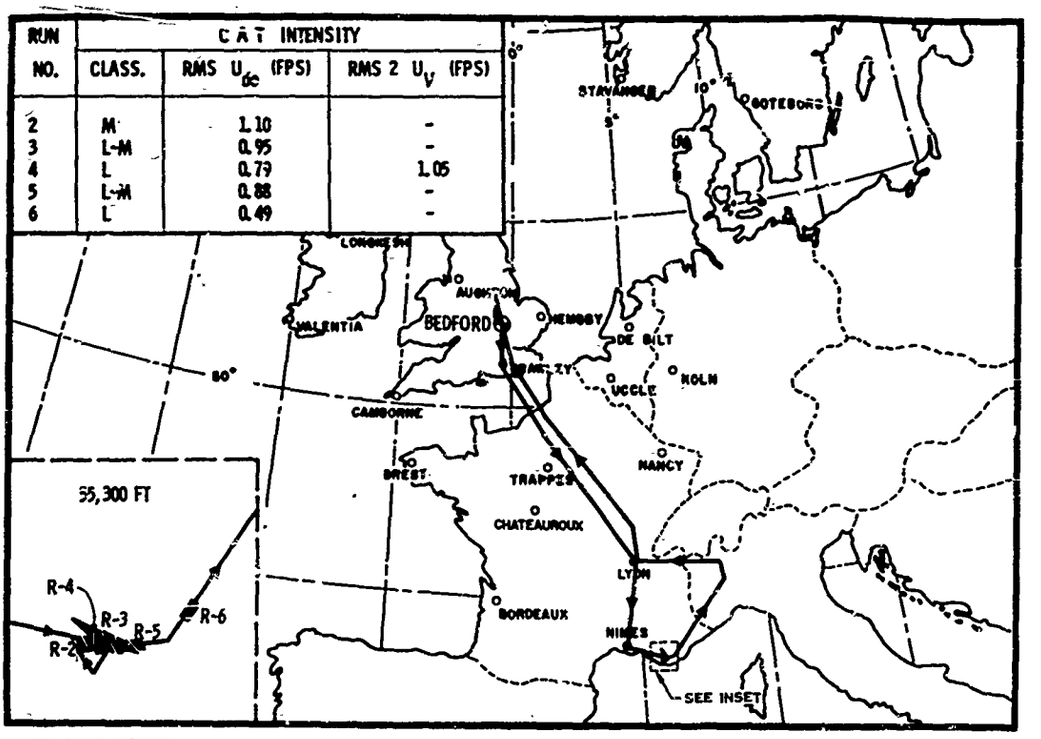
APPENDIX VI

TEST 193

14 April 1967, 0850-1345Z

Royal Aircraft Establishment (RAE), Bedford, England, U.K.

FLIGHT TRACK



FLIGHT SUMMARY

The 1200Z surface synoptic chart for 14 April 1967 showed an elongated ridge oriented southwest-northeast across the British Isles and North Sea. Over Sicily a weak closed low was apparent from the surface through 50 mb. Winds were comparatively light at all reported levels.

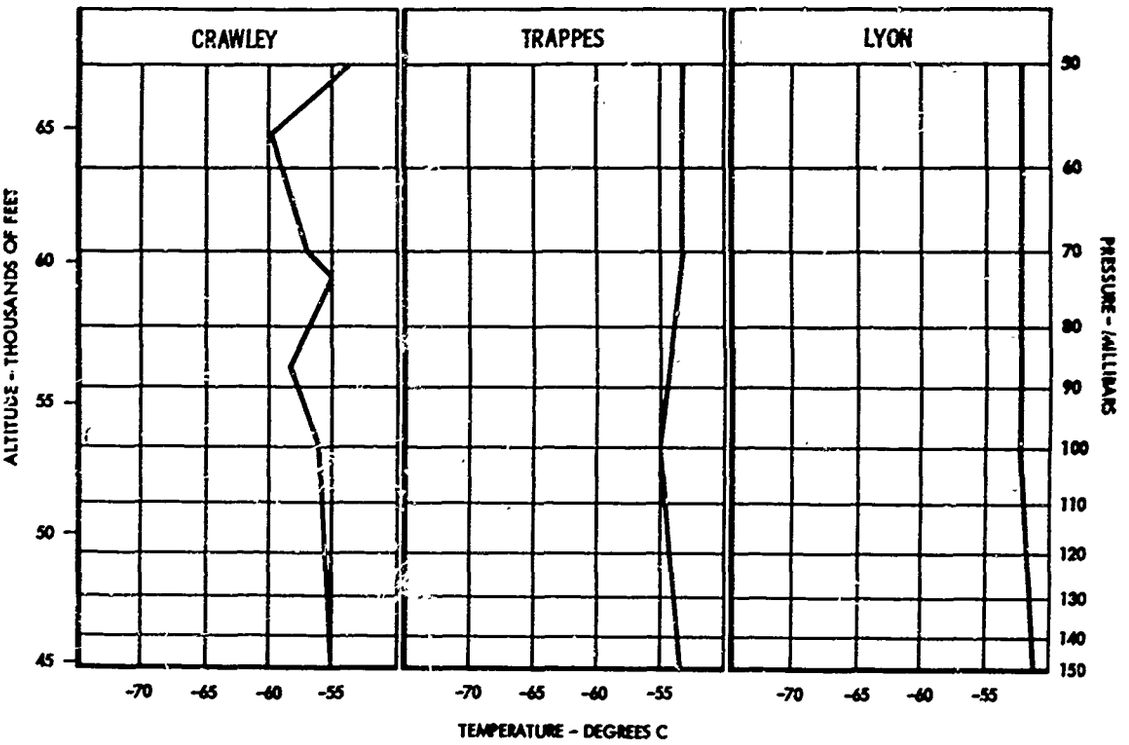
The pilot reported two areas in which he encountered significant CAT. The first encounter was at flight levels 28,000 to 34,000 feet on climbout (no runs processed). The second area was at flight levels 54,500 to 56,000 feet near Nice, France (runs 2 through 6 were processed indicating light to moderate CAT was encountered).

The RAOB chart shows vertical temperature and gradient changes over Crawley from 53,000 to 67,500 feet. This region was not sampled.

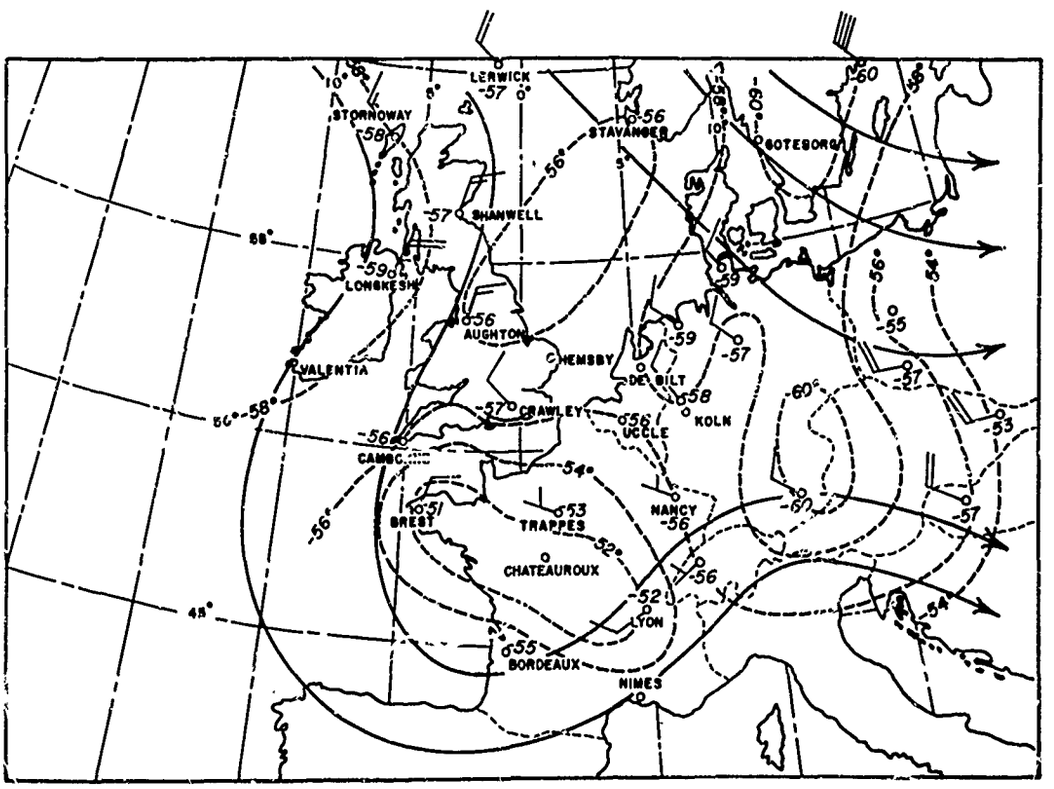
The RAOBs for Trappes and Lyon, France show very small vertical temperature changes and are not typical of the RAOBs normally associated with light to moderate CAT.

The winds and temperature chart shows the broad trough over central France as indicated by the wind flow analysis. Also note the warm thermal trough at the 70 mb level. These conditions are normally associated with light to light-plus CAT.

RAOB CHARTS (1200Z, 14 Apr 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 14 Apr 1967)



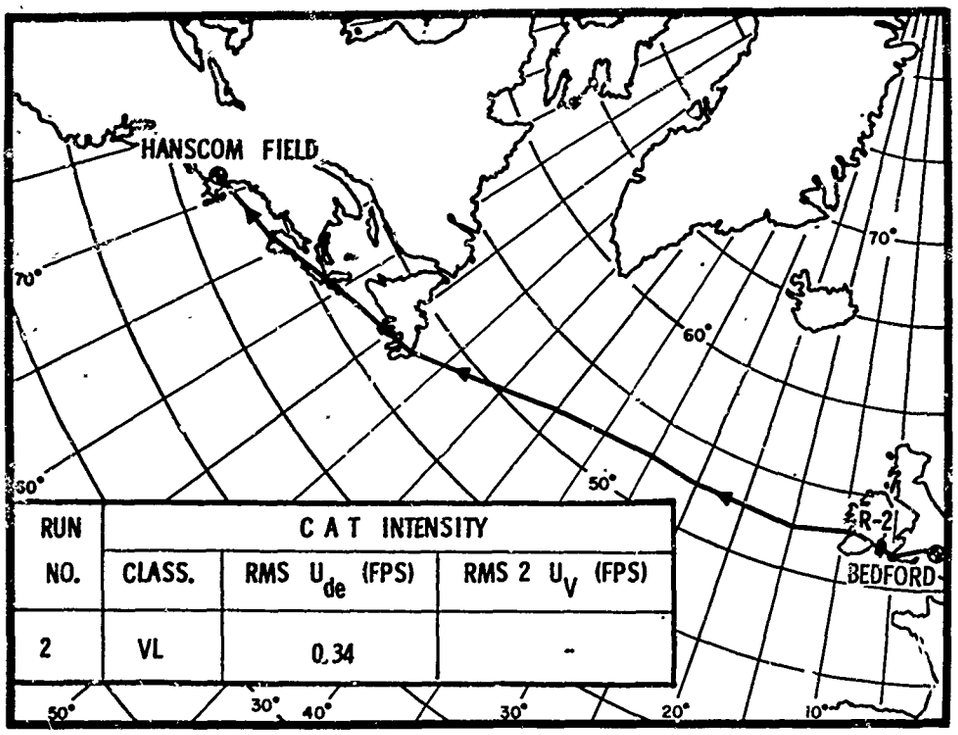
APPENDIX VI

TEST 194

17 April 1967, 0859-1632Z

Ferry Flight from RAE, Bedford, England, U.K. to Hanscom Field, Bedford Massachusetts, U.S.A.

FLIGHT TRACK



RUN NO.	C A T INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.34	-

FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

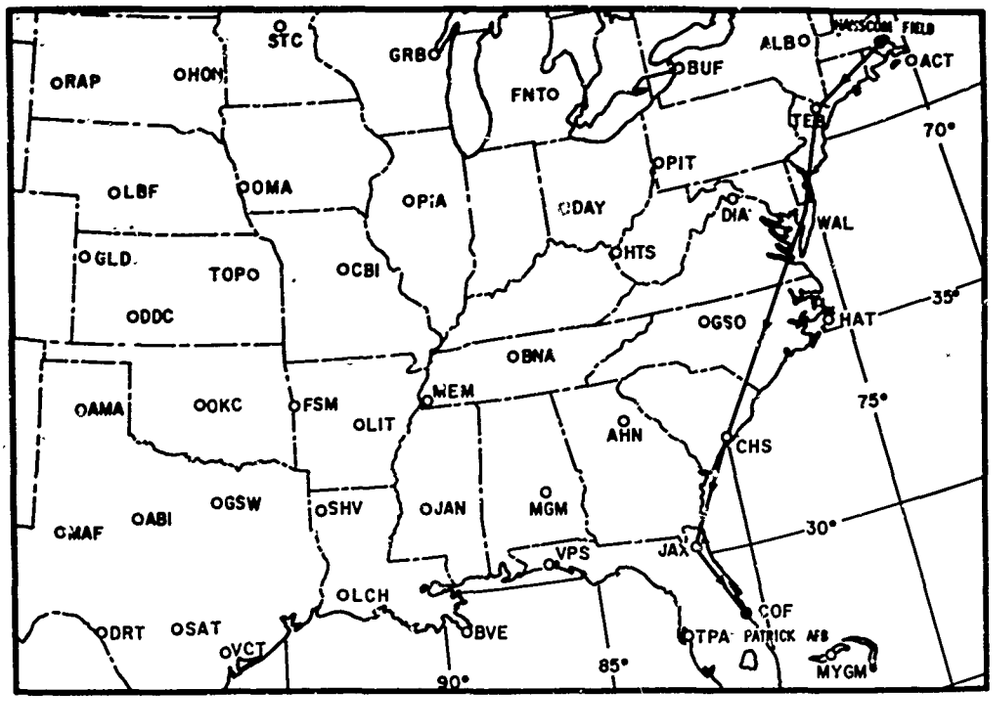
APPENDIX VI

TEST 195

18 April 1967, 0542-0942Z

HICAT search and ferry flight from Hanscom Field, Bedford, Massachusetts, to Patrick AFB, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

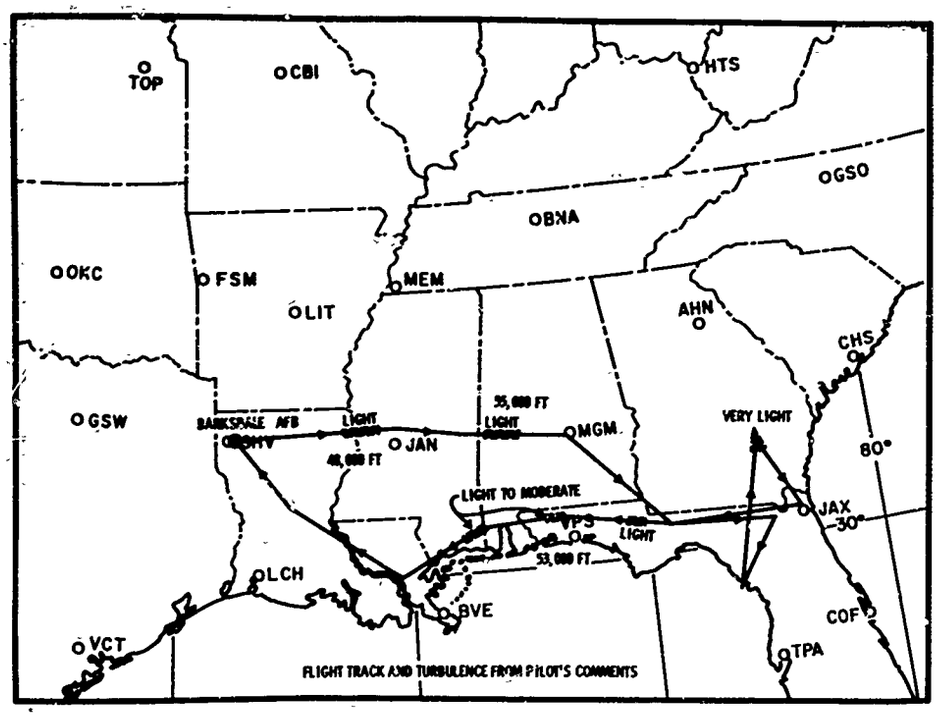
APPENDIX VI

TEST 196

2 May 1967, 1602-2103Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Late during the day, prior to this flight, a squall line and cold front passed over the Shreveport, Louisiana area. The cold front preceded an unusually cool outbreak of polar continental air for this time of the year and temperature records were broken over many of the states east of the Rockies.

Near the time of the flight, on 2 May 1967, the cold front was oriented northeast-southwest and lying over the state of Mississippi with the associated squall line approximately 100 miles to the east.

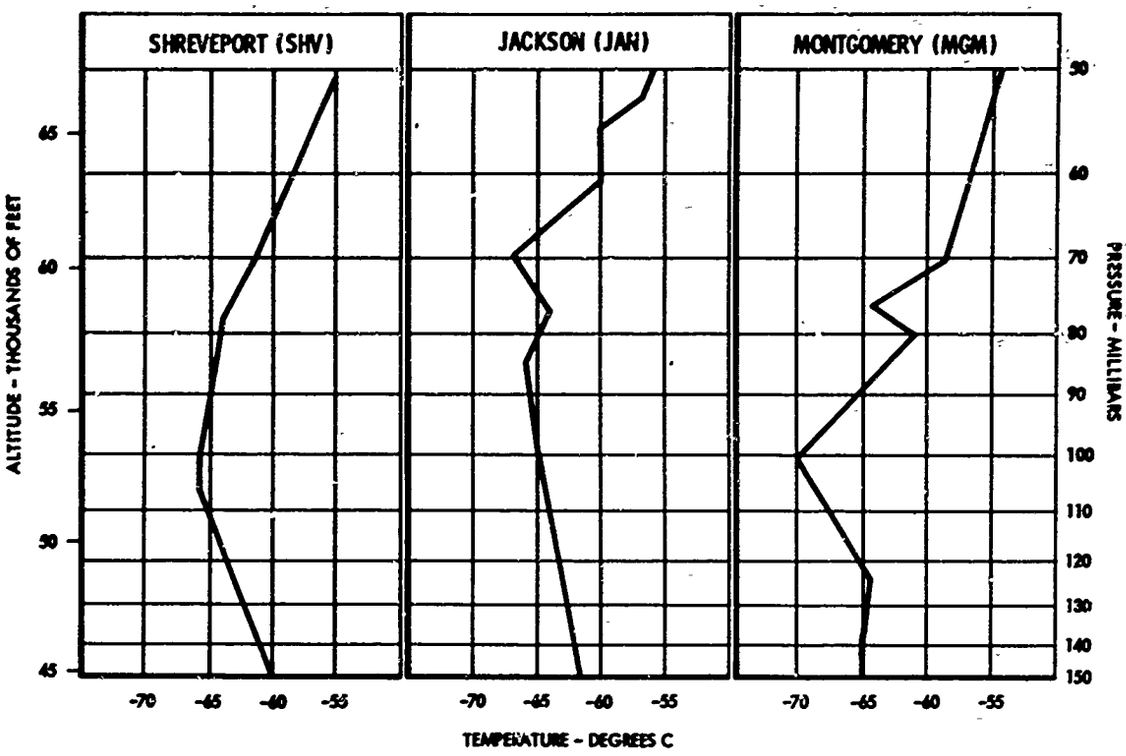
The mission plan was to fly over the front and squall line (see flight track).

The pilot encountered significant CAT between Monroe, Louisiana, and Tallahassee, Florida. CAT was very light or absent near Shreveport (SHV) and Jacksonville (JAX), the west and east extremities of the flight path.

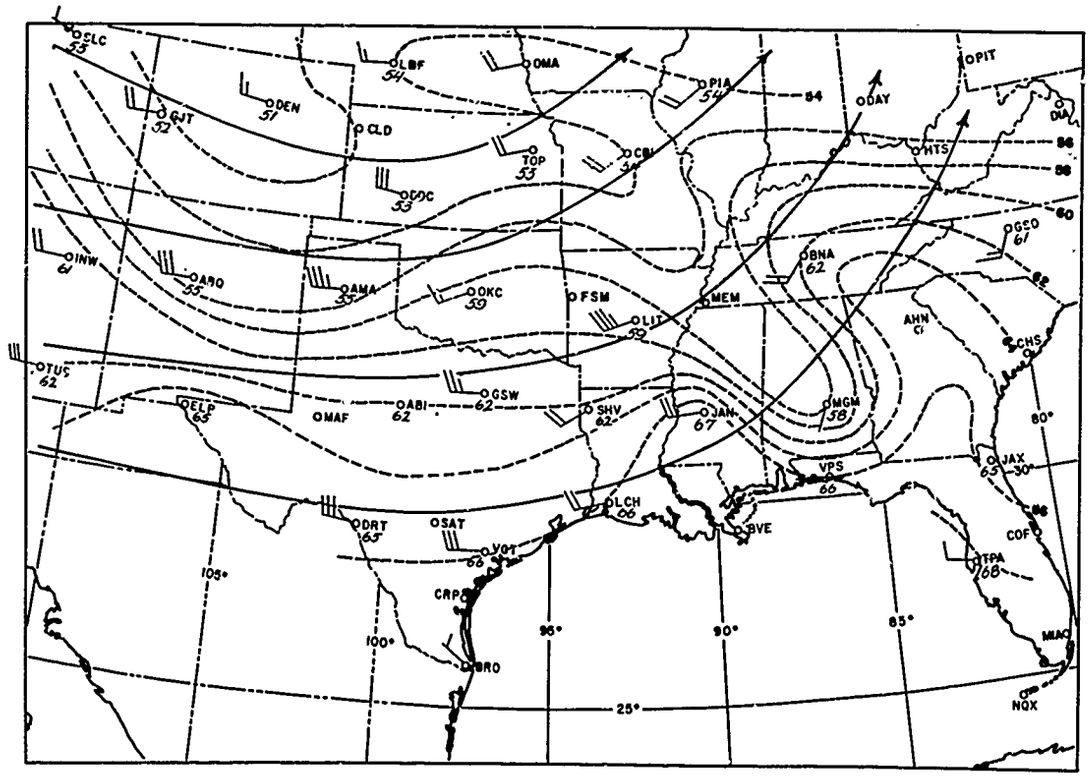
Note the irregular appearance and moderate slope of the vertical temperature gradient over Jackson (JAN) and Montgomery (MGM) on the RAOB chart.

The winds and temperatures chart shows the well defined warm thermal trough and the large horizontal temperature gradient that were present over the JAN-MGM-VPS area to be located almost precisely where the turbulence was sampled.

RAOB CHARTS (0000Z, 3 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 3 May 1967)



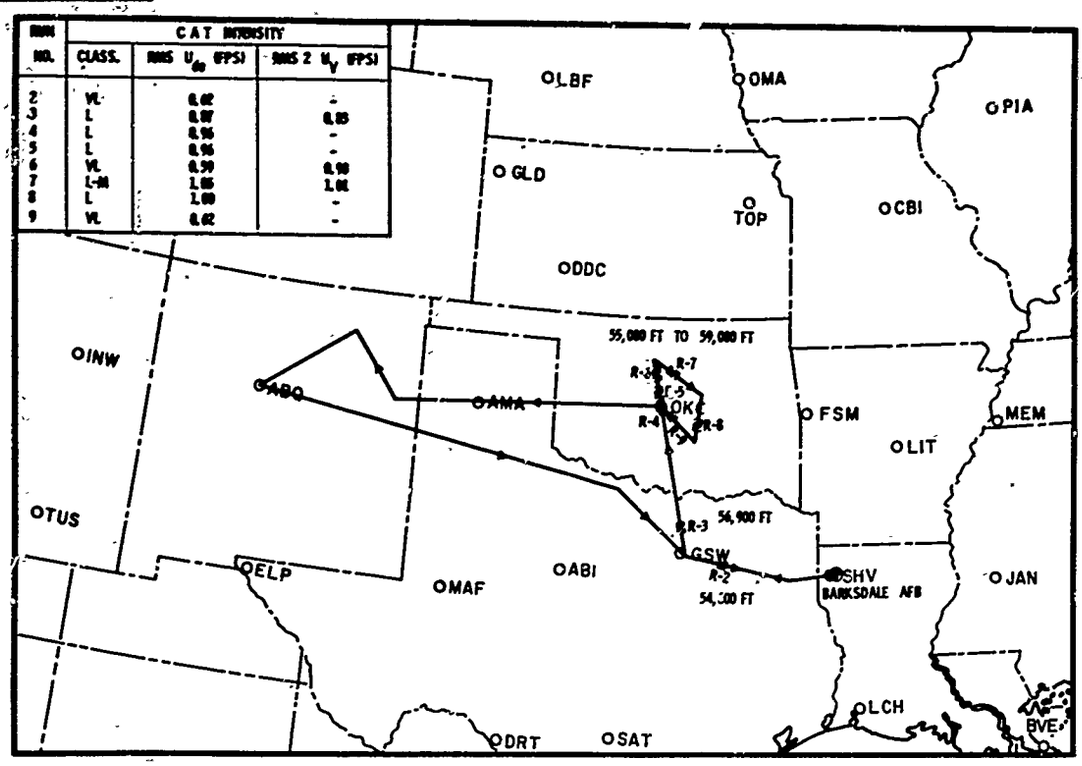
APPENDIX VI

TEST 197

3 May 1967, 1603-2103Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Near the surface on this date, quasi-stationary fronts were situated over south Texas through the Houston area and to the north through central Kansas.

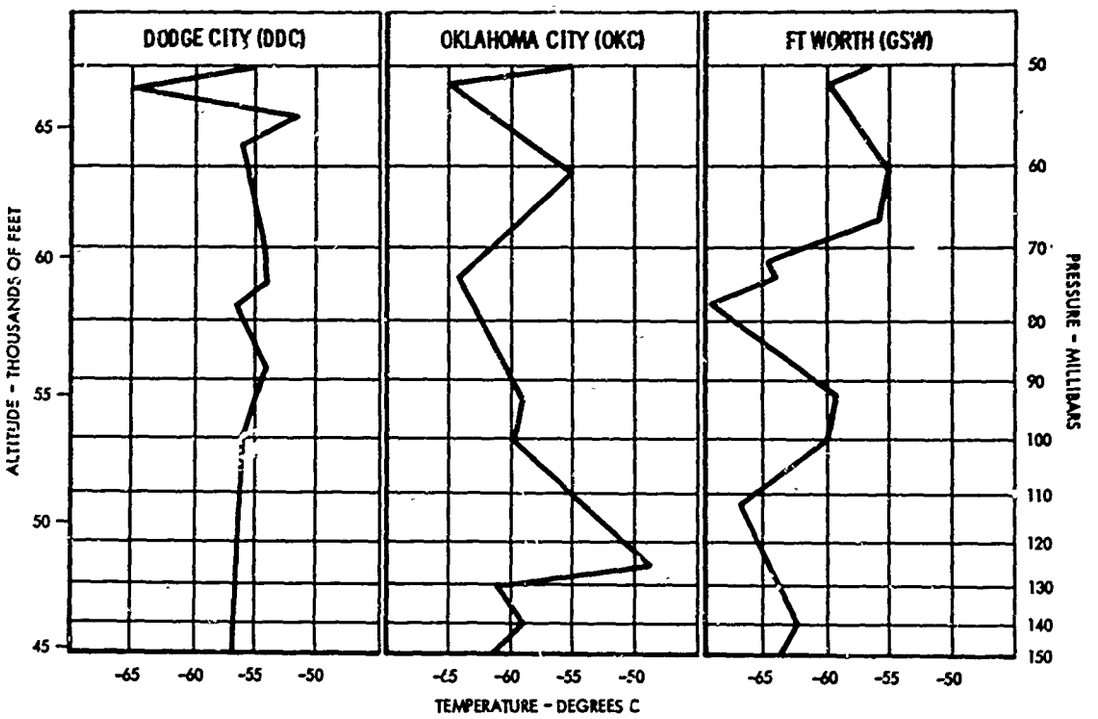
The 0000Z, 4 May 1967, tropopause analysis showed a band of maximum winds (> 100 knots) at about 38,000 feet oriented west-east over OKC. Upper level winds were near zonal over the operating area. Considerable thunderstorm activity occurred from the Red River valley southward to the Gulf Coast.

The flight track shows that most of the turbulence encountered was located over OKC. The pilot sampled altitudes between 53,000 - 58,000 feet over OKC, the turbulence was light to moderate continuous.

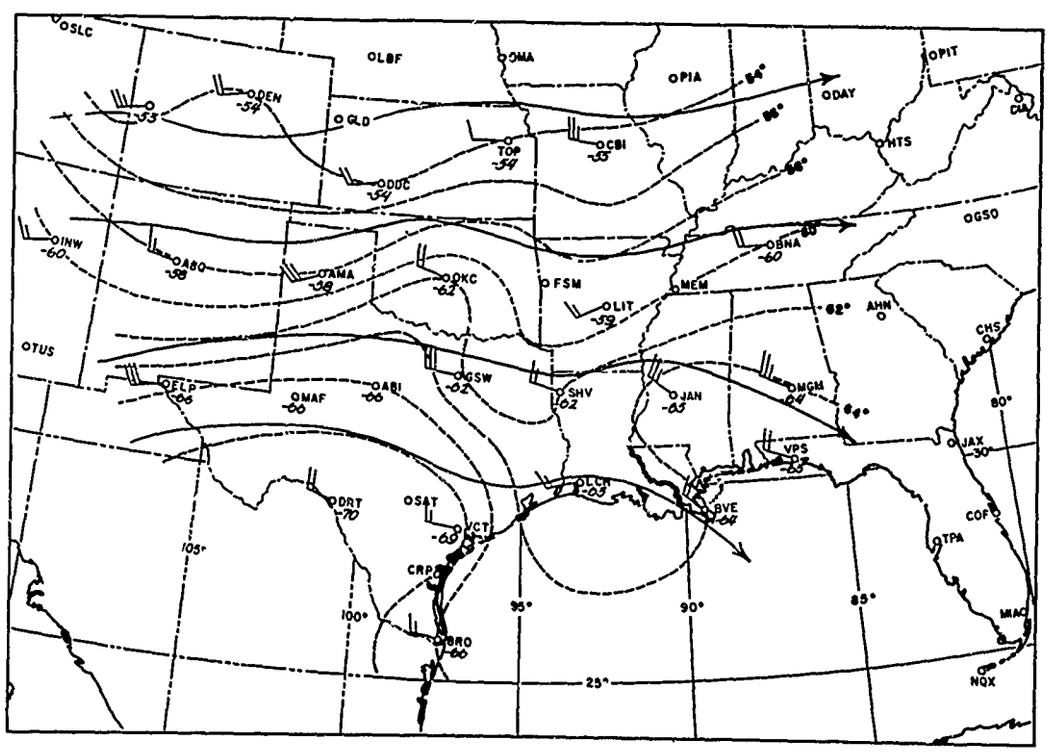
The RAOB chart indicates that large vertical temperature gradients were present over OKC and GSW. It appears the pilot was in the altitude band of the least vertical gradient over OKC.

The 70 mb analysis shows the thermal trough between OKC and LIT. A comment by the pilot was that the turbulence ended abruptly 20 miles west of OKC which is at the crest of the thermal ridge.

RAOB CHARTS (0000Z, 4 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 4 May 1967)

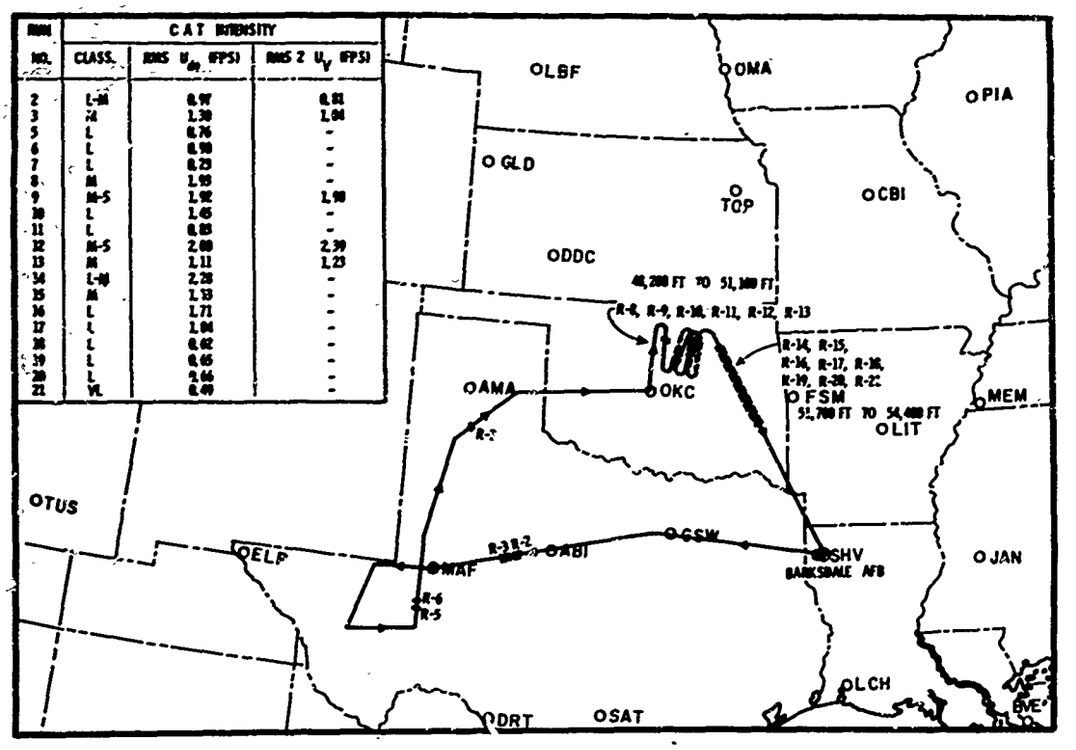


APPENDIX VI

TEST 198

5 May 1967, 1759-2343Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.



FLIGHT SUMMARY

This mission was a joint test with the National Severe Storms Laboratory at Norman, Oklahoma.

During the morning of 5 May 1967, a line of thunderstorms began to form between Oklahoma City and the Kansas-Oklahoma border. This squall line was about 60 miles in advance of a slowly moving surface front positioned along the Kansas-Oklahoma border. The 2045Z radar summary chart showed a solid band of echos oriented in a west-east direction between Oklahoma City and Ponca City, Oklahoma.

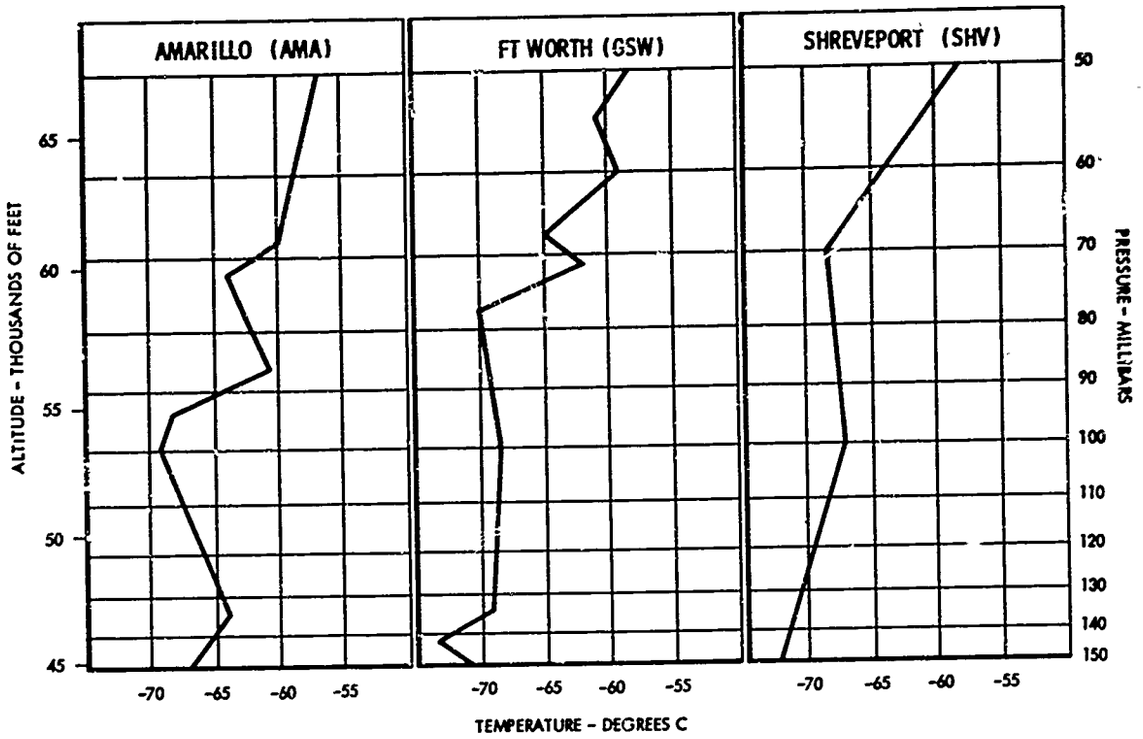
The flight track indicates that the turbulence was sampled over this area of convective activity. The pilot was in moderate to severe turbulence for about 45 minutes.

Aloft, a wide band of 100 knot winds was flowing across north Texas, Oklahoma and Kansas at the tropopause level of 39,000 feet.

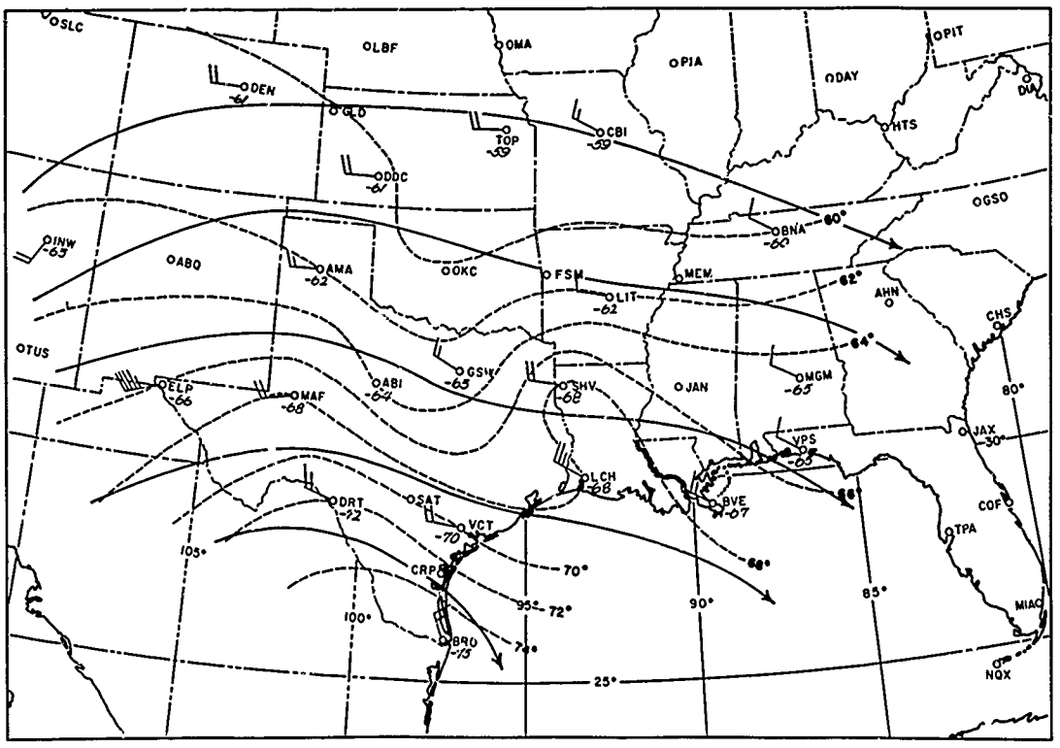
The RAOB chart shows large vertical gradients for AMA and GSW (OKC was missing).

In the winds and temperature chart, it is perhaps significant that the thermal trough at the 70 mb level is centered over the OKC area.

RACB CHARTS (0000Z, 6 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 6 May 1967)



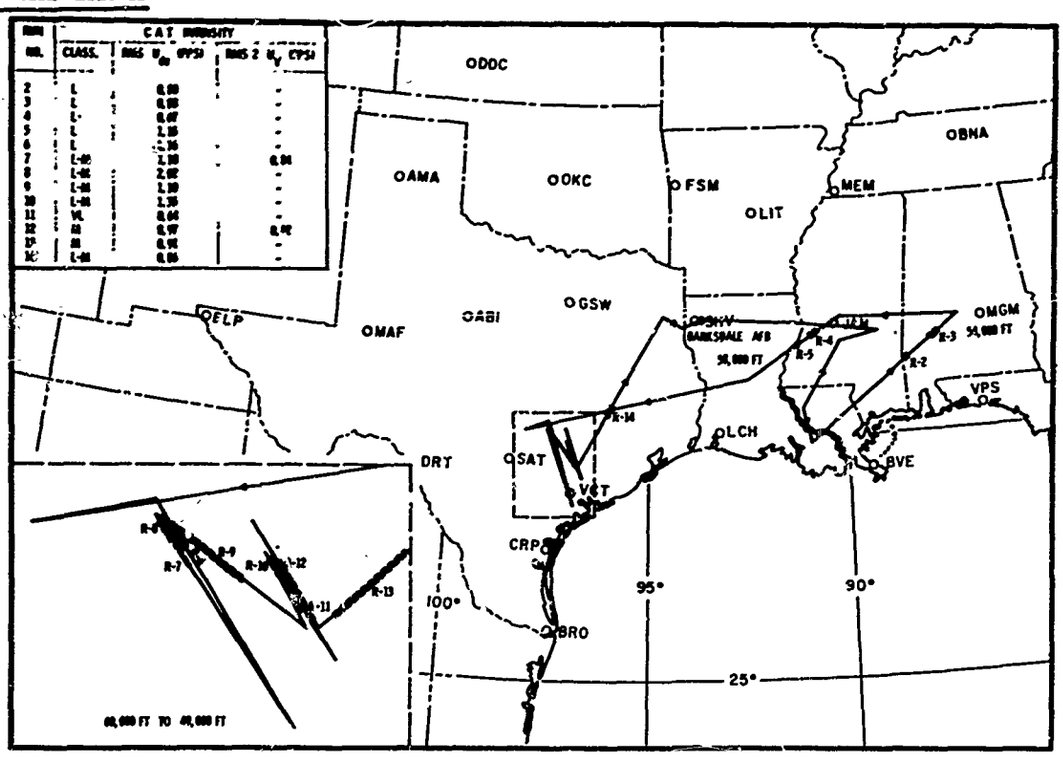
APPENDIX VI

TEST 199

8 May 1967, 1619-2202Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

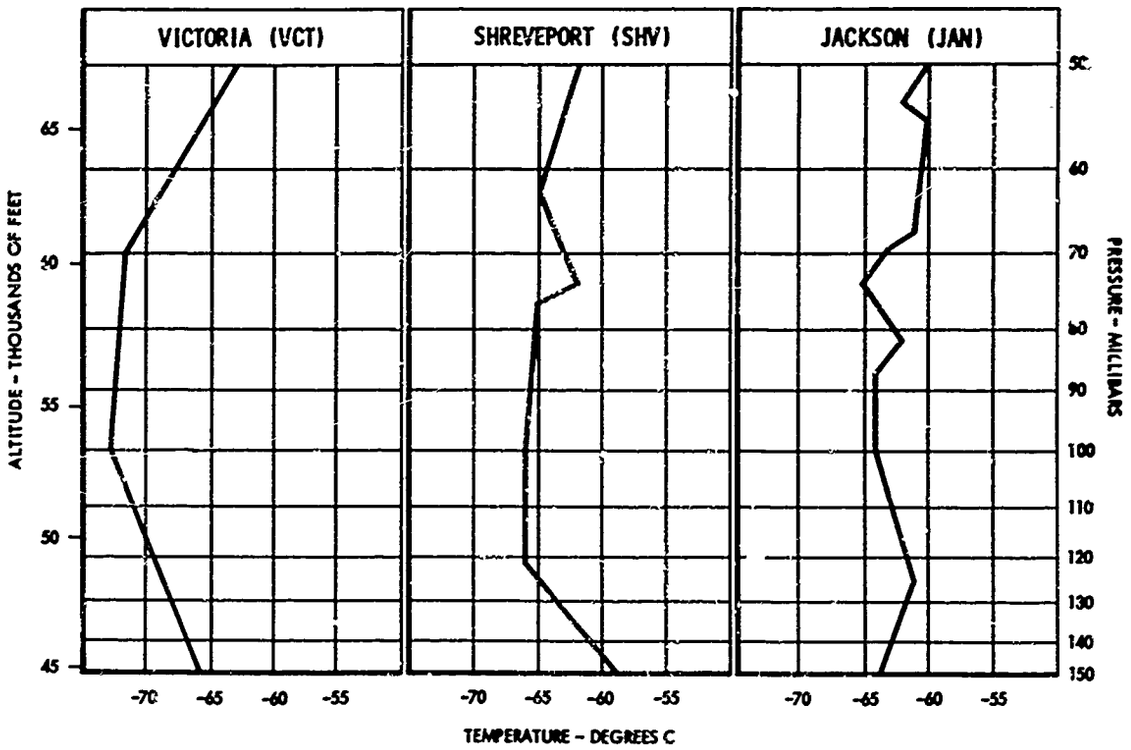
The 1800Z surface chart for 8 May 1967 shows a cold front oriented west-east across central Texas and northern Louisiana. Aloft, the 1200Z, 8 May 1967, 200 mb analysis indicates that jetstreams were converging at that level over Arkansas and Louisiana.

The flight track for this day was back and forth across the south Central States. The pilot encountered abundant light CAT over Mississippi and Alabama. Upon reaching the San Antonio area he could see a thunderstorm developing near Austin; he proceeded to that area, and encountered light to moderate CAT over the convective activity for approximately 30 minutes. (Ref. Runs 7-13.)

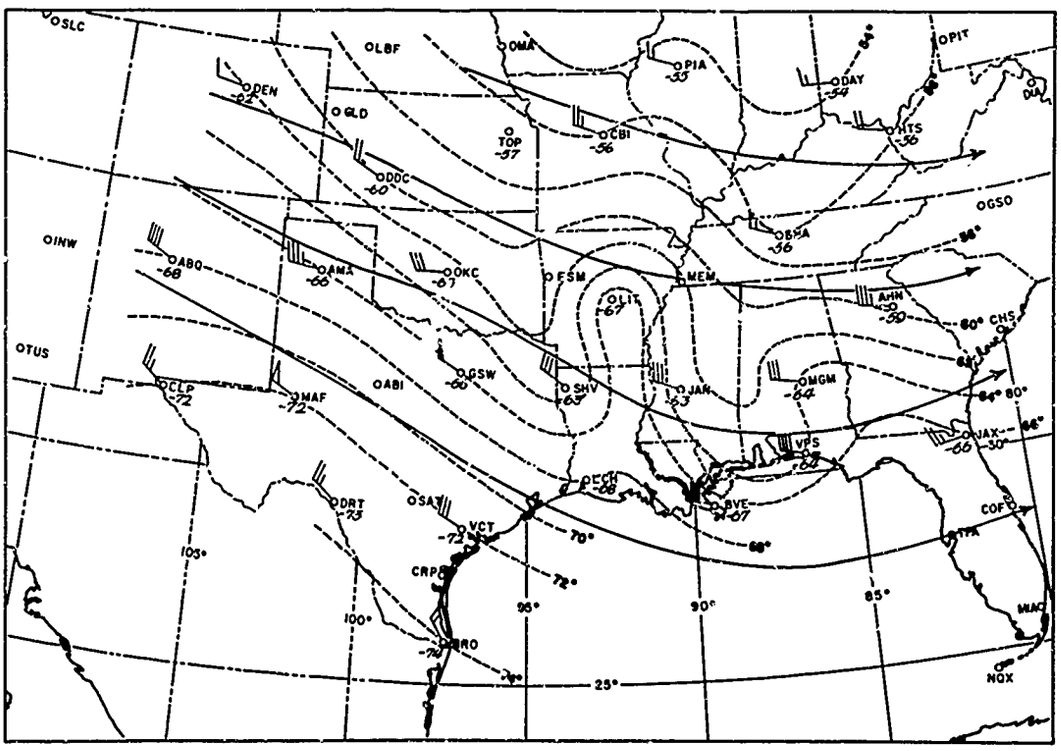
The RAOB shows small vertical gradients near VCT (the thunderstorm over which the pilot flew was isolated). SHV and JAN have a medium vertical gradient.

The 70 mb analysis depicts the well defined wave, as indicated by the isotherms, that was located between Oklahoma and Alabama. This wave was also near the axis of trough visible on the 200 mb analysis.

RAOB CHARTS (1200Z, 8 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 8 May 1967)



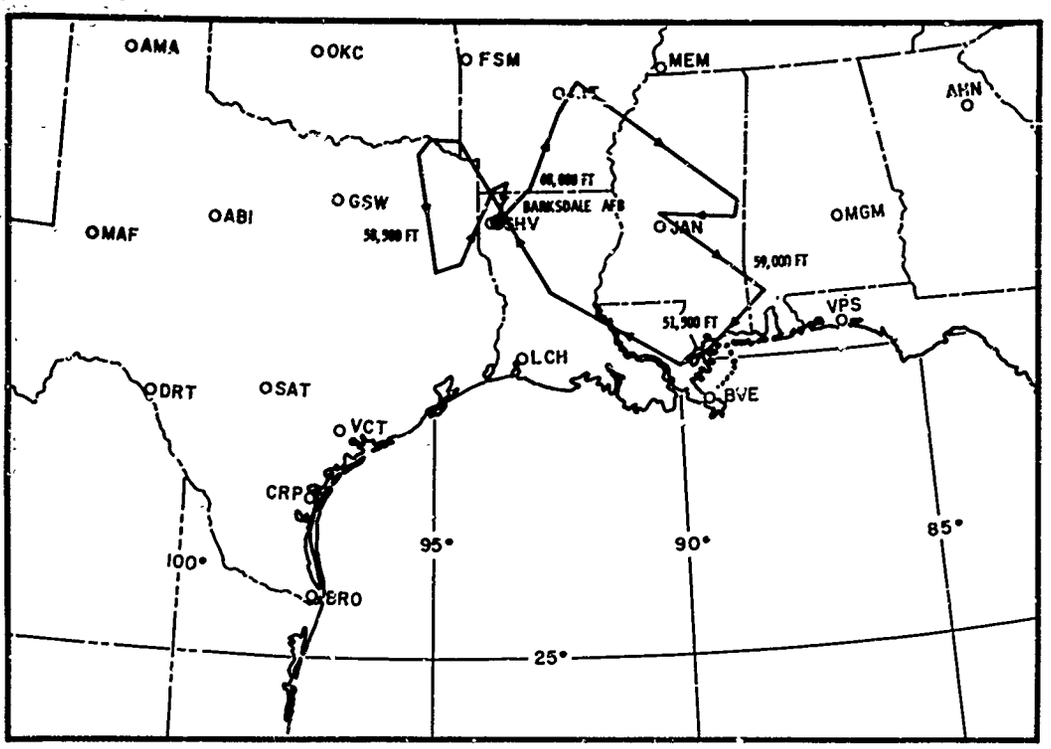
APPENDIX VI

TEST 200

9 May 1967, 1536-1937Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

On the 1800Z surface map, 9 May 1967, a weak stationary front was located across south central Texas with a high pressure area centered over southern Arkansas. The radar summaries showed isolated cumulonimbus activity over the sampling area.

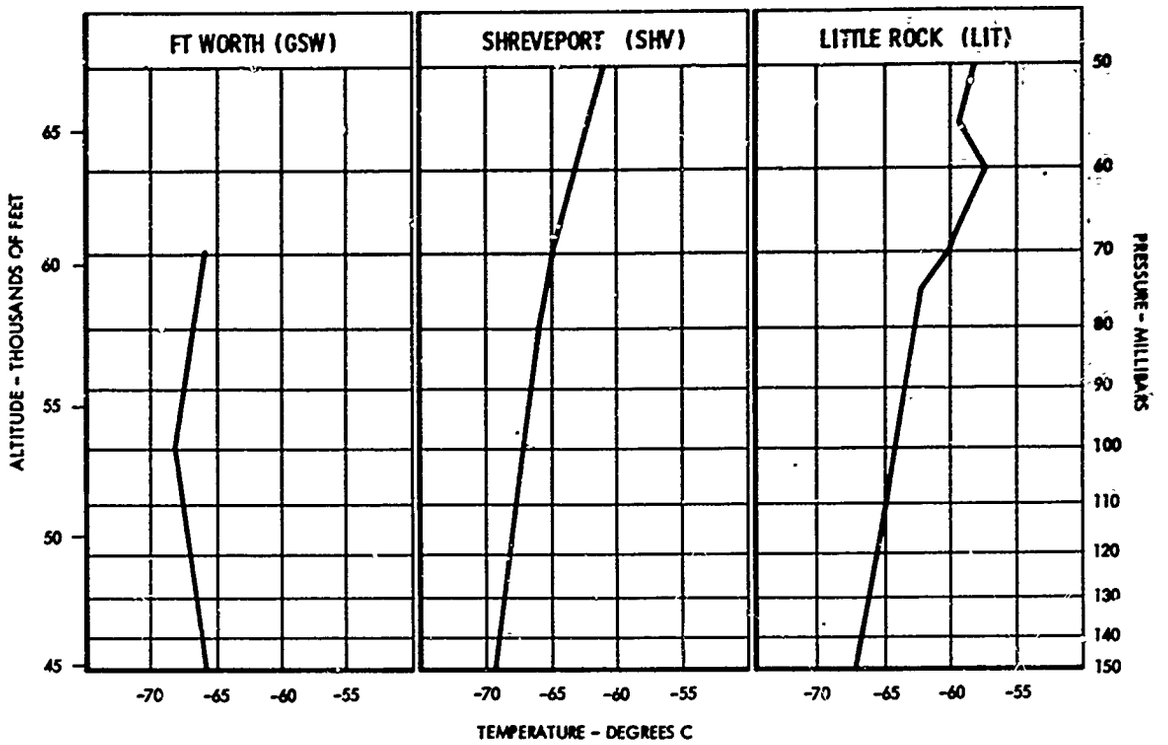
Aloft the winds were northwest-southeast with near straight line flow.

Very light CAT was reported by the pilot. No runs were processed.

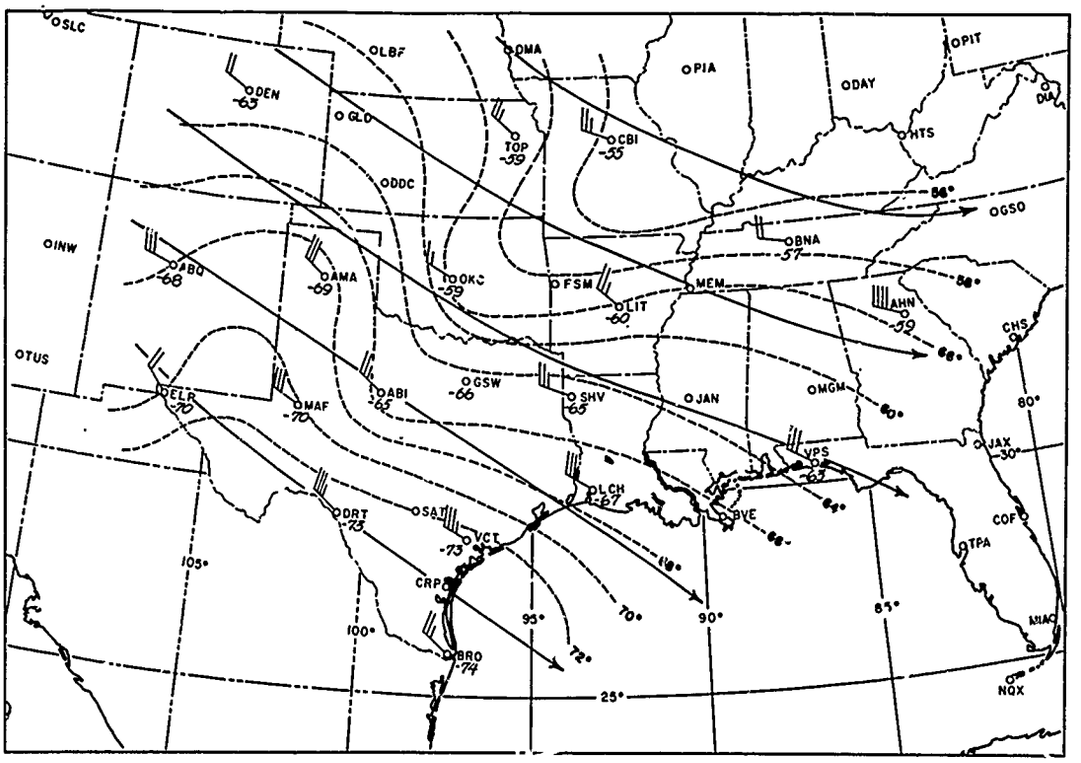
The RAOB charts show the vertical temperature gradients at GSW, SHV and LIT were very small.

A fairly well defined thermal trough over OKC is evident on the 70 mb analysis. However, the flight was to the east of this area and so the area was not sampled.

RAOB CHARTS (1200Z, 9 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 9 May 1967)



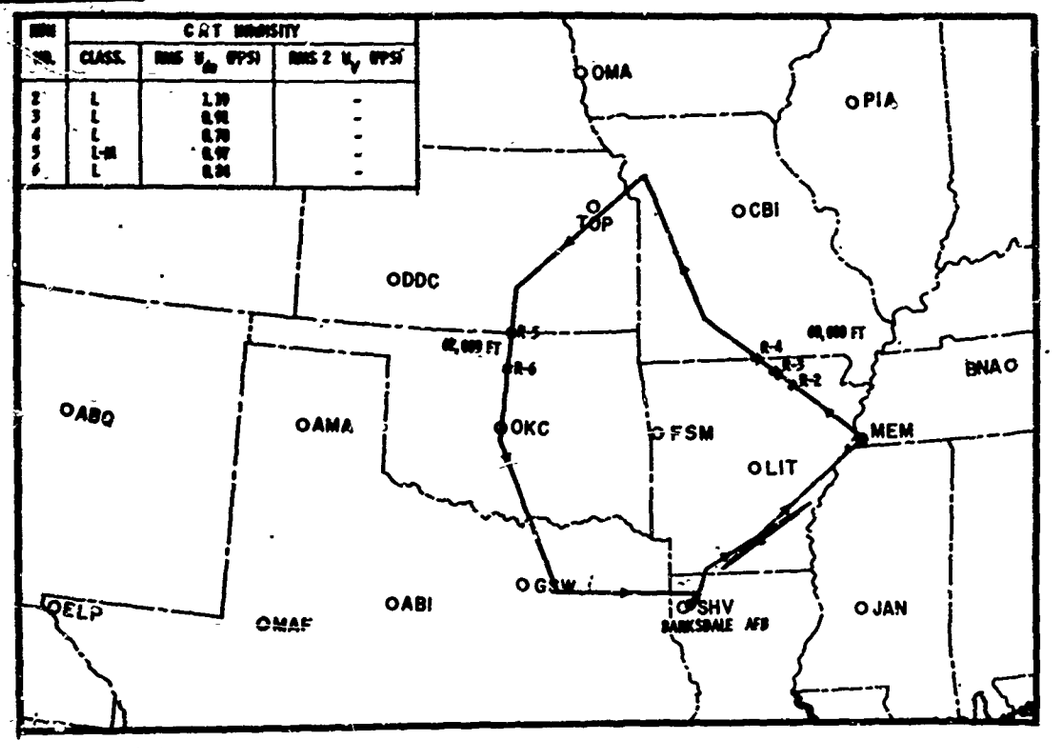
APPENDIX VI

TEST 201

10 May 1967, 1658-2123Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



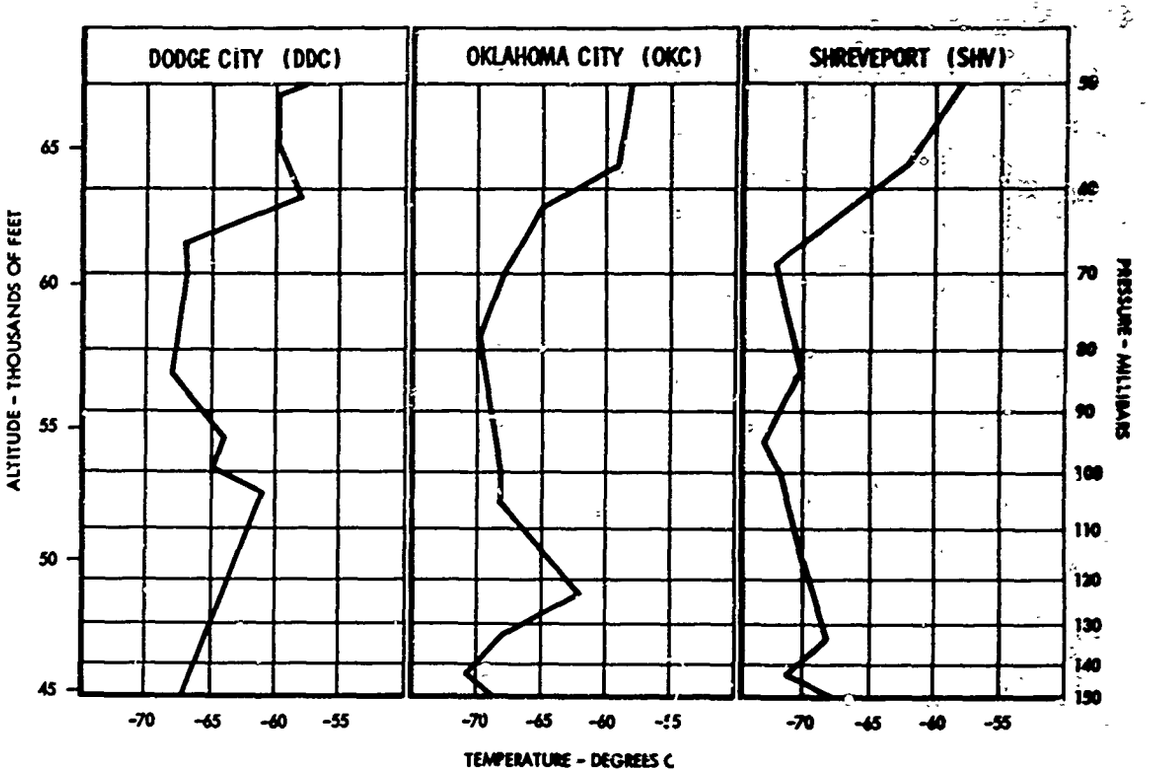
FLIGHT SUMMARY

The 1800Z, 10 May 1967, surface chart showed a 991 mb low pressure center over Nebraska. A cold front trailed southwestward to Albuquerque, New Mexico and a warm front across eastern Oklahoma - central Louisiana. The 1200Z 200 mb analysis indicated that a jetstream with pronounced anticyclonic curvature extended across Colorado, Nebraska, Missouri, and Mississippi.

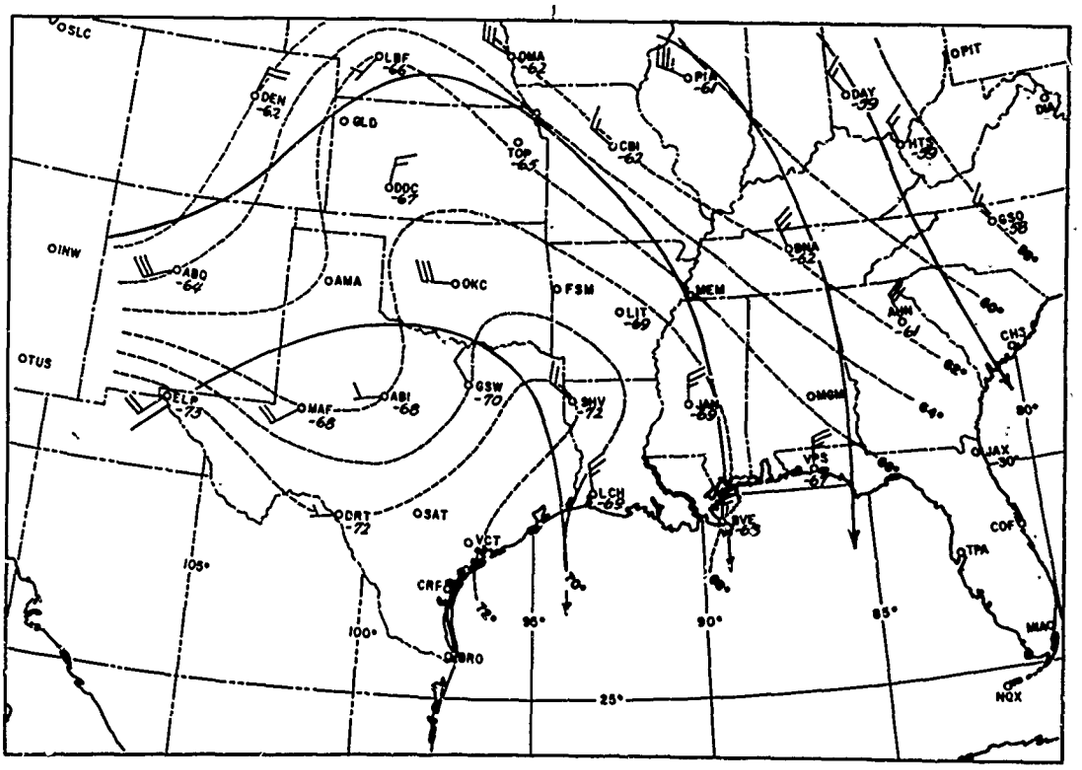
The mission was originally planned to fly over Nebraska but radio trouble caused the flight to be shortened. The flight track shows the route of flight and that light to moderate CAT was encountered along the northern borders of Oklahoma and Arkansas. The altitude of the CAT sampled in runs 5 and 6 was near 62,500 feet and the level of the strong inversion over DDC.

Notice the 90° wind shift between DDC and OKC in the winds and temperature chart.

RAOB CHARTS (0000Z, 11 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 11 May 1967)



APPENDIX VI

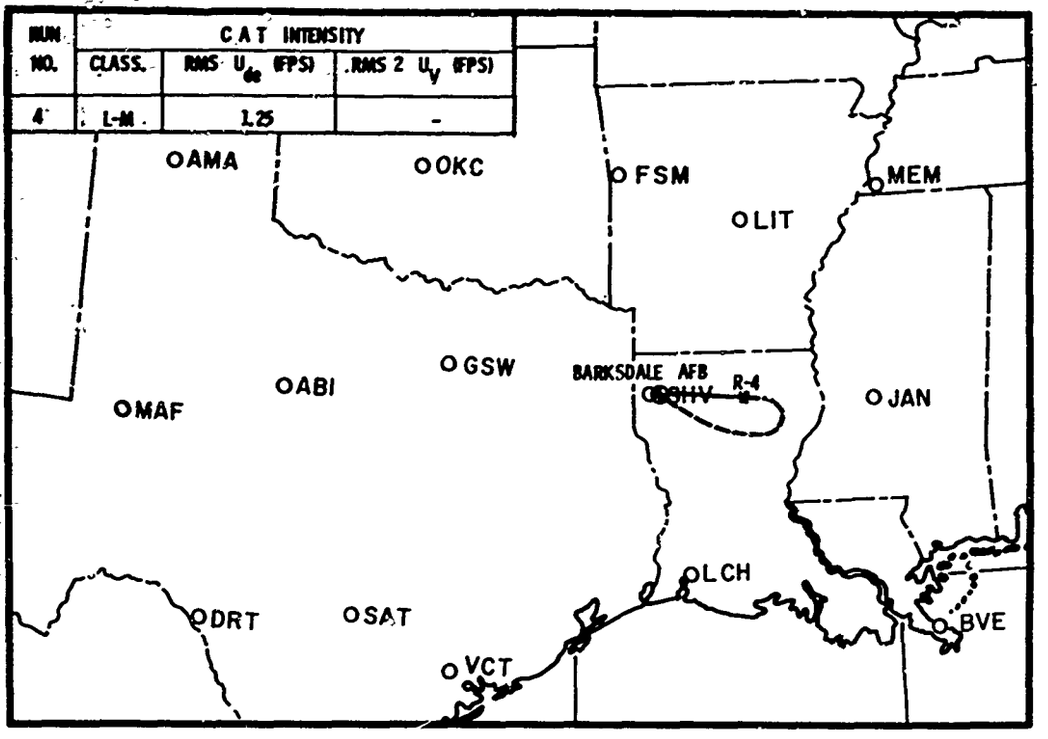
TEST 203

15 May 1967, 1555-1805Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK

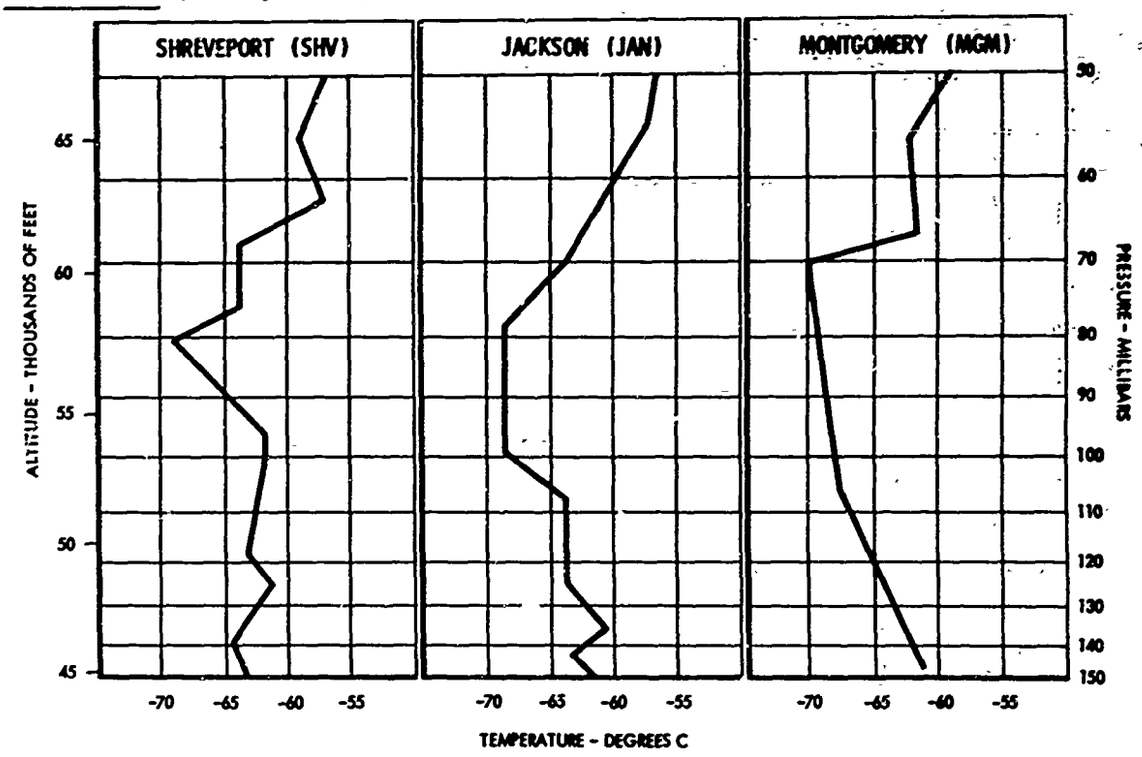
RUN NO.	CAT INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
4	L-M	1.25	-



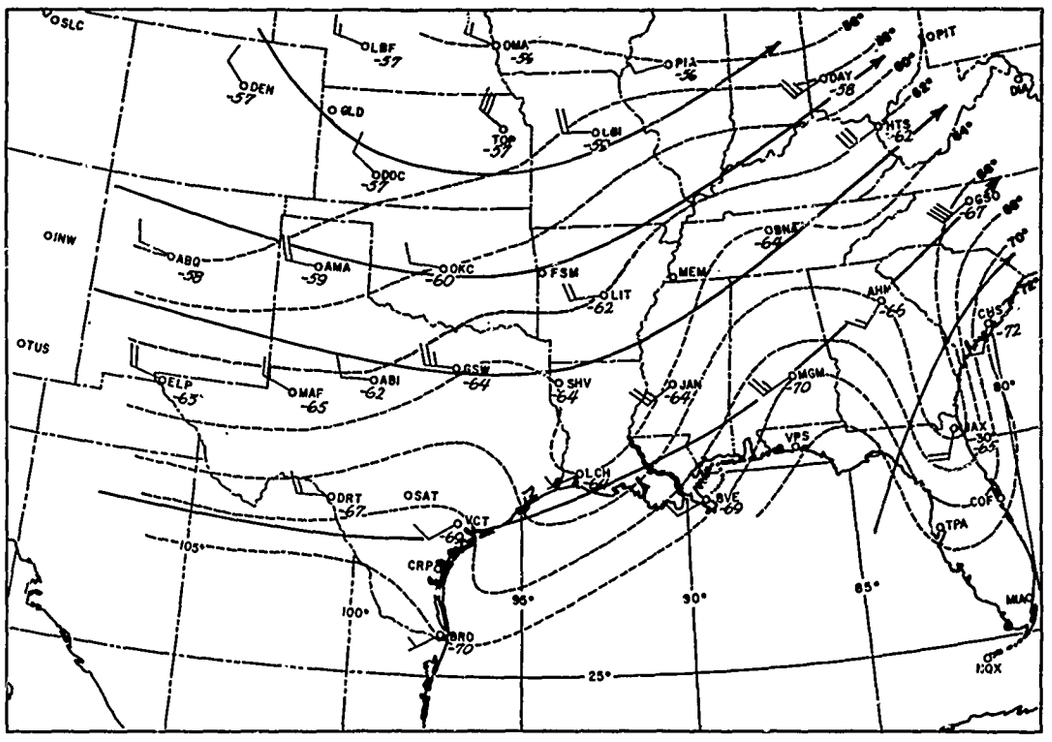
FLIGHT SUMMARY

This test was aborted fairly soon after takeoff because of engine difficulties. The meteorological discussion of this test appears with that of Test 204, one of the ten HICAT tests analyzed in considerable detail in Appendix I-G, Volume I.

RAOB CHARTS (0000Z, 16 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 16 May 1967)



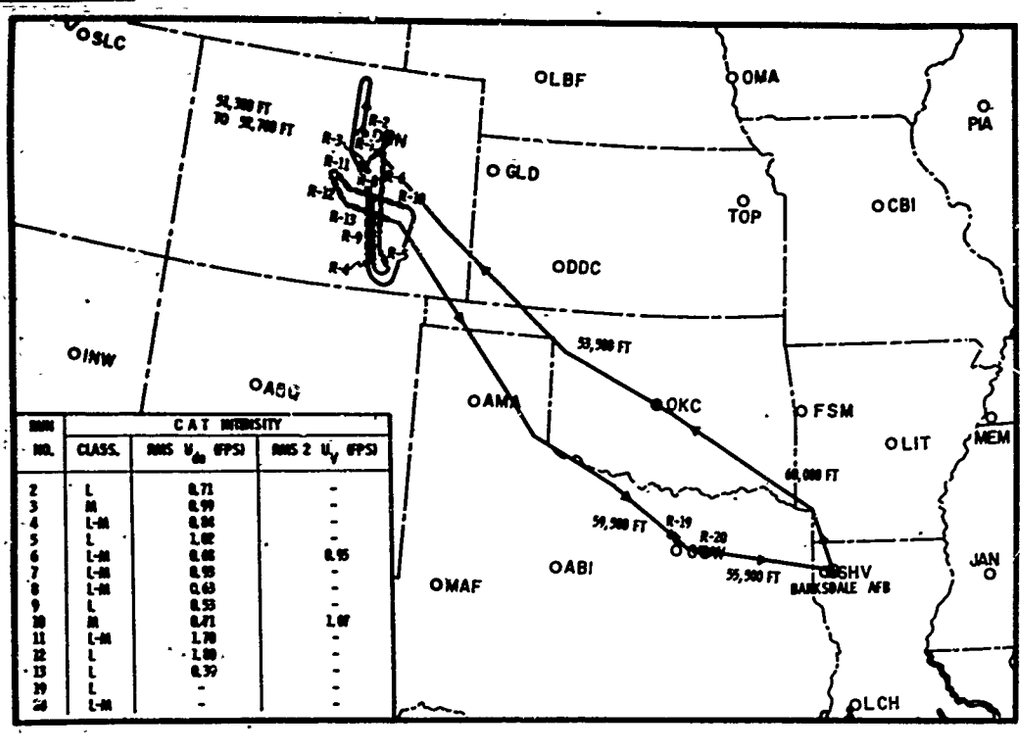
APPENDIX VI

TEST 205

16 May 1967, 1526-2050Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



RUN NO.	CAT INTENSITY CLASS.	RMS V_{dc} (FPS)	RMS 2 U_V (FPS)
2	L	0.71	-
3	M	0.99	-
4	L-M	0.84	-
5	L	1.02	-
6	L-M	0.85	0.95
7	L-M	0.95	-
8	L-M	0.63	-
9	L	0.53	-
10	M	0.71	1.07
11	L-M	1.70	-
12	L	1.09	-
13	L	0.59	-
19	L	-	-
20	L-M	-	-

FLIGHT SUMMARY

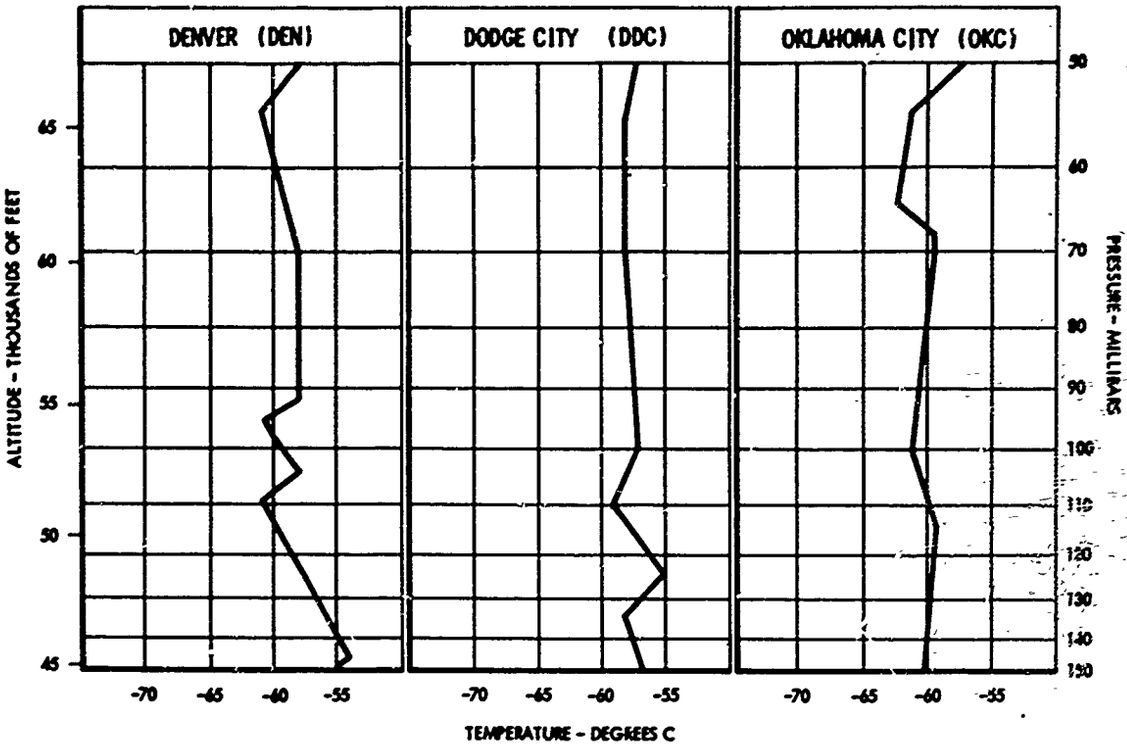
On 16 May 1967, a weak high pressure system was centered over Kansas. This circulation created upslope motion along the eastern Rockies and caused some stratus to form in the lower levels in the Denver - Colorado Springs area. Above this low stratus skies were clear.

Aloft winds were northwest-southeast with almost straight line flow and were relatively light.

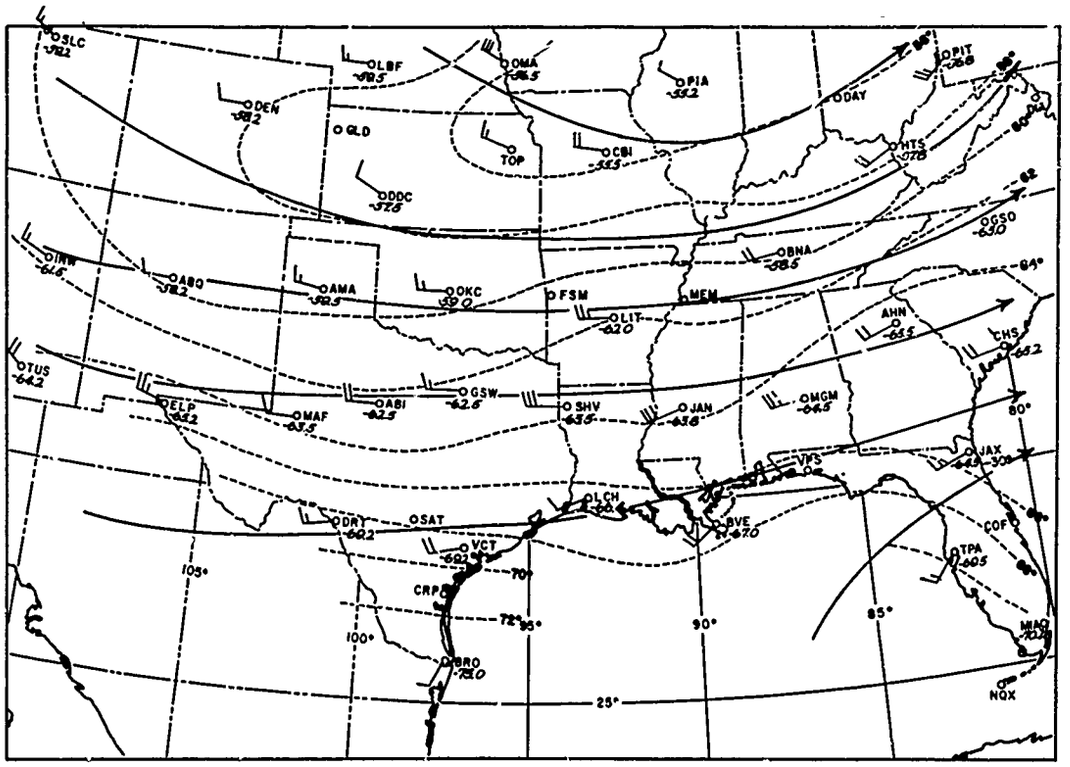
The pilot reported light CAT 120 nm northwest of OKC at flight level 53,000 feet and abundant light to moderate CAT between Colorado Springs and Pueblo at 51,000 - 52,000 feet. Compare these altitudes with the 51,000 - 52,000 feet area of the Denver RAOB.

Note the thermal trough shown in the winds and temperature chart from TOP to DEN. The east-west orientation is not usually observed.

RAOB CHARTS (1200Z, 16 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 16 May 1967



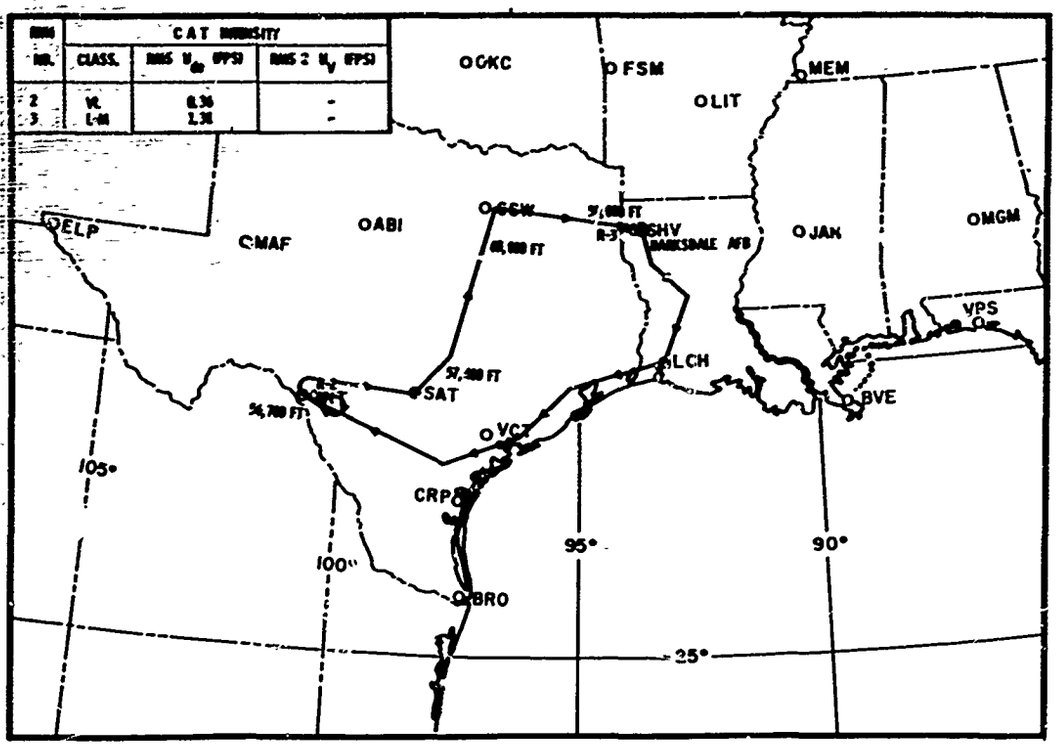
APPENDIX VI

TEST 206

17 May 1967, 1544-1932Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At the surface, on 17 May 1967, a large high pressure system was centered over western Arkansas and covered the southern half of the nation east of the Rocky Mountains. A southerly flow of air prevailed over Texas advecting moisture from the Gulf of Mexico. Convective activity was at a minimum.

Aloft a 60-80 knot jetstream was flowing in a straight path across Texas from El Paso towards Alexandria, Louisiana.

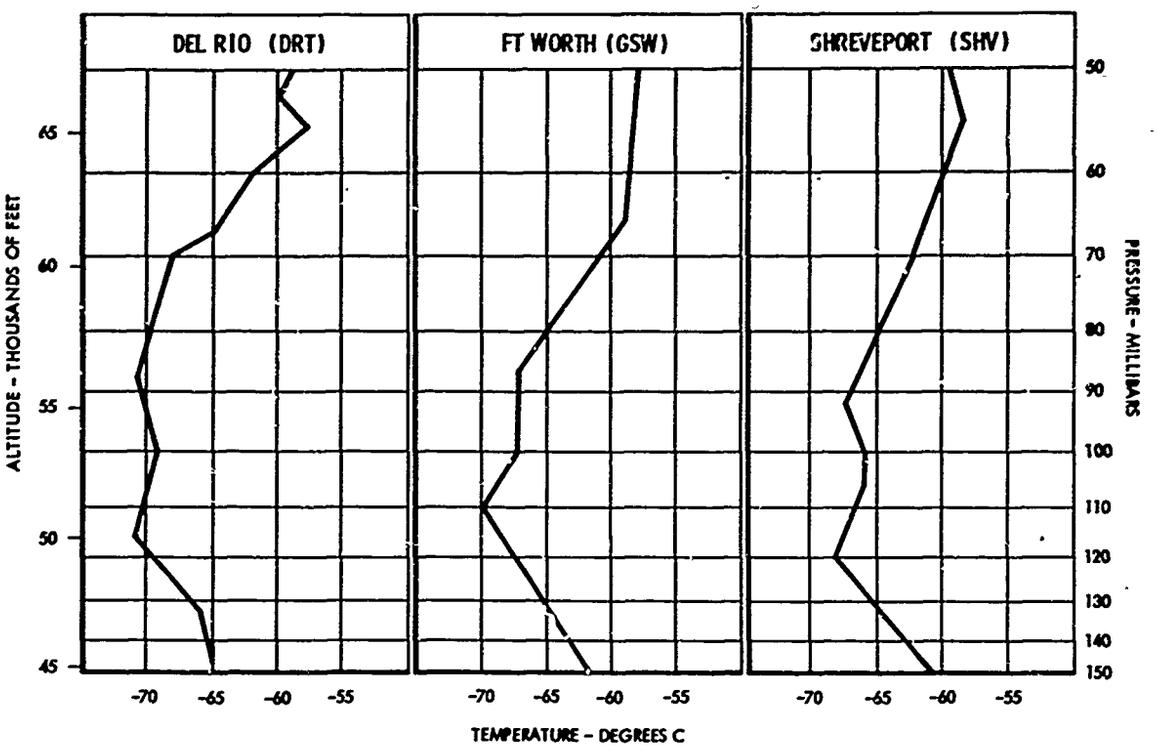
The flight track was planned to cross this band of winds. The Del Rio, Texas (DRT) RAOB had shown large vertical gradients on the 0000Z, 17 May 1967, sounding.

As indicated in the flight track, the pilot encountered light CAT over DRT and light to moderate CAT between GSW and SHV. He also reported other very light patches that were not processed.

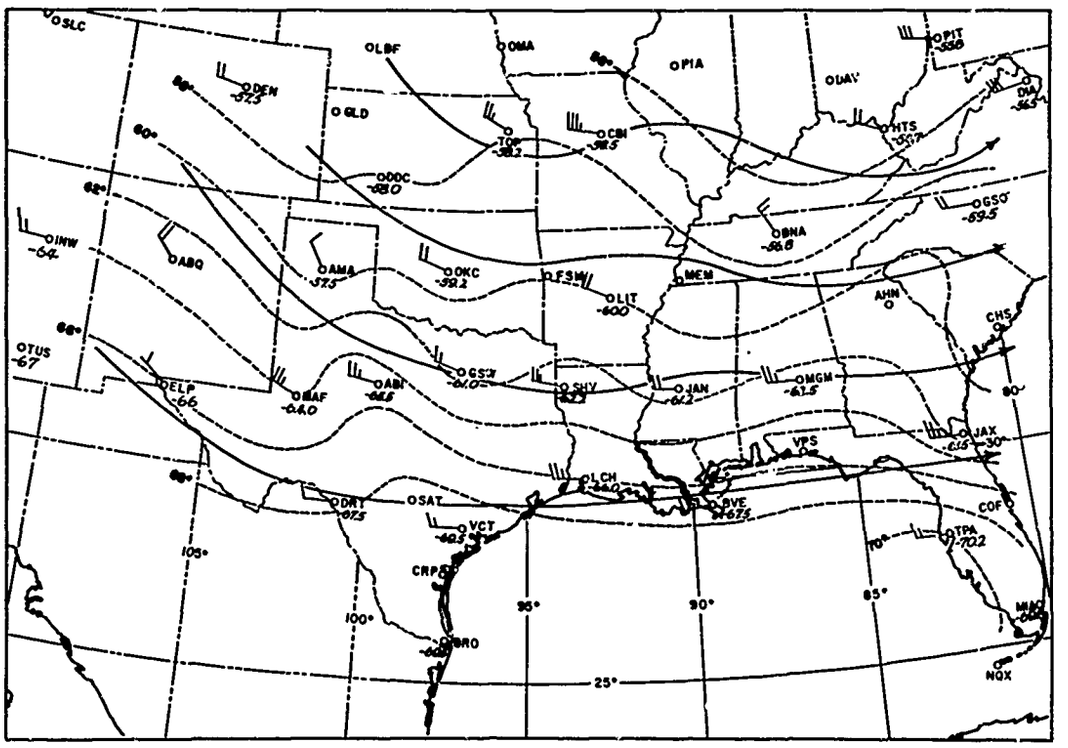
The vertical temperature gradients shown in the RAOB chart are of a type associated with light-plus CAT. In this case note that the RAOB time is six to seven hours prior to sampling time.

The isotherms in the 70 mb analysis indicate a shallow wave with thermal troughs was located over MAF and GSW at 1200Z, 17 May 1967.

RAOB CHARTS (1200Z, 17 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 17 May 1967)



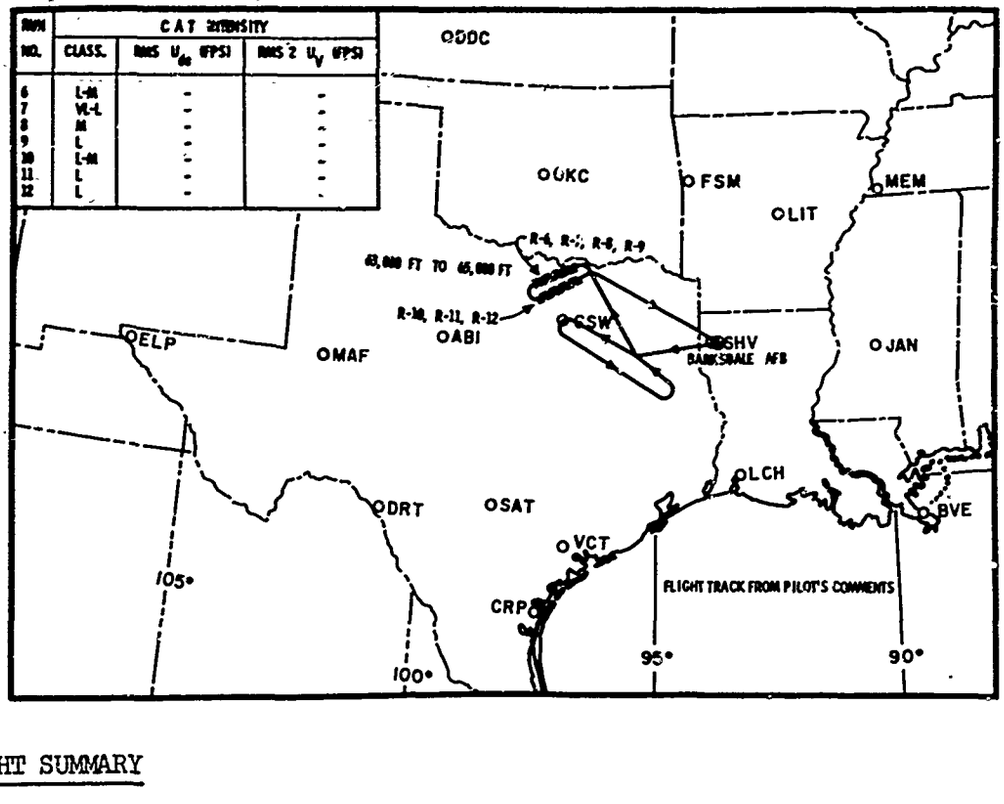
APPENDIX VI

TEST 207

19 May 1967, 1918-2217Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At 1800Z, 19 May 1967, a cold front was moving slowly from north to south across southern Oklahoma. A line of thunderstorms formed along the Red River and slightly in advance of the front.

Aloft the 0000Z, 20 May 1967, 200 mb chart indicated a west-northwest wind flow at 60-80 knots. Jetstreams were positioned over south Texas and the north Central States.

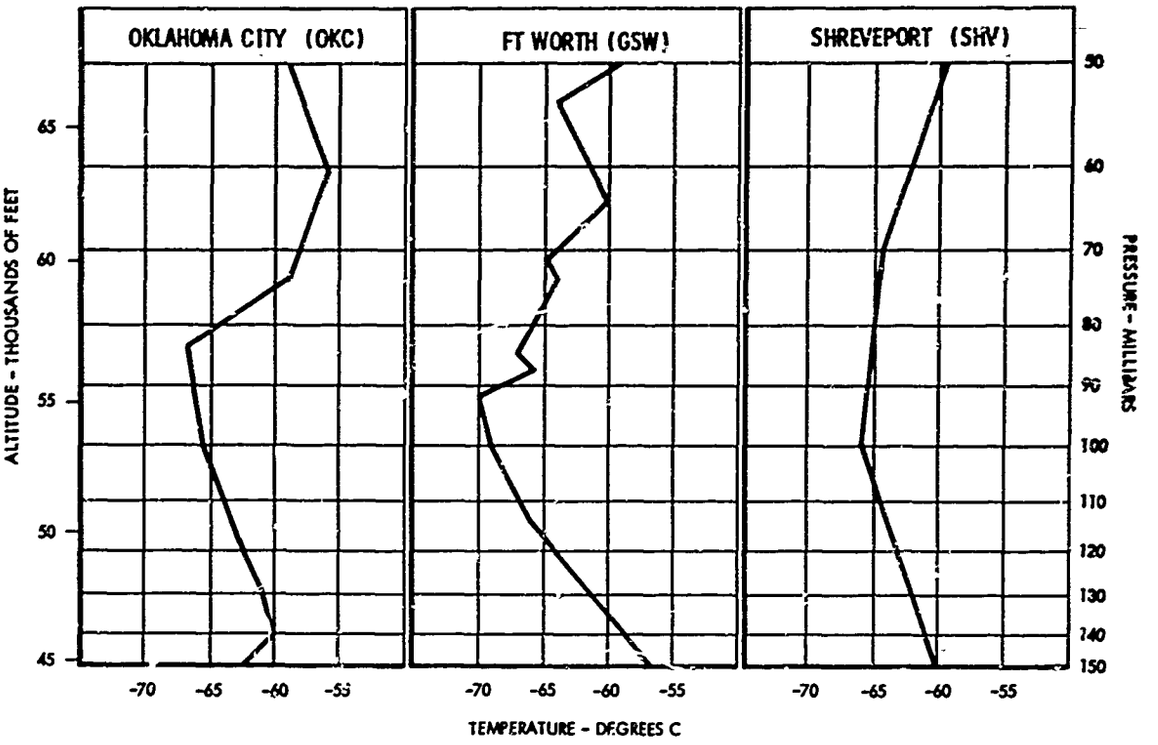
The 2045Z, 19 May 1967, radar summary chart showed a solid line of echos with tops to 53,000 feet oriented west-southwest east-northeast, 50 nm north of Dallas, Texas.

The pilot reported he flew across the tops of the thunderstorms first at 65,000 feet well above all clouds and encountered light CAT. During the second pass across the tops, he descended to 63,000 feet and the turbulence increased to moderate. Approximately 9 minutes of turbulence data was processed.

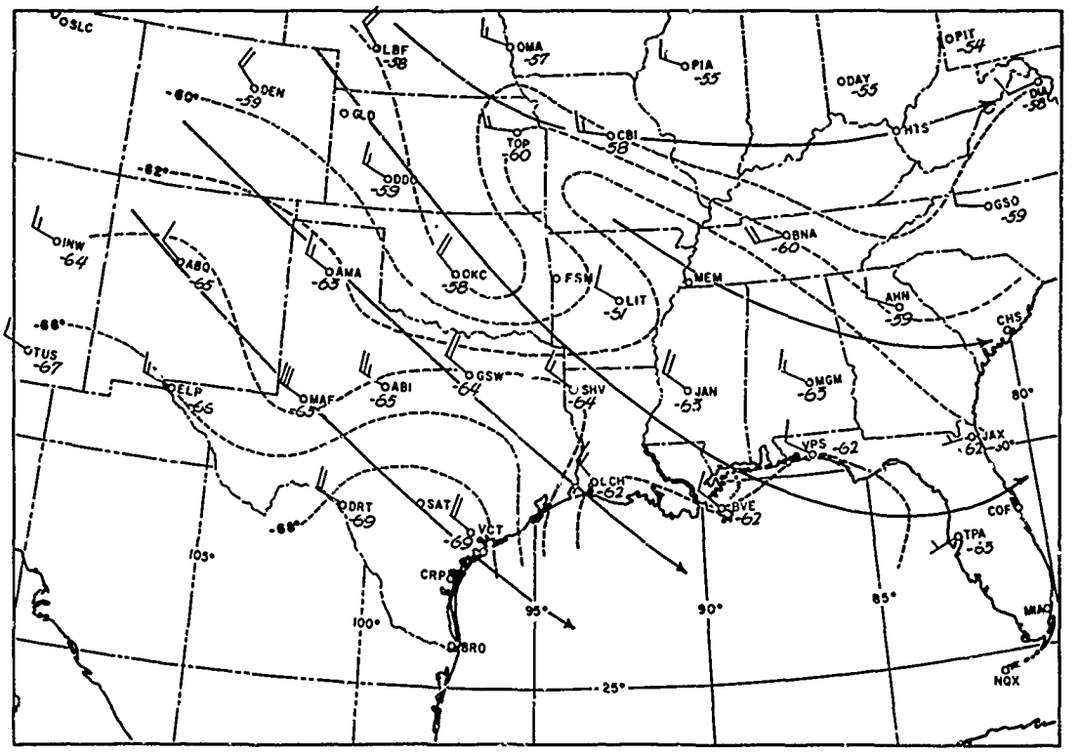
The closest RAOB to the sampled area was that of GSW at 0000Z, 20 May 1967.

The 70 mb analysis shows a well defined thermal trough with the axis between OKC and GSW.

RAOB CHARTS (0000Z, 20 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 20 May 1967)



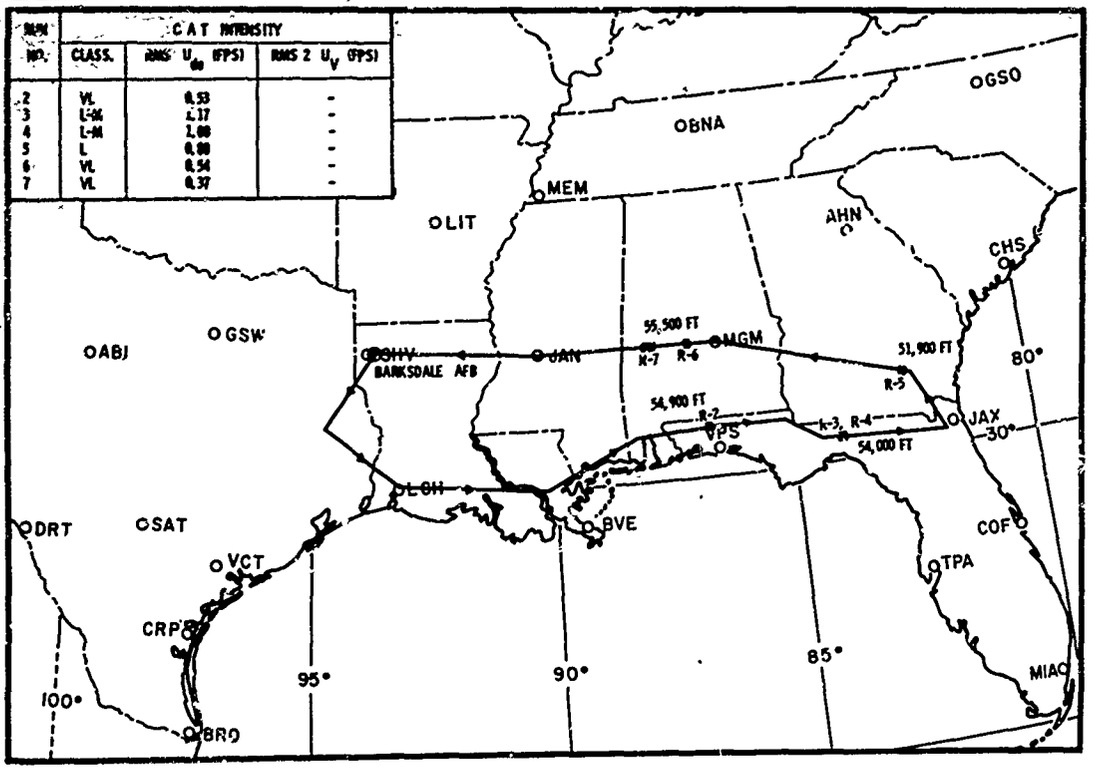
APPENDIX VI

TEST 208

22 May 1967, 1529-1941Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

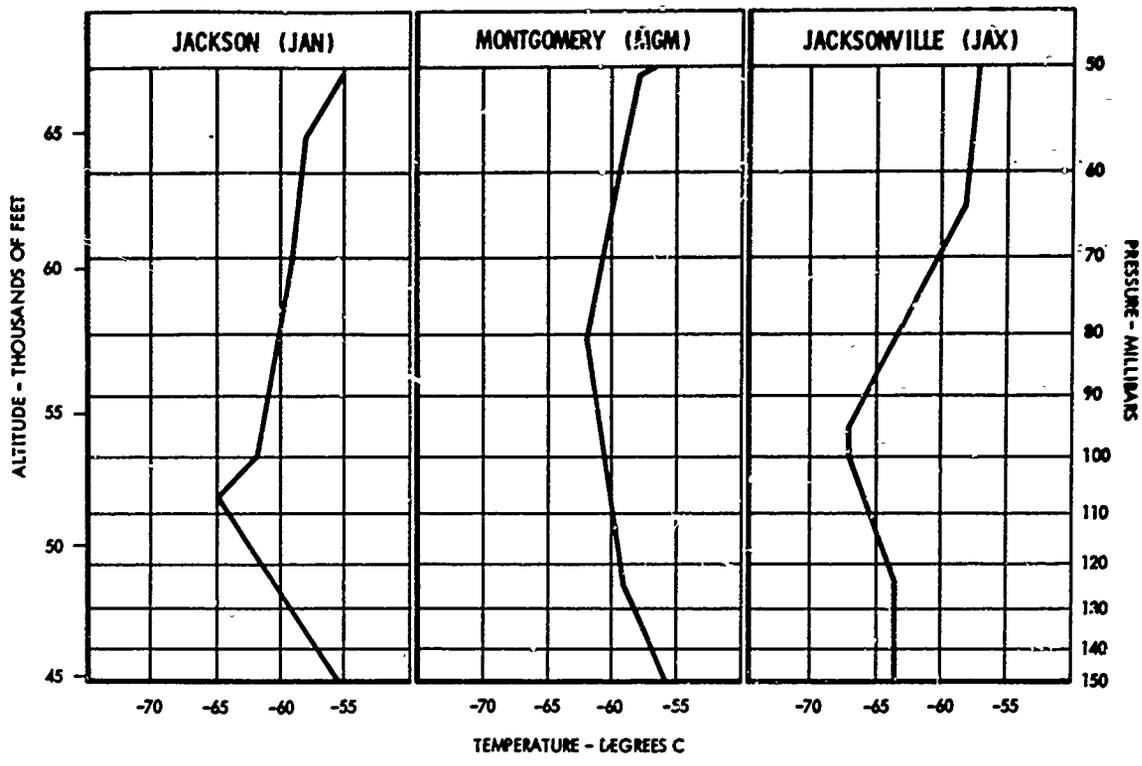
The surface chart for 1800Z, 22 May 1967, showed a closed, 1004 mb, low pressure center positioned over western Florida. The cold front trailed southwestward into the Gulf of Mexico. A warm front extended northeastward across Georgia. Heavy thunderstorm activity was occurring over the extreme southeastern states.

At the 200 mb level (00 Z, 23 May 1967) a deep trough was located over the sampled area with the a: - over the Mississippi-Alabama border.

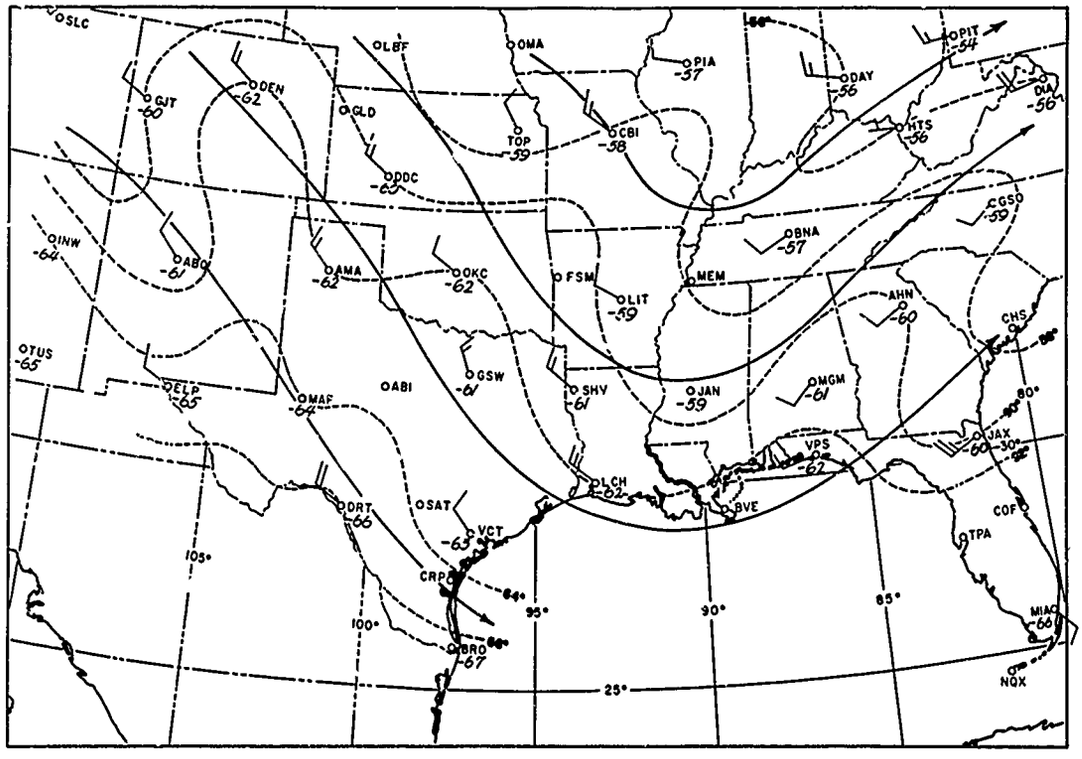
The RAOB chart shows small ver ical temperature gradients and not the type normally associated with the light to moderate turbulence that was detected. It should be noted the time difference between mission and observations was six hours.

The wind flow on the 70 mb analysis shows a distinct cyclonic curvature. Thermal troughs and ridges over the sampled area are apparent.

RAOB CHARTS (0000Z, 23 May 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 23 May 1967)



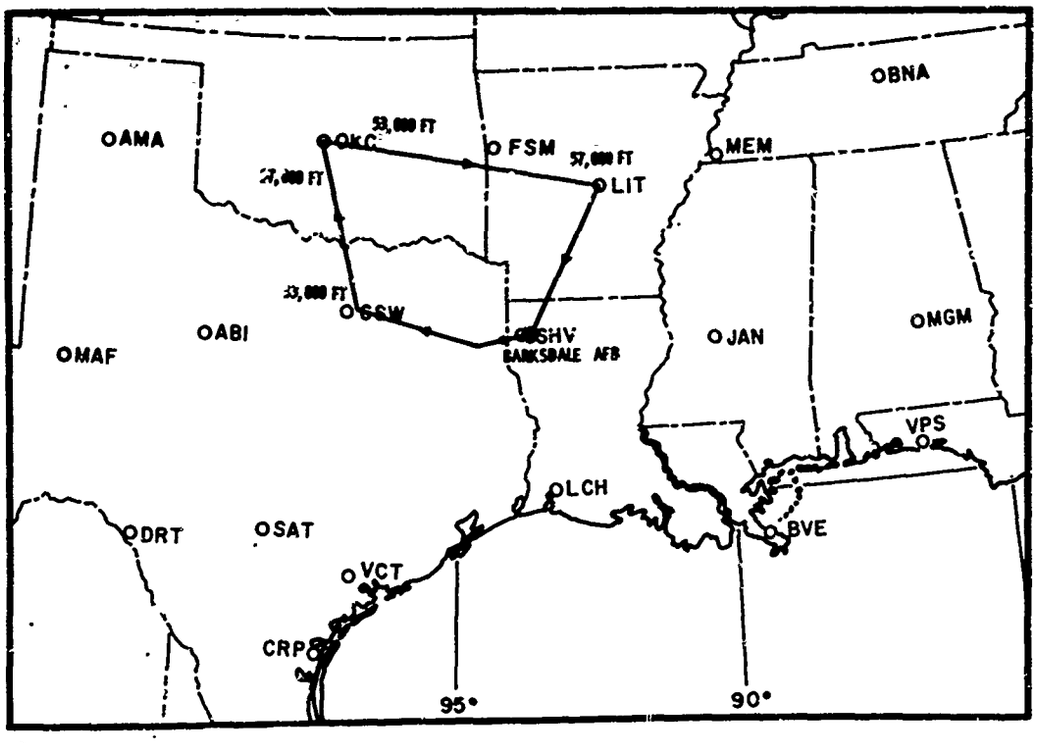
APPENDIX VI

TEST 209

24 May 1967, 1528-1744Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Conditions seemed unfavorable for the production of turbulence on 24 May 1967. This mission, therefore, was planned and flown to verify the absence of CAT.

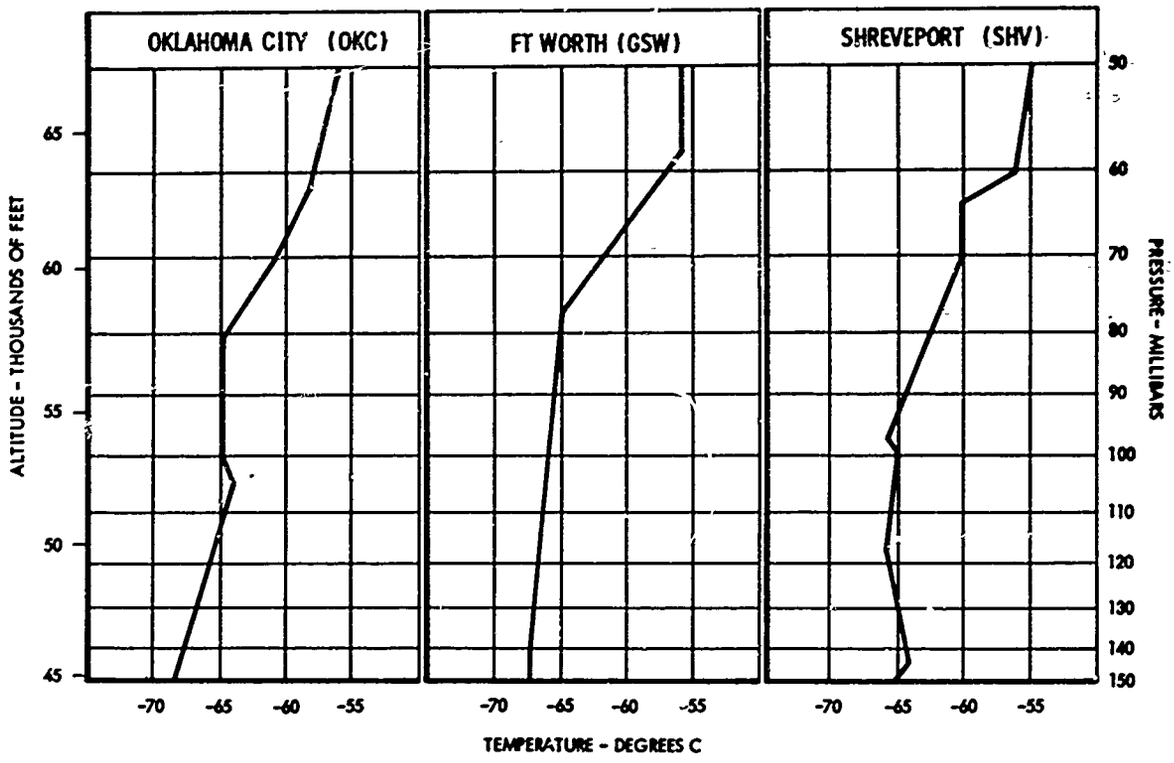
The surface map showed a high pressure area centered over Mississippi and covering the south Central States.

A ridge at the 200 mb level (1200Z) was oriented north-south along the Oklahoma panhandle. A jetstream was located over the Dakotas and to the east.

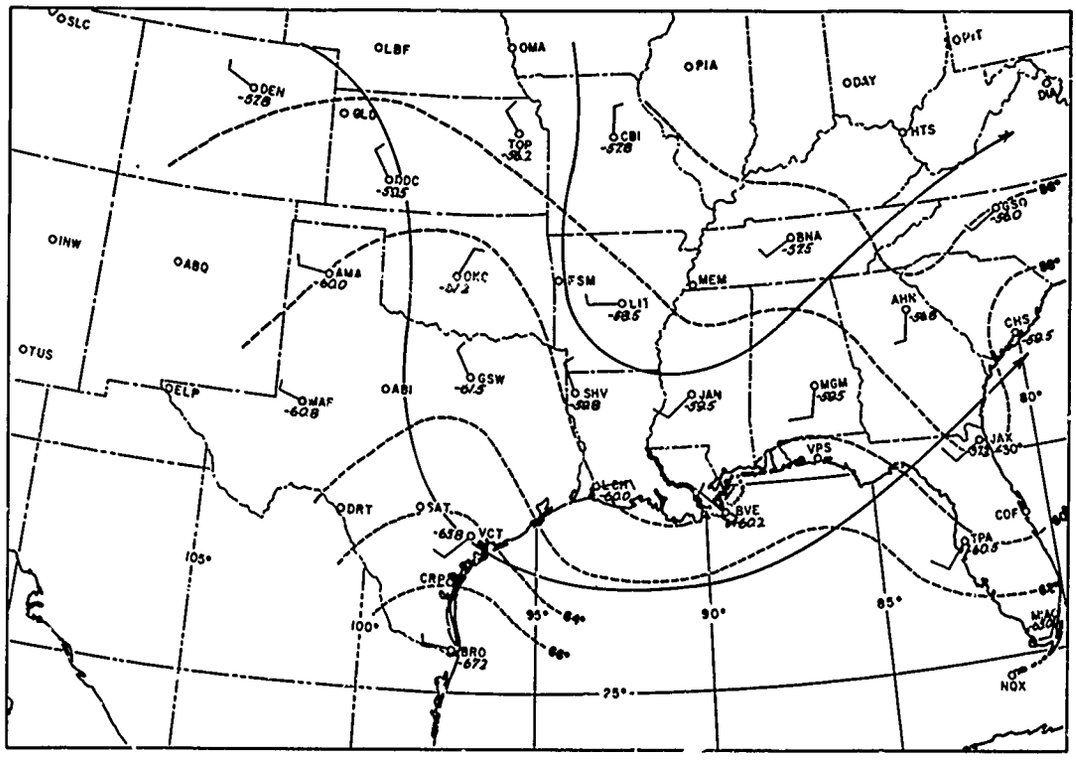
The pilot reported that the flight was perfectly smooth except for a few "ripples" halfway between Dallas, Texas and Oklahoma City, Oklahoma at flight level 53,000 feet. Notice the very small vertical temperature gradient for the OKC sounding in the RAOB chart.

The 70 mb analysis shows that the flight occurred in a thermal ridge at the 70 mb level.

RAOB CHARTS (1200Z, 24 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 24 May 1967)



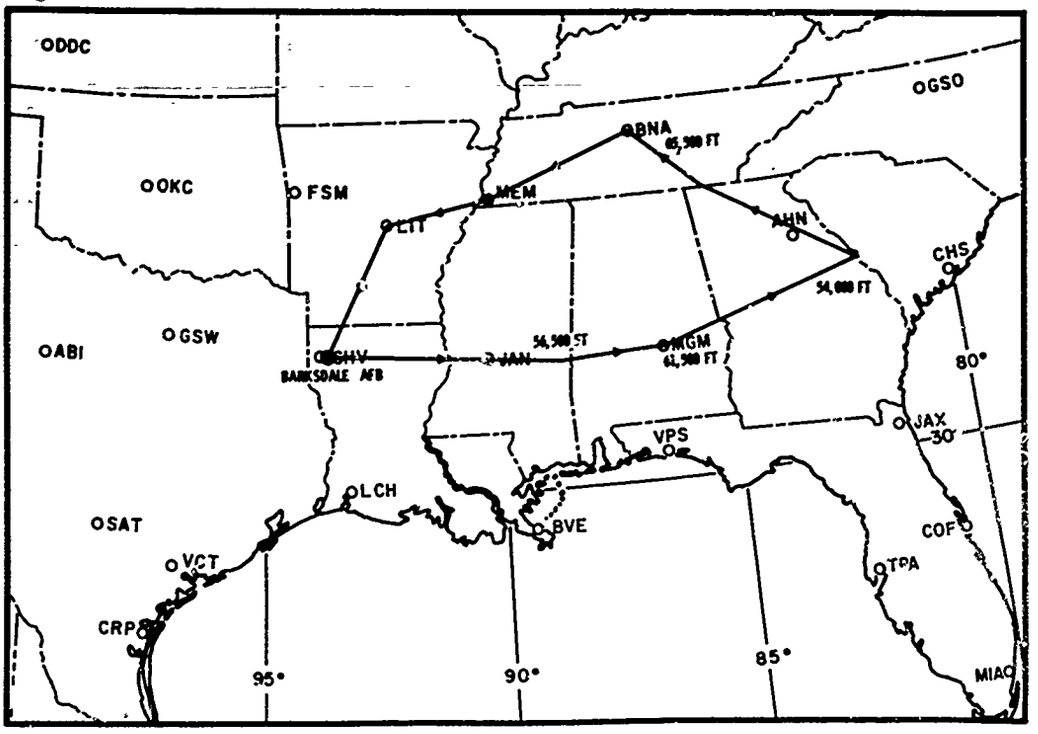
APPENDIX VI

TEST 210

25 May 1967, 1528-1910Z

Barksdale AFB, Shreveport, Louisiana, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

A surface high pressure system prevailed over the area of the route of flight for this date. Weather conditions were good over the operating area.

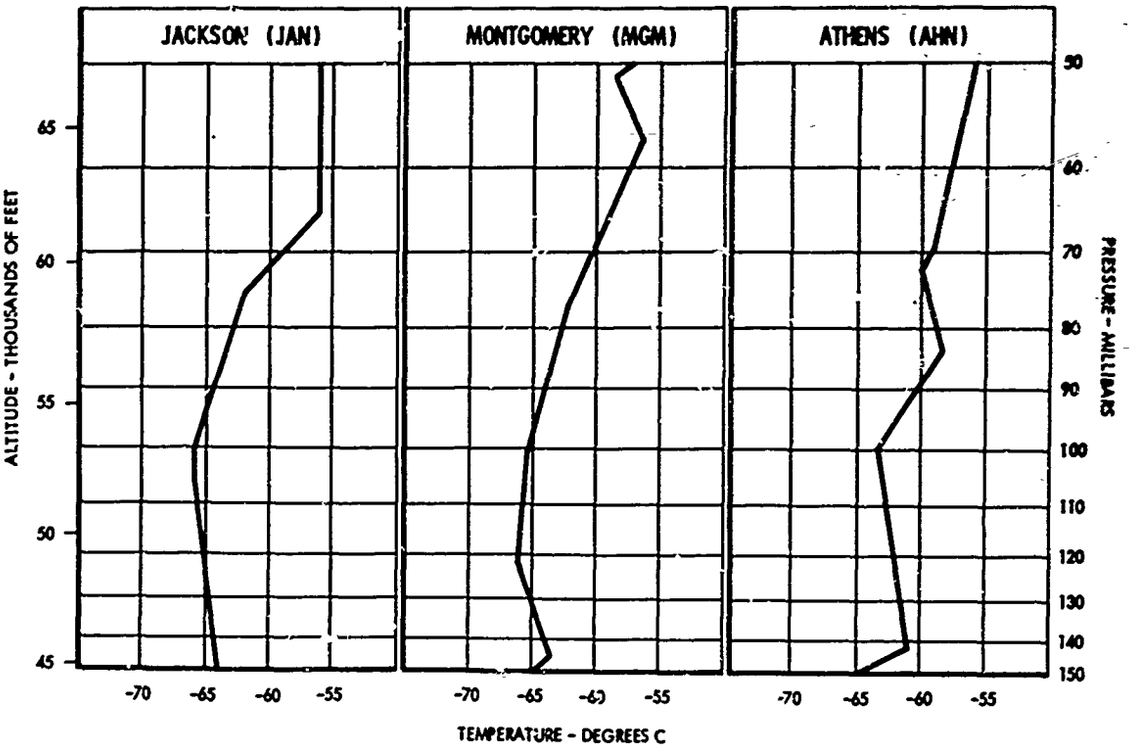
The 1200Z, 200 mb analysis showed a strong ridge with the north-south axis over Oklahoma. A jetstream was positioned over the Great Lakes region and extended southeast to just off the Florida coast.

The pilot reported very light CAT near the eastern extremity of the flight route. No runs were processed.

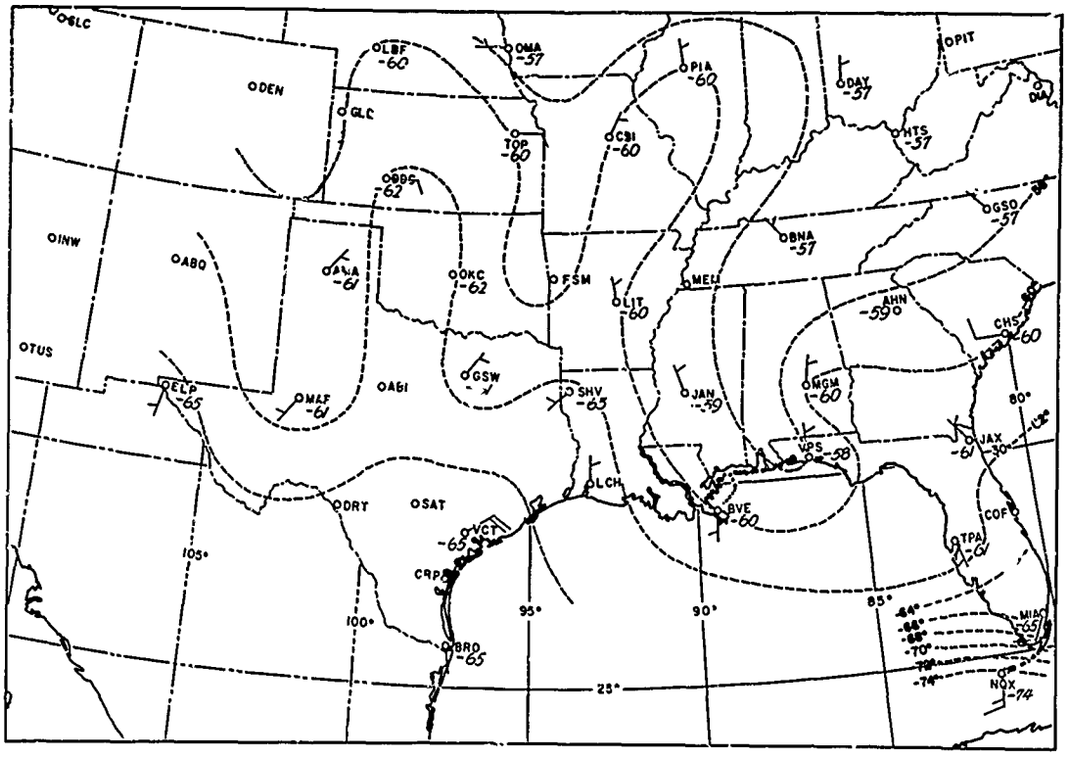
The RAOBs for JAN and MGM present a smooth appearance with small vertical temperature gradient. The RAOB for AHN shows more of a typical waveform and increased vertical temperature gradient. Note also that AHN is very close to the jetstream.

The 70 mb analysis depicts a horizontal waveform of the isotherms. The winds were so light and irregular at the 70 mb level that streamline analysis was not completed.

RAOB CHARTS (1200Z, 25 May 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 25 May 1967)



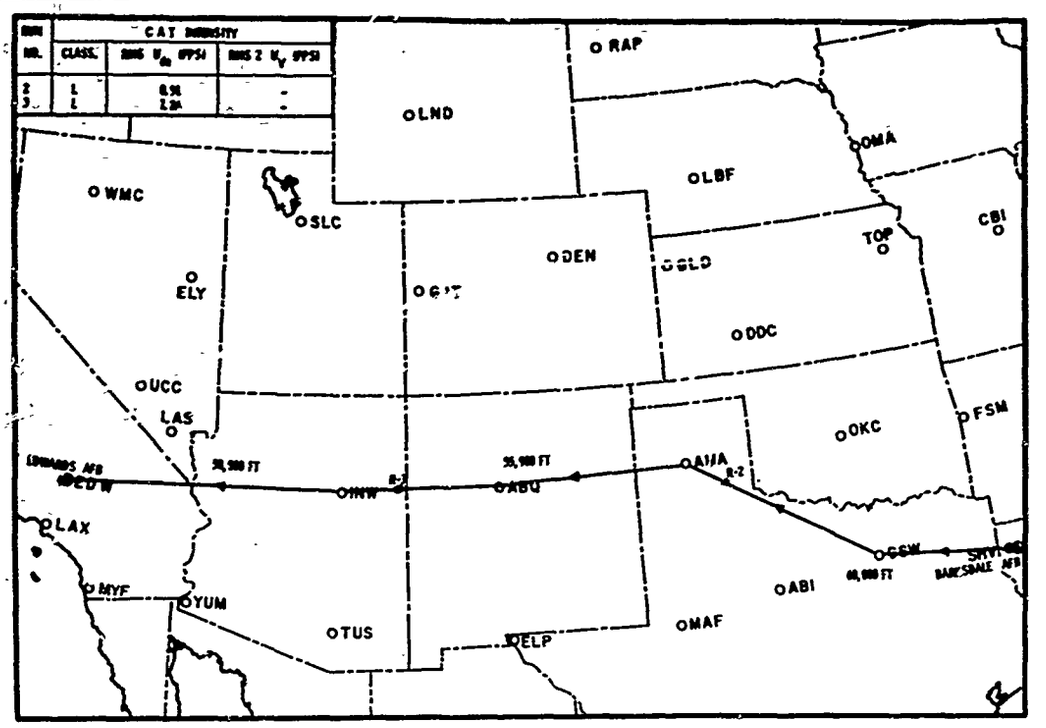
APPENDIX VI

TEST 211

26 May 1967, 1456-1831Z

Ferry flight from Barksdale AFB, Louisiana to Edwards AFB, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

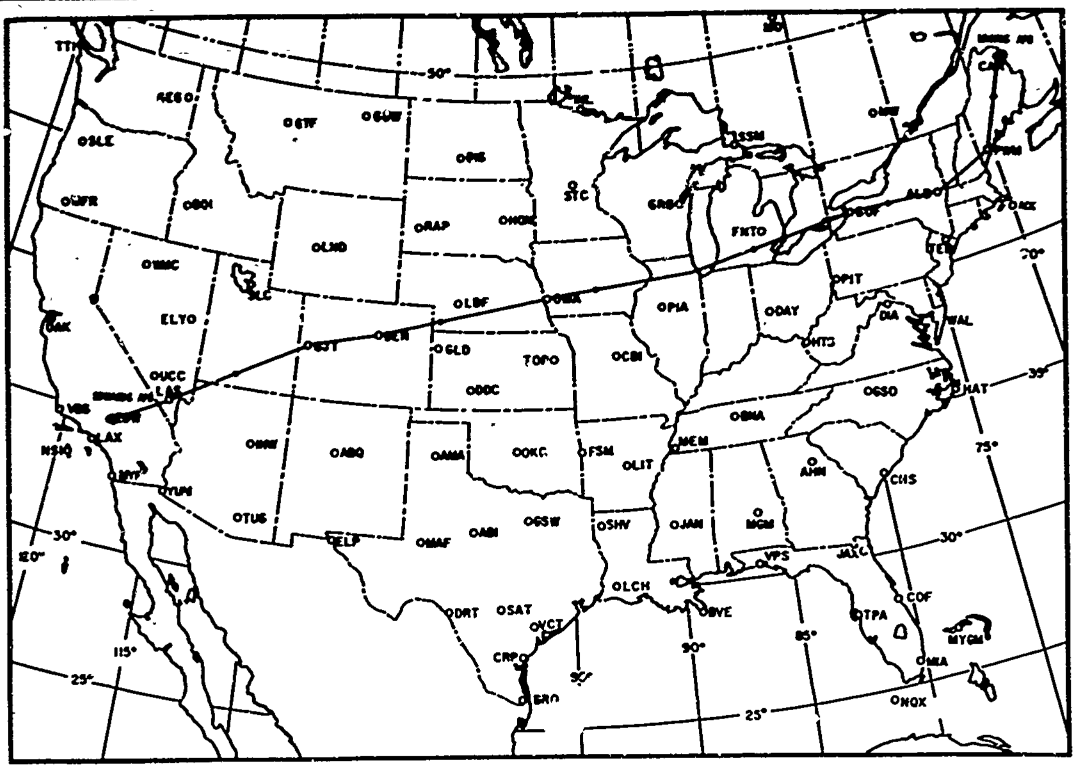
APPENDIX VI

TEST 212

18 June 1967, 1457-2116Z

Ferry flight from Edwards AFB, California to Loring AFB, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

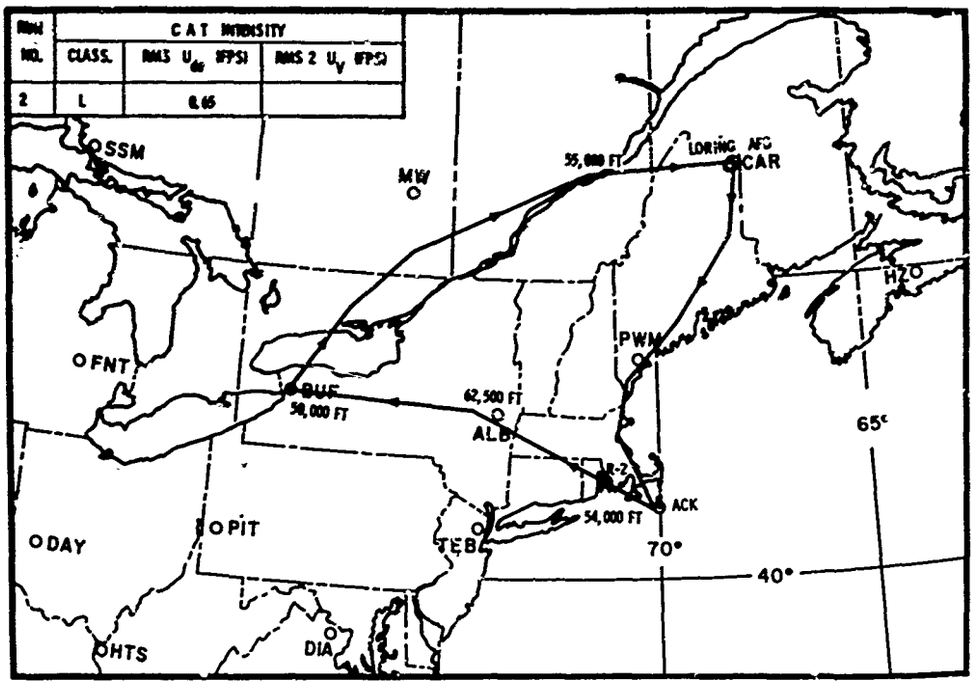
APPENDIX VI

TEST 213

20 June 1967, 1423-1820Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

This flight was the first of ten missions flown from Loring Air Force Base, Maine.

The 1200Z surface analysis for this date showed the flight route to be over a rather weak high pressure ridge lying across the Northeastern States. Aloft the tropopause analysis for the same time showed jetstreams well to the north and south of the sampled area.

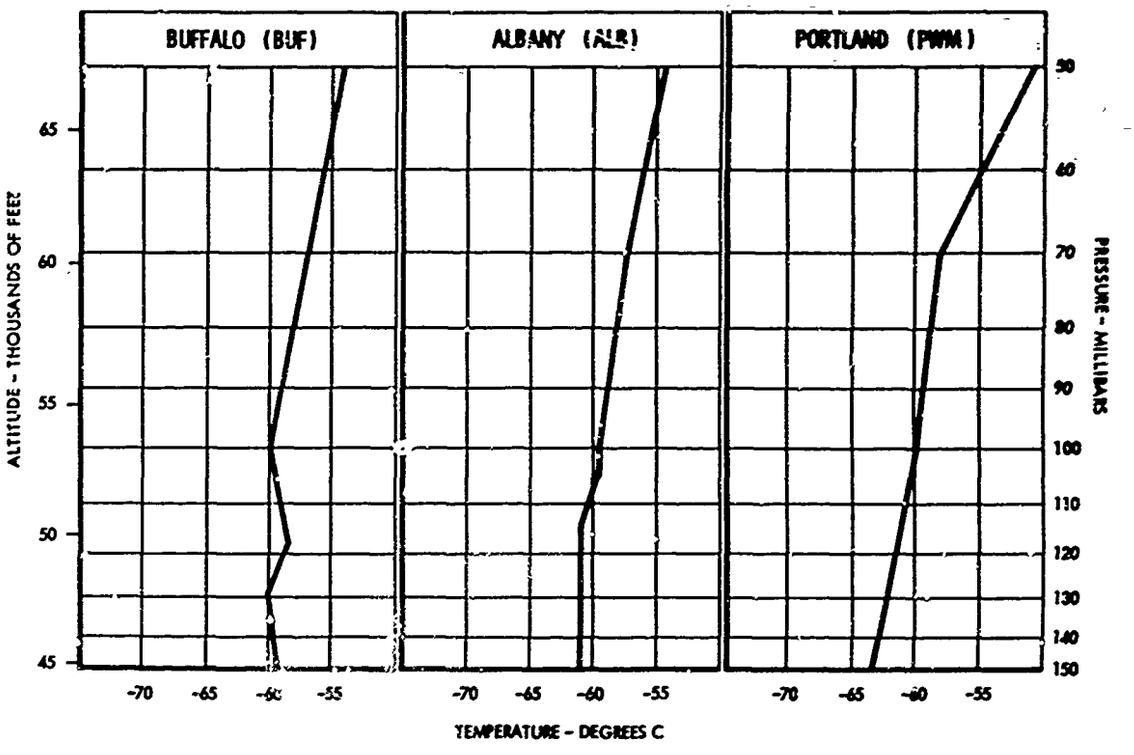
The light CAT (Run 2) that was observed over Rhode Island at 53,000 feet was near the level of a slight vertical temperature change shown on the ALB sounding.

The RAOB chart indicates small vertical temperature gradient.

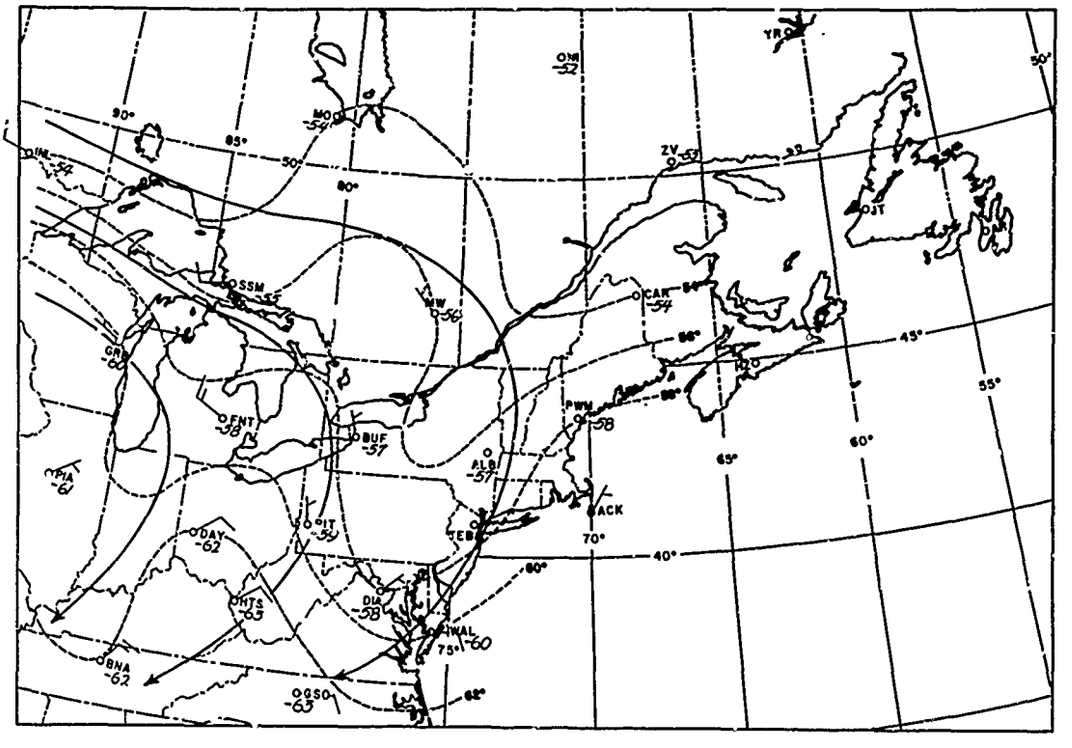
A pronounced anticyclonic curvature of the wind flow can be seen on the 70 mb analysis. A well defined thermal trough is evident over Virginia, Pennsylvania, and New York. The horizontal temperature gradient is small (~1°C/100 nm) over the sampled area.

APPENDIX VI

RAOB CHARTS (1200Z, 20 Jun 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 20 Jun 1967)



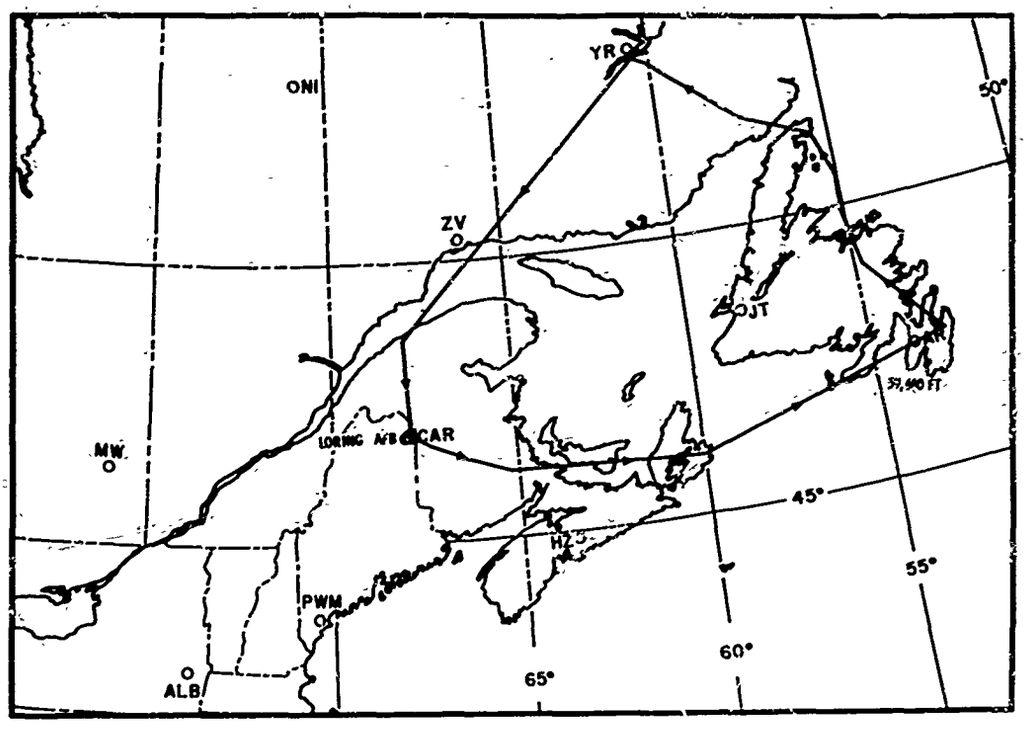
APPENDIX VI

TEST 214

22 June 1967, 1429-1905Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At 1800Z, 22 June 1967, a small surface low pressure center was situated near Quebec City, Canada. From this point a cold front trailed southwestward through Pennsylvania and a weak warm front extended to the northeast. Cloudy skies with light continuous rain and drizzle prevailed over the New England States and the flight route area.

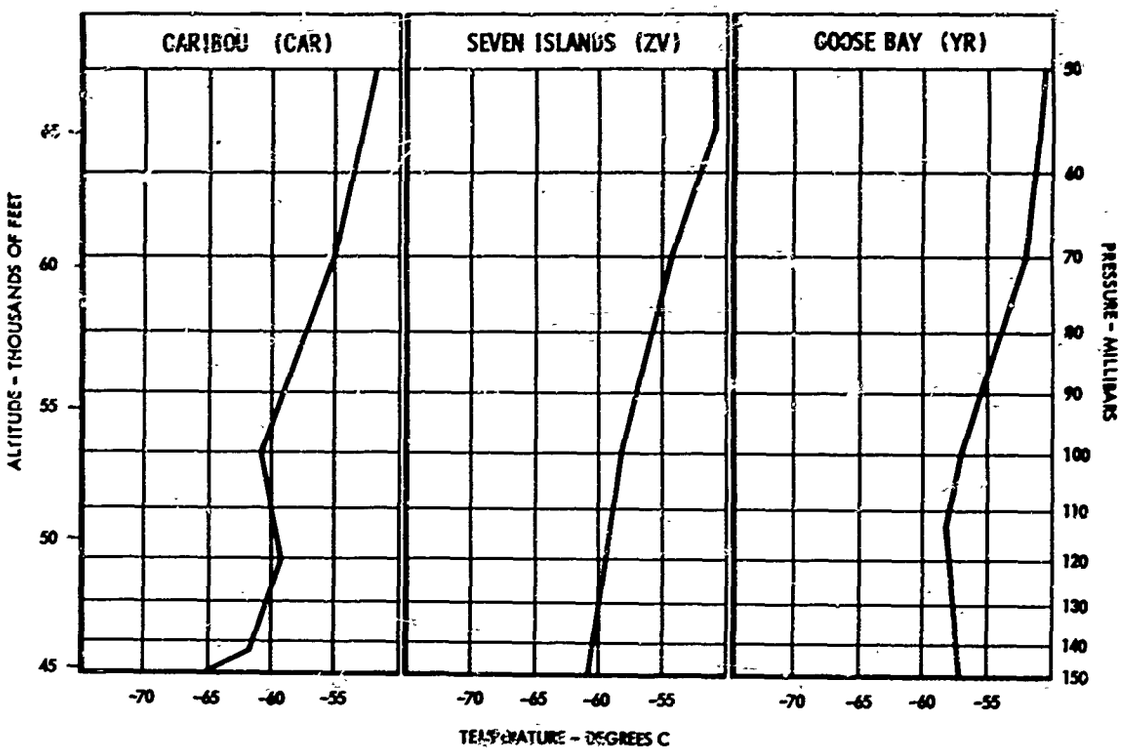
At the 200 mb level, the 1200Z analysis showed a weak jetstream (80 knots) oriented southwest-northeast passing over Lake Ontario.

The pilot reported two very light patches of turbulence. No runs were processed.

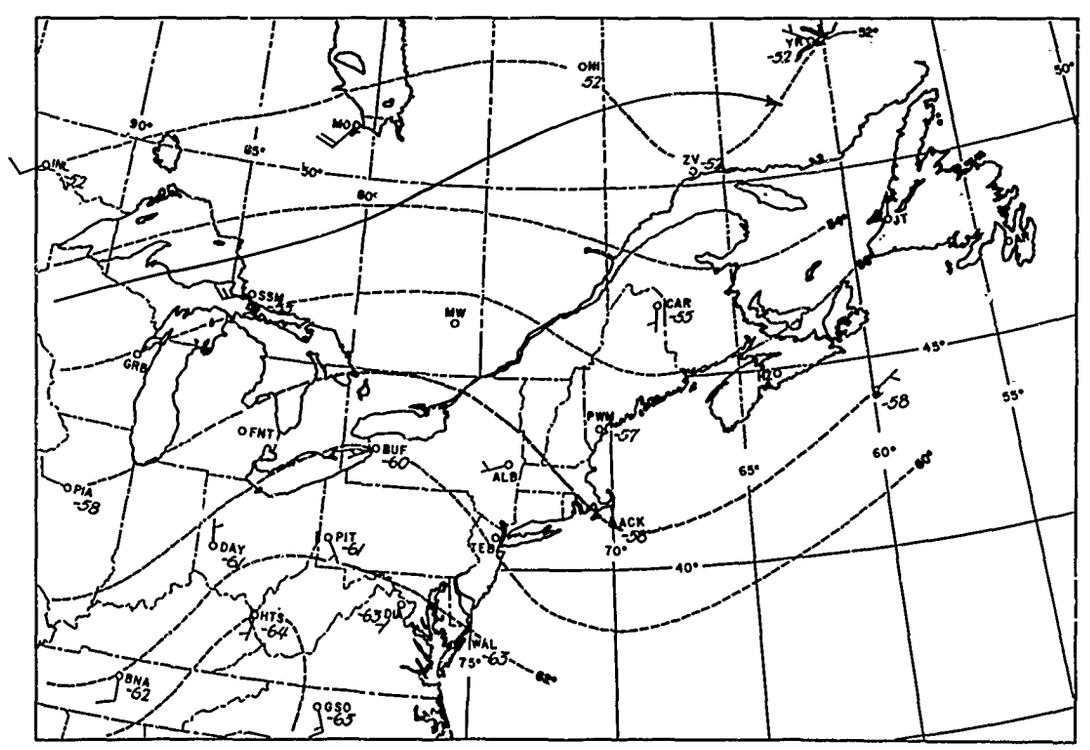
The RAOB chart shows very small vertical temperature gradients for ZV and YR. Between 45,000 and 49,000 feet over CAR a gradient of 6° can be seen. The very light CAT was near 50,000 just to the north of CAR.

The 70 mb analysis depicts very light winds and small horizontal temperature gradients at the 70 mb level over the sampled area.

RAOB CHARTS (1200Z, 22 Jun 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 22 Jun 1967)



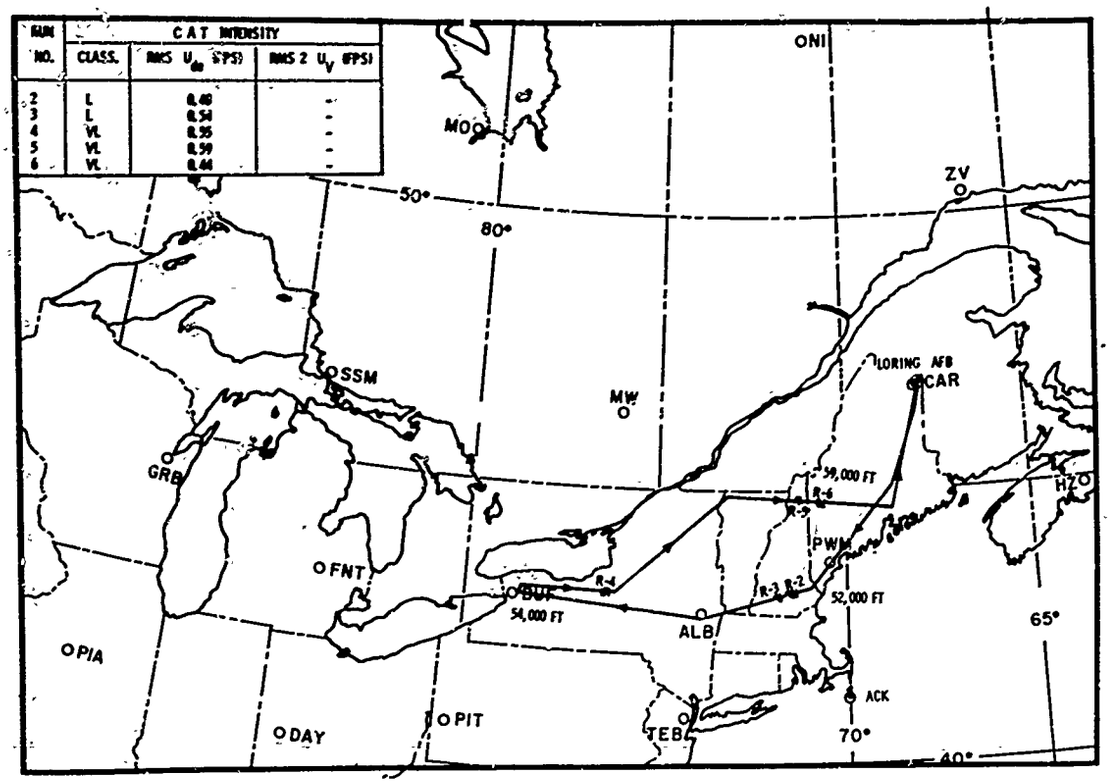
APPENDIX VI

TEST 215

23 June 1967, 1432-1807Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The 1800Z surface chart for 23 June 1967 showed a cold front over Pennsylvania extending northeastward through New Hampshire and along the western border of Maine.

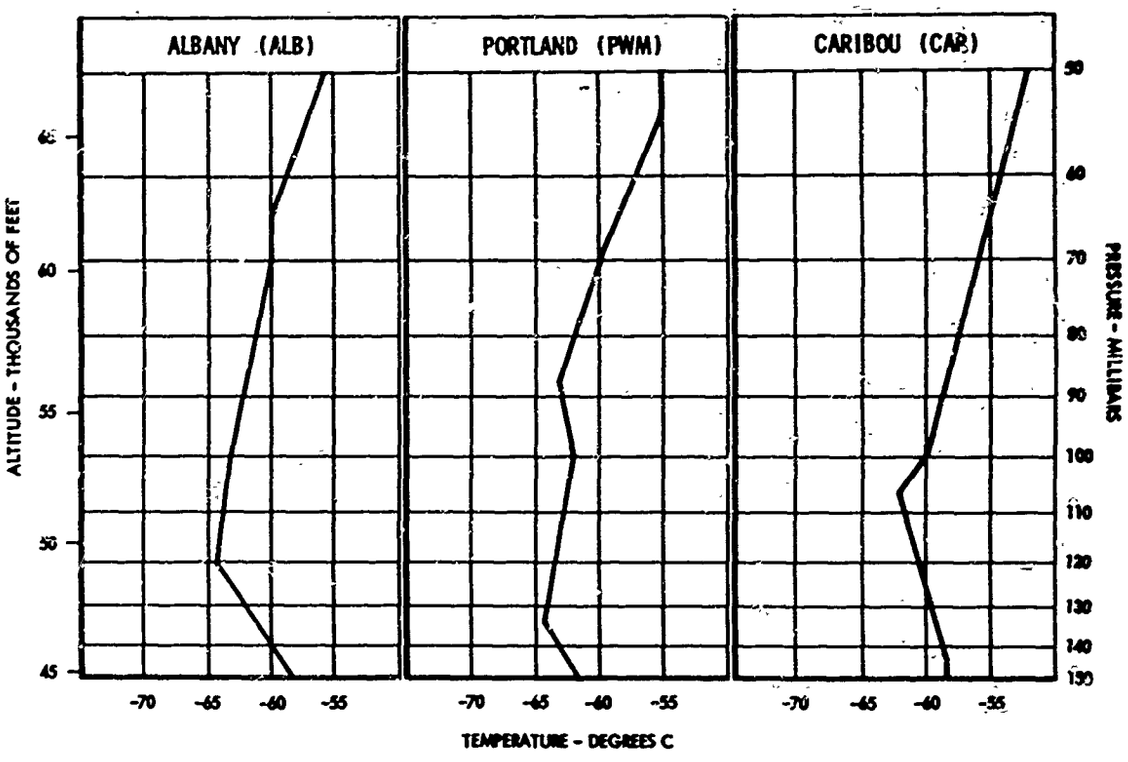
Wind flow at the 200 mb level was southwesterly, with a wide band of winds of about 50 knots, across the flight track area.

The pilot reported an extensive area of light to very light CAT at 54,000-56,000 feet mostly over New York state. Also some very light CAT over northern Vermont and New Hampshire at 52,000 and 59,000 feet. Runs 2 through 7 were processed for this test.

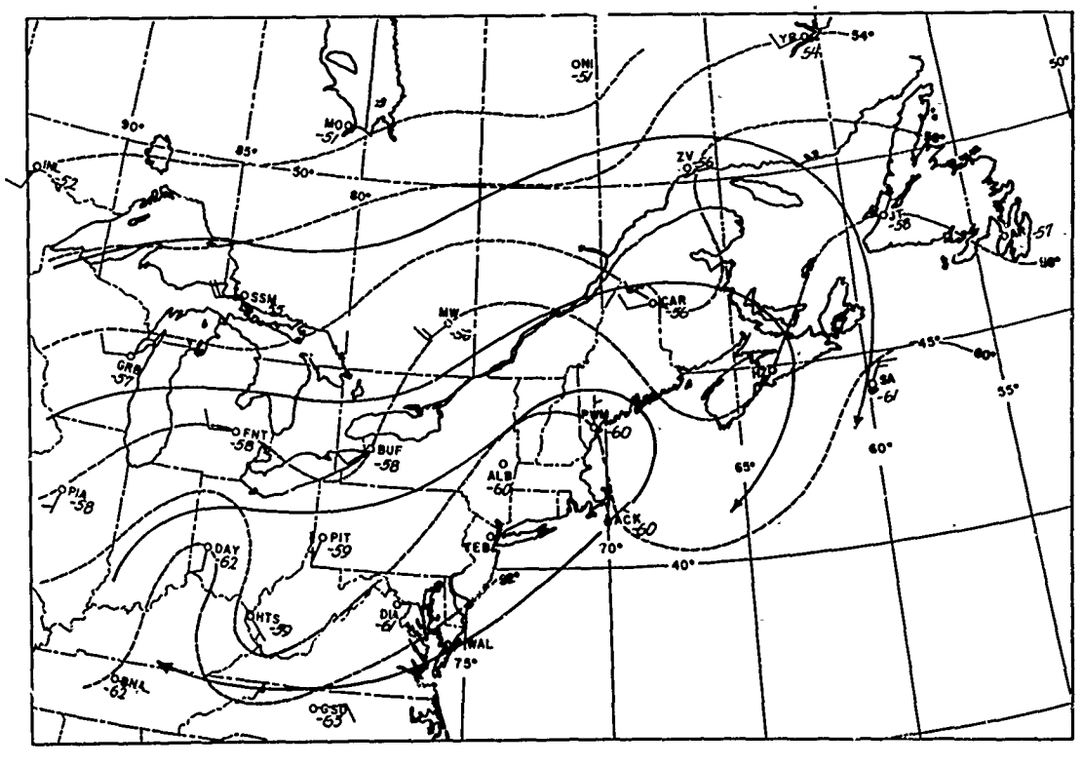
The RAOB chart shows vertical temperature gradient changes at 52,000 feet and 56,000 feet over PWM. ALB has gradient change at about 49,000 feet.

The 70 mb analysis for 1200Z depicts the thermal trough located along a line from HTS to Lake Erie. Six hours after the time of the 70 mb analysis the thermal trough would have been over the area where the light CAT was detected.

RAOB CHARTS (1200Z, 23 Jun 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 23 Jun 1967)



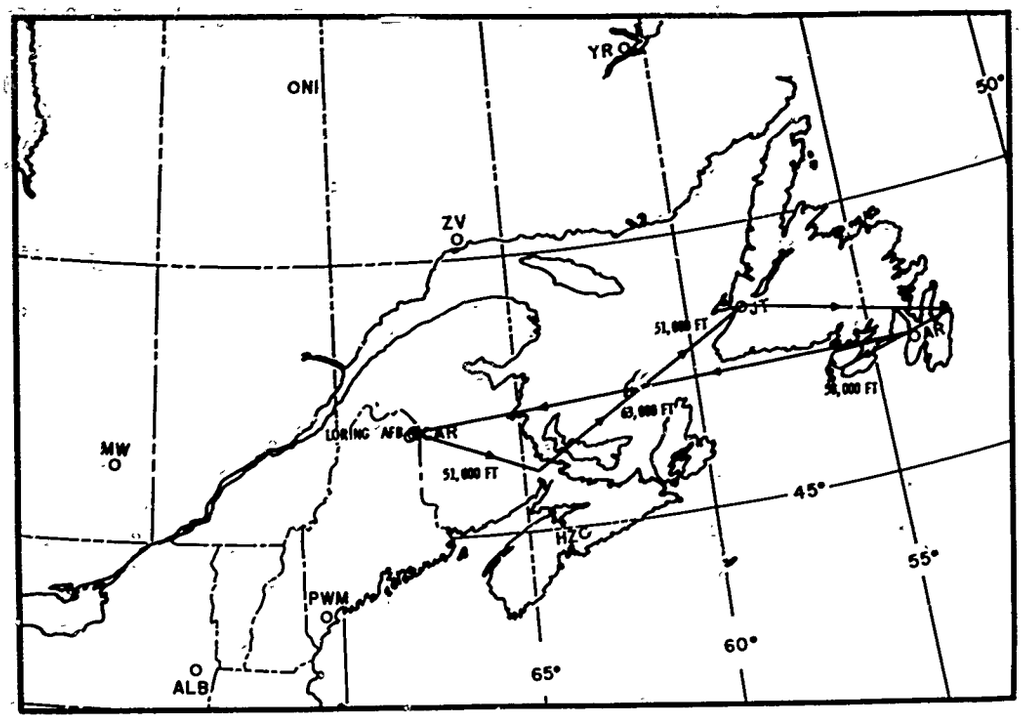
APPENDIX VI

TEST 216

27 June 1967, 1448-1913Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The 1800Z surface chart for 27 June 1967 had a high pressure system centered over Pennsylvania and prevailing over all of the Northeastern States.

At the 200 mb level a shallow trough was positioned along the 60°W meridian. Winds at this level over the sampled area were westerly and light (20-40 knots).

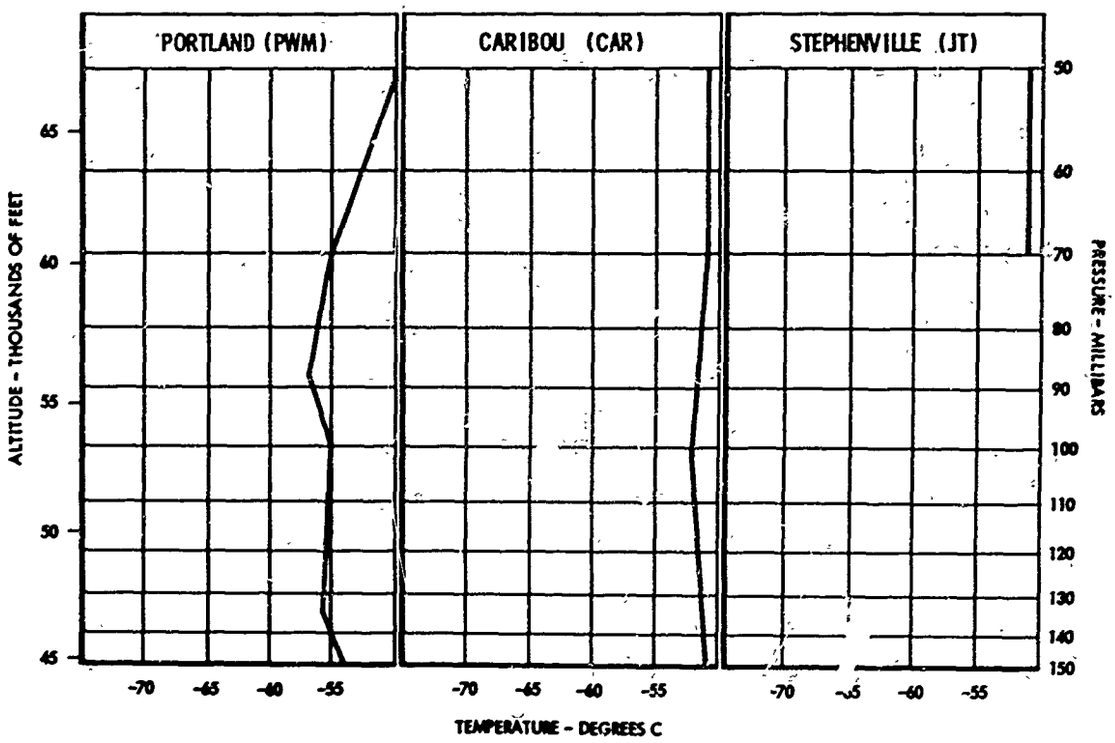
The pilot reported a few patches of very light CAT. No runs were processed from the flight.

The RAOB chart shows that the vertical temperature gradients were very small over CAR and a portion of JT.

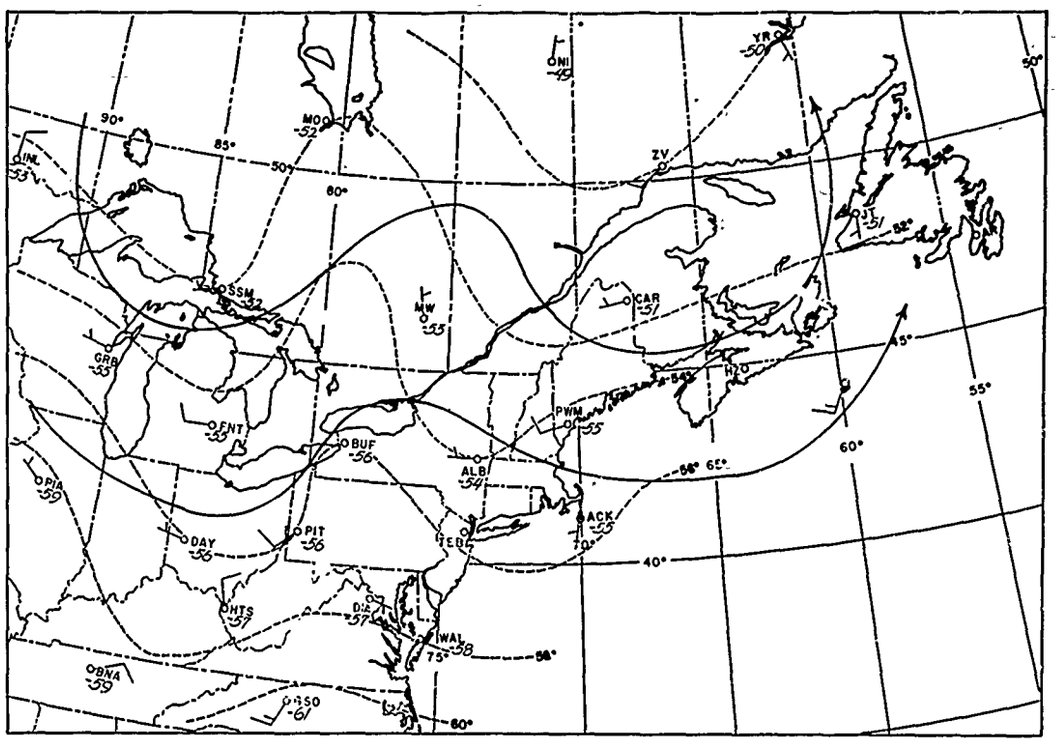
The 70 mb analysis shows light winds, 5-10 knots and small horizontal temperature gradients (~1°C/150 nm) over the flight track area.

APPENDIX VI

RAOB CHARTS (1200Z, 27 Jun 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 27 Jun 1967)



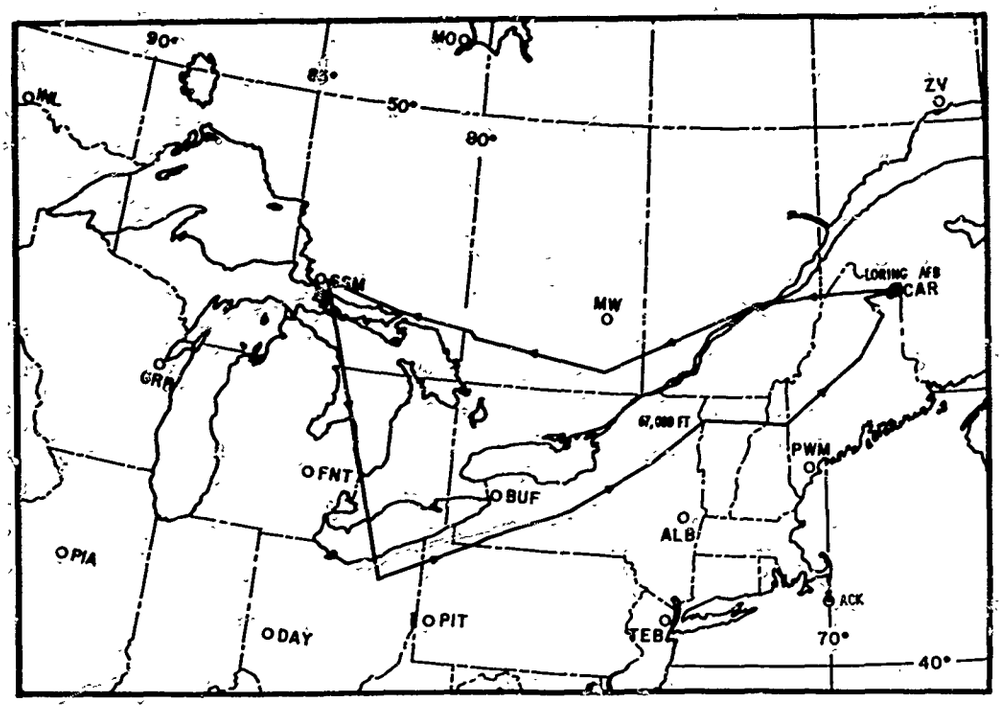
APPENDIX VI

TEST 217

29 June 1967, 1420-1918Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At 1800Z, 29 June 1967, the surface chart showed a low pressure system centered over Lake Huron. Extensive cloudiness, drizzle, and light rain prevailed over the eastern Great Lakes region.

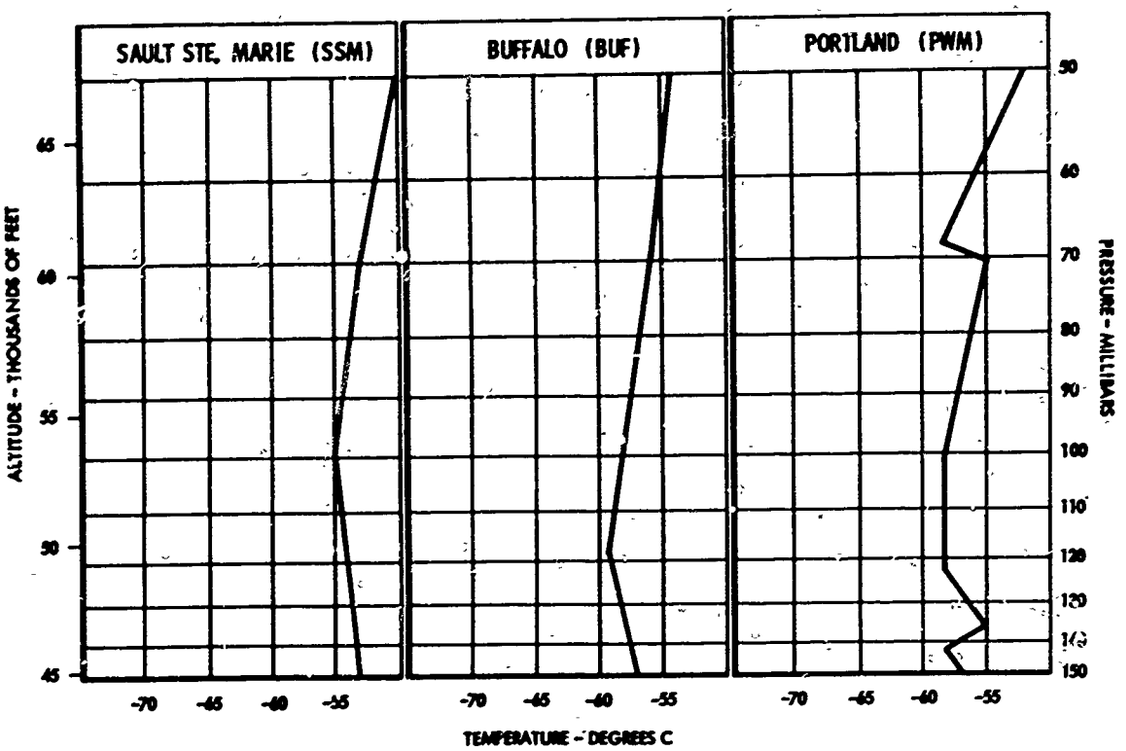
At the 200 mb level a wide but dynamically weak trough was located near vertically above the surface system. Winds were west-northwest at 20-30 knots.

The pilot reported a very smooth flight over the entire route.

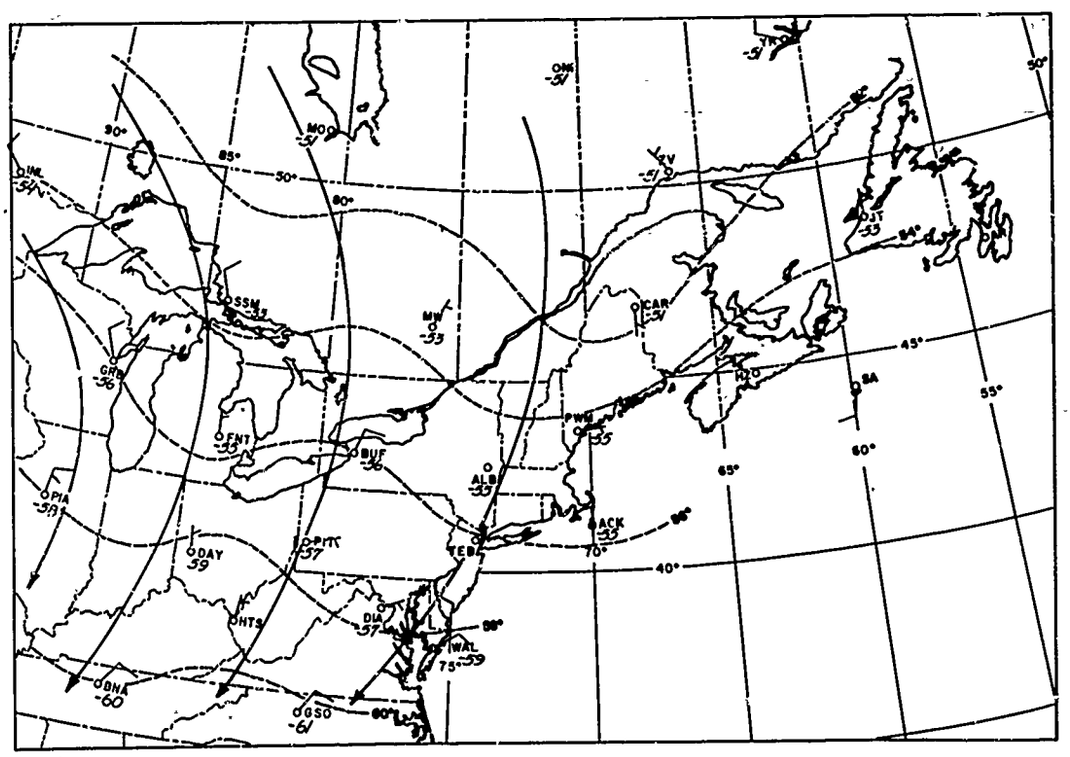
Notice the extremely small vertical temperature gradients in the RAOB chart over SSM and BUF. Over PWM vertical temperature gradient changes are apparent near 140 mb and 70 mb. It is probable that some turbulence would have been detected if that area had been sampled.

The 70 mb analysis shows rather uniform troughs and ridges as indicated by the isotherms. Notice winds were light northerly and curving anticyclonically.

RAOB CHARTS (1200Z, 29 Jun 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 29 Jun 1967)



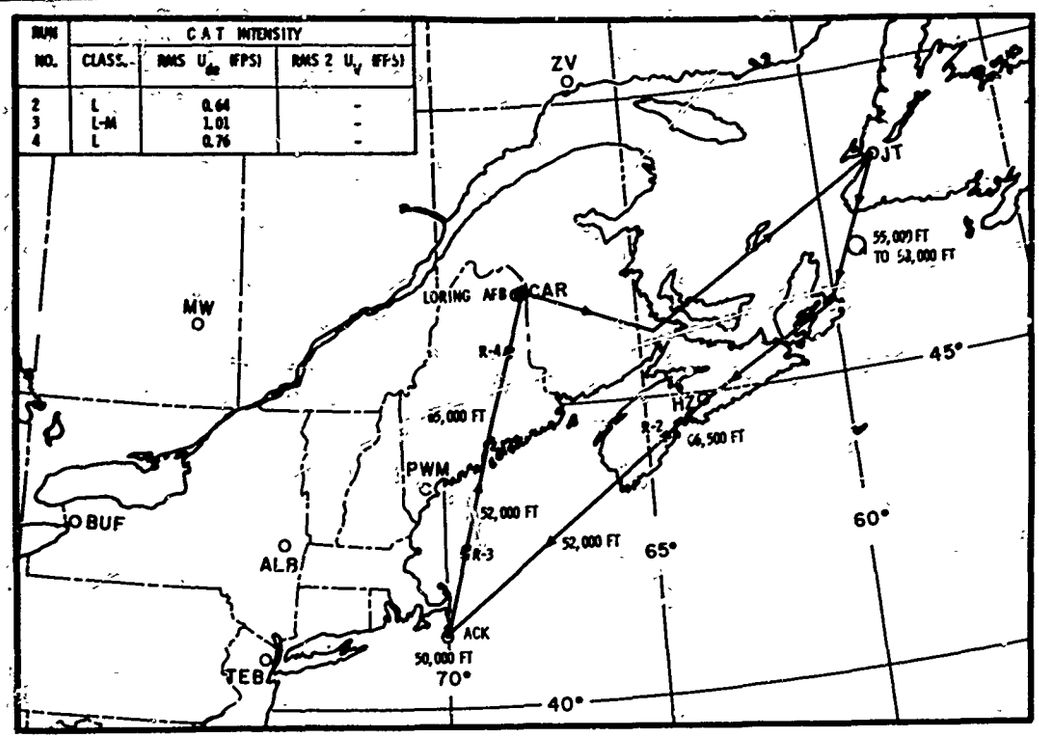
APPENDIX VI

TEST 219

5 July 1967, 1440-1904Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

A surface low pressure system was centered over Cape Cod, Massachusetts, at 1200Z, 5 July 1967. The cold and warm fronts extending from the center had just begun to occlude, and the system was producing considerable weather over the New England States.

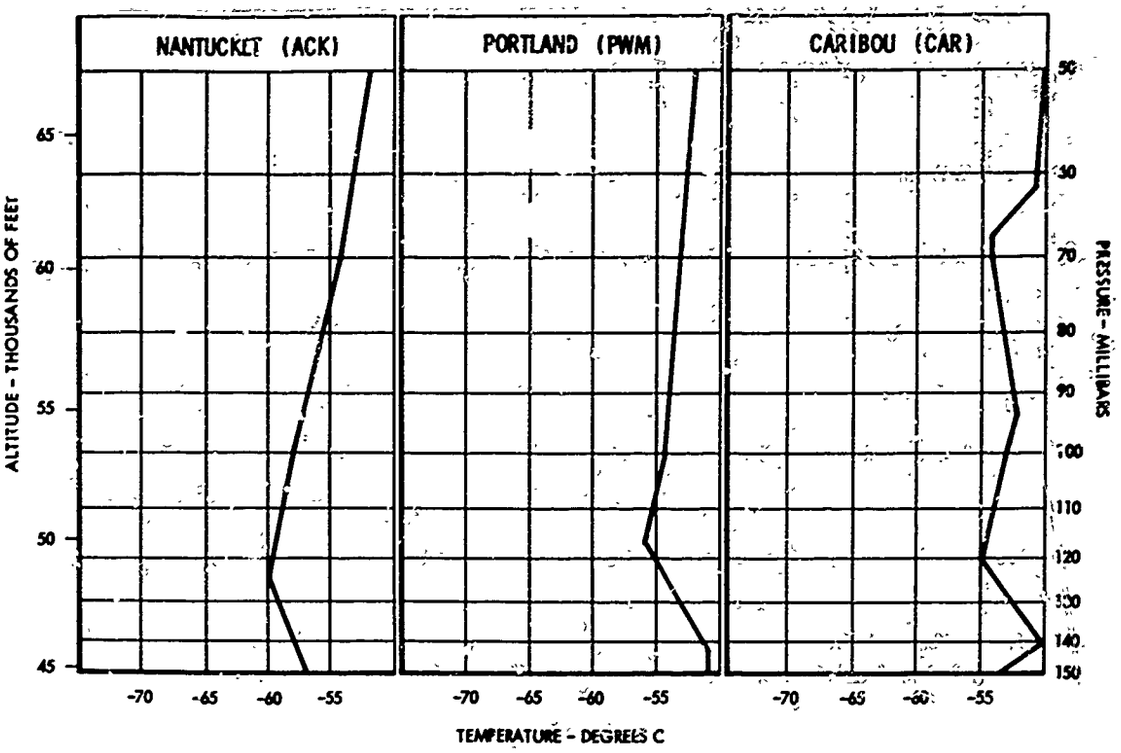
At the 500 mb to 200 mb levels, the well defined associated troughs were aligned near the 80°W meridian to the west of the surface low.

The pilot reported some very light CAT 50 nm south of JT and abundant CAT over the area between ACK and PWM. Run 3 indicates light to moderate CAT was encountered.

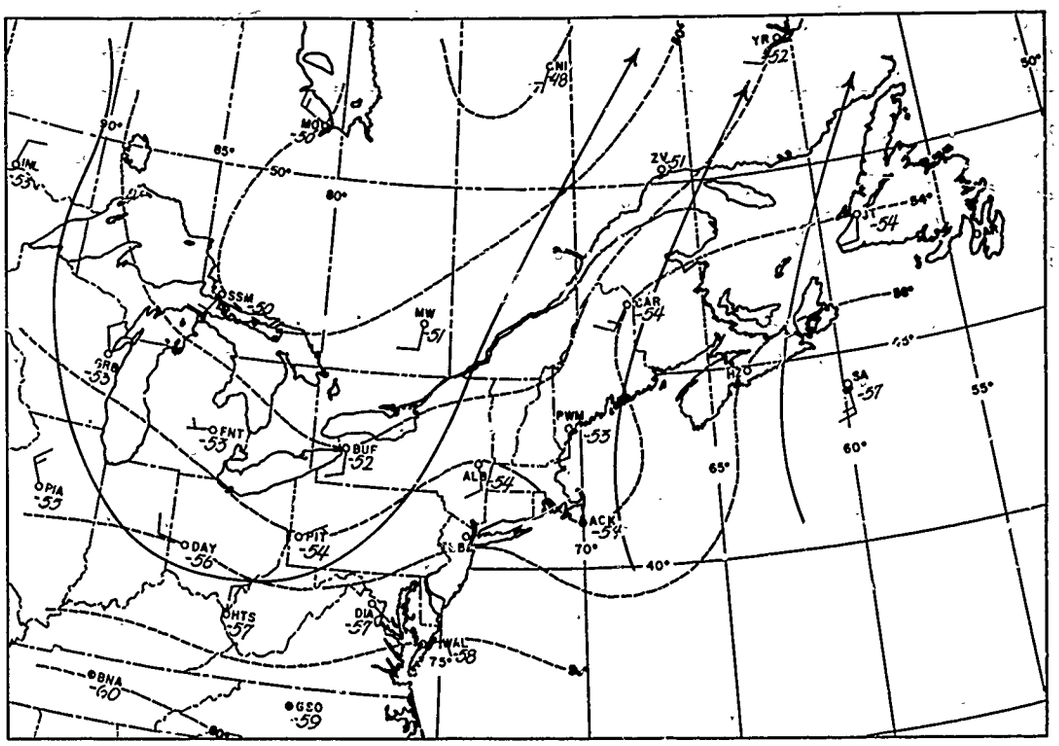
The RAOB chart shows vertical temperature changes near 48,000 feet over ACK and 50,000 feet over PWM.

The winds and temperature chart shows the CAT occurred in a rather sharply defined thermal trough over ACK and PWM.

RAOB CHARTS (1200Z, 5 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 5 Jul 1967)



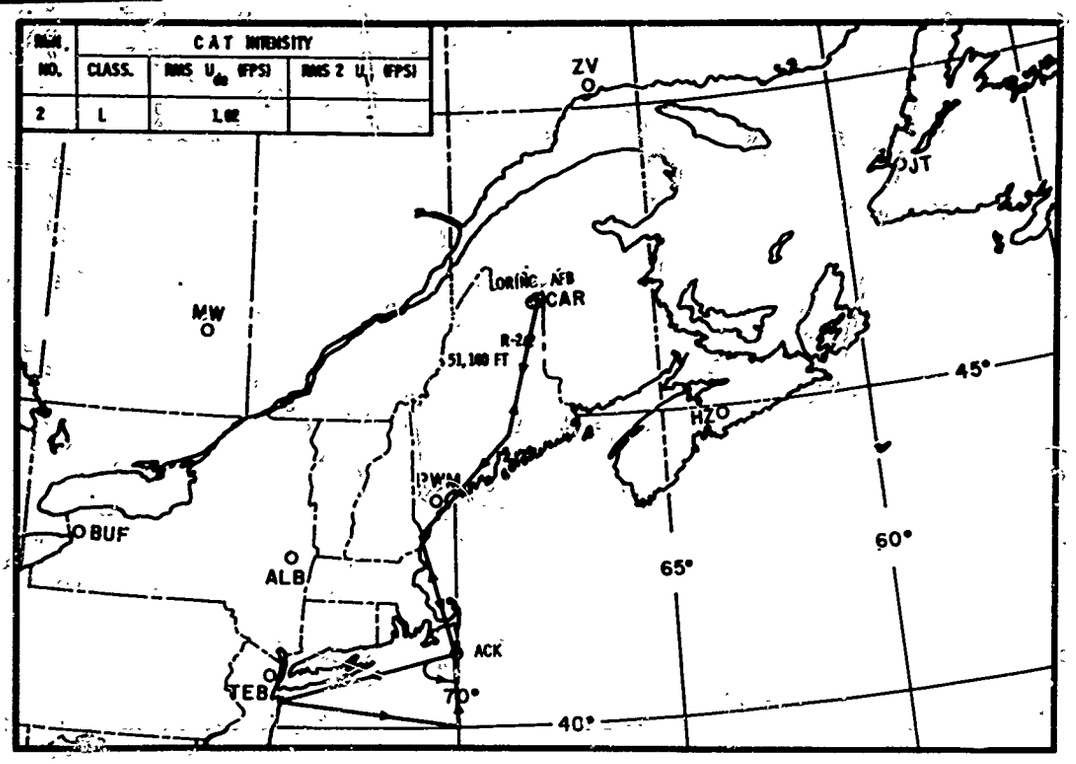
APPENDIX VI

TEST 221

7 July 1967, 1355-1740Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



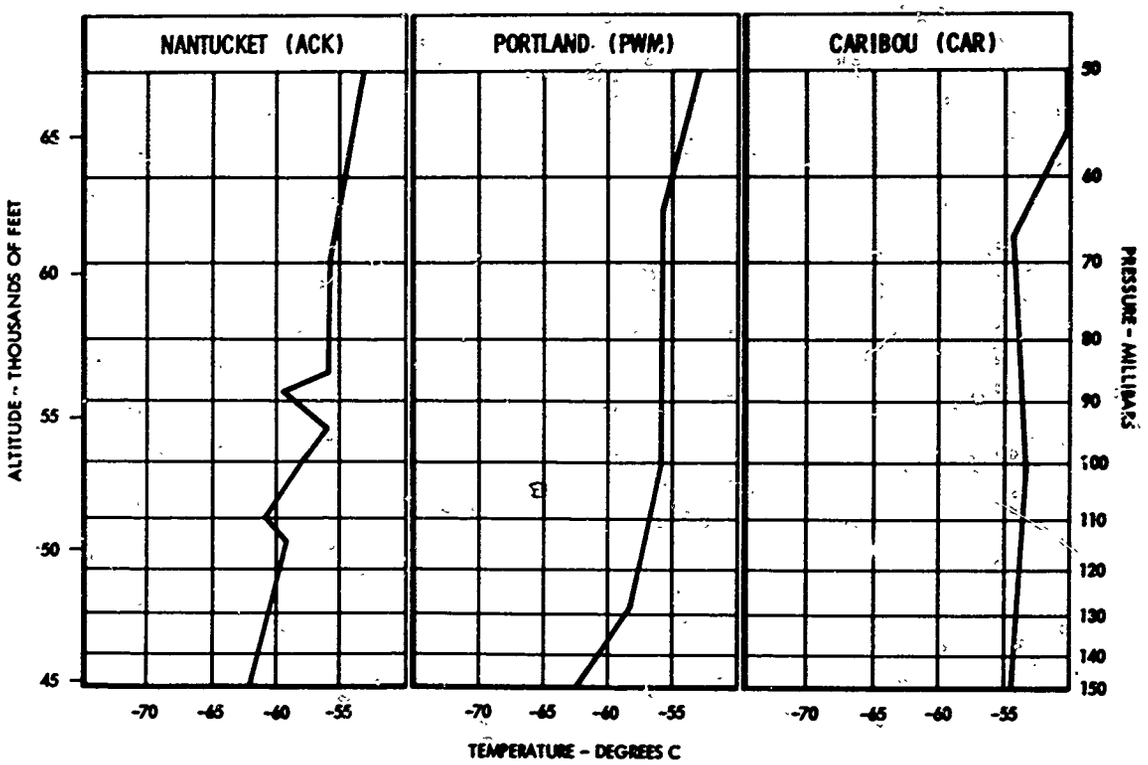
FLIGHT SUMMARY

The flight route on this date was over a surface high pressure system centered over Philadelphia, Pennsylvania. Weather conditions were generally good with clear to scattered skies. Aloft a low pressure trough was located over Newfoundland and a ridge over the New England States.

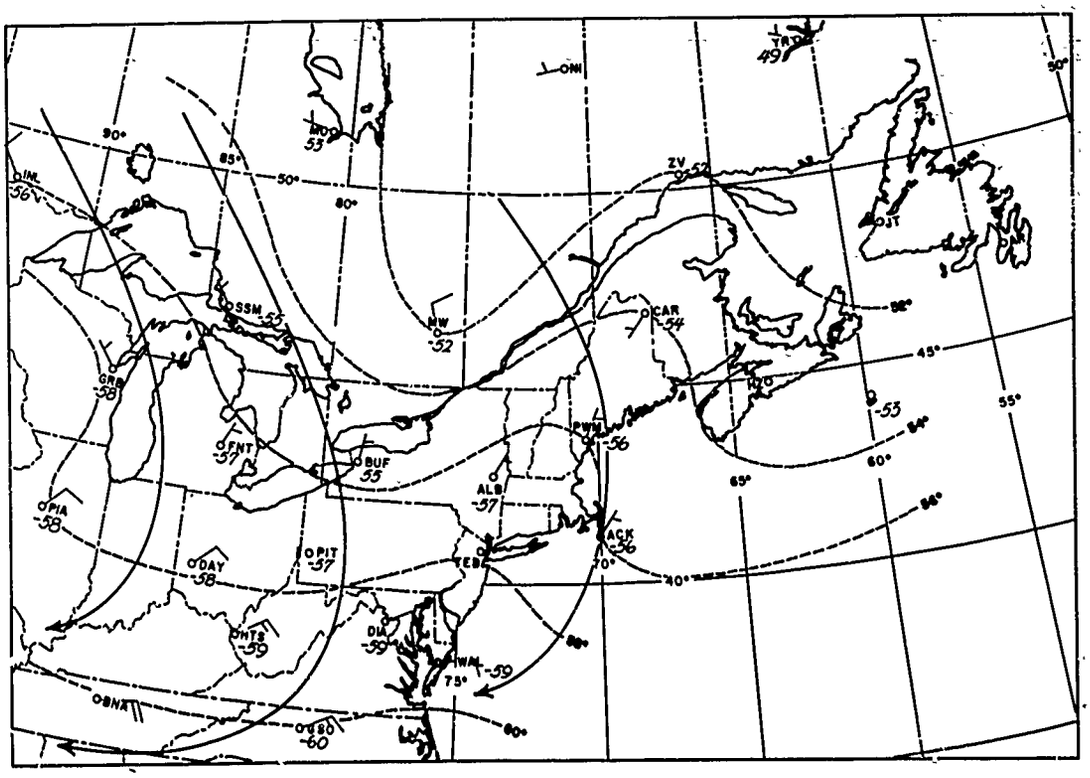
The pilot reported light CAT over the ACK; however, no runs were processed. On the RAOB chart the vertical temperature gradient over ACK shows evidence of wave motion from 50,000-56,000 feet.

The 70 mb analysis indicates ACK was in an area of a thermal trough with anticyclonic wind flow.

RAOB CHARTS (1200Z, 7 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 7 Jul 1967)



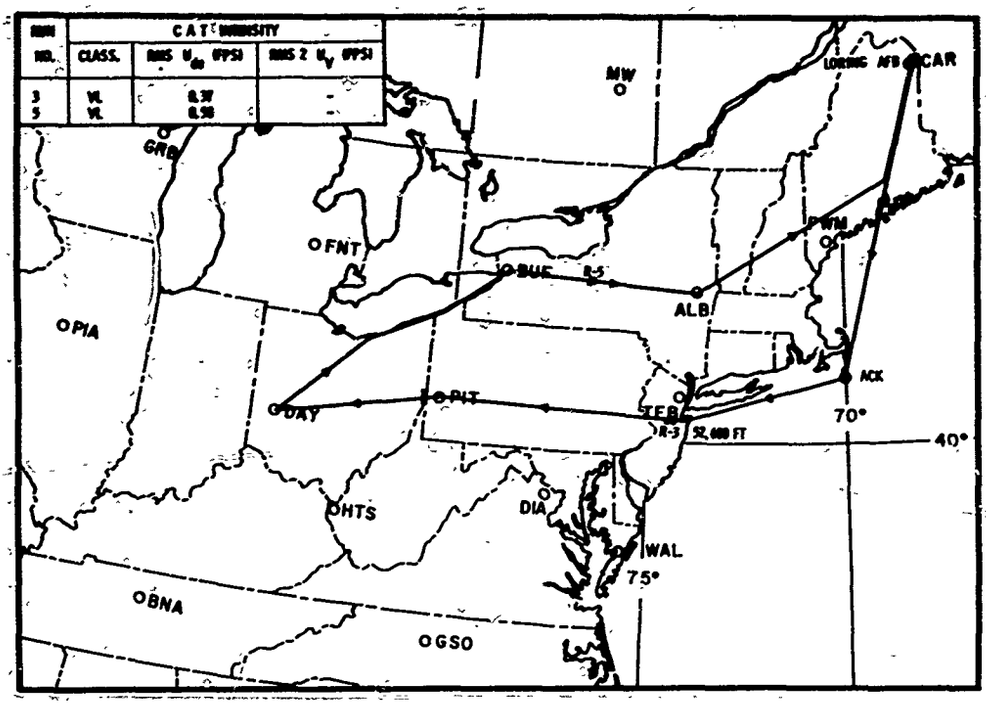
APPENDIX VI

TEST 222

14 July 1967, 1359-1959Z

Loring AFB, Limestone, Maine, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

On the 1200Z, 14 July 1967, surface chart, a front extended from near DIA to PWM and east-northeast toward HZO. Cloudy skies, rain and some thunderstorm activity prevailed along the frontal zone. Aloft, the tropopause analysis showed a jetstream paralleling and slightly to the west of the position of the surface front. The upper trough was positioned over a line from Lake Huron to Kentucky. Maximum winds were about 120 knots at 35,000 feet.

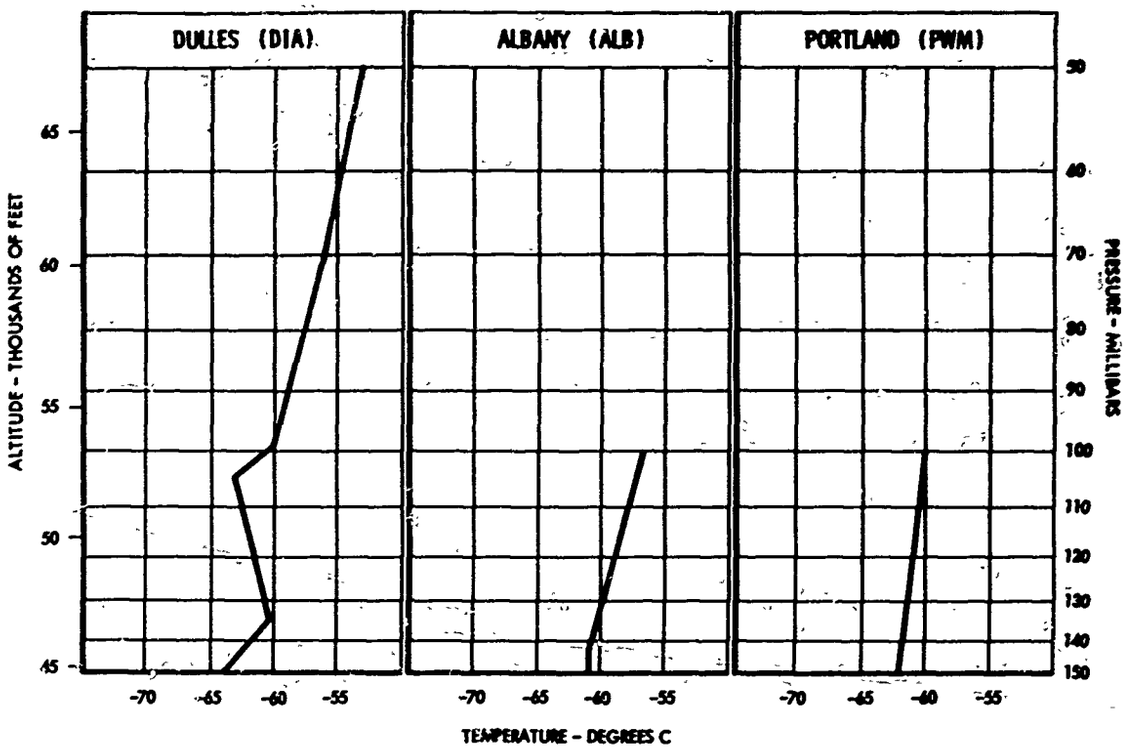
The pilot reported numerous patches of very light to light CAT over the part of the flight route between 70°-80°W longitude. The processed turbulence data shows runs 3 and 4 of very light CAT.

The RAOB plotted are not representative of the flight route area but are the best available. DIA shows changes in vertical temperature gradient from 45,000 feet to 53,000 feet.

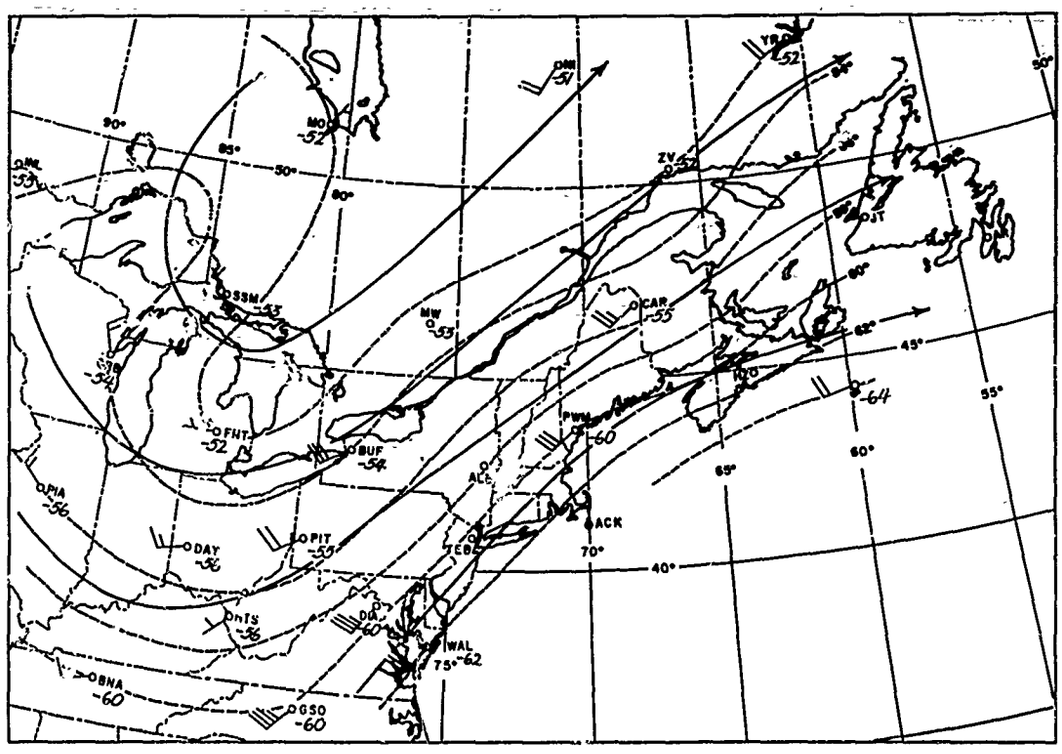
The wind flow pattern at the 100 mb level is similar to the 300-200 mb pattern.

APPENDIX VI

RAOB CHARTS (1200Z, 14 Jul 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 14 Jul 1967)



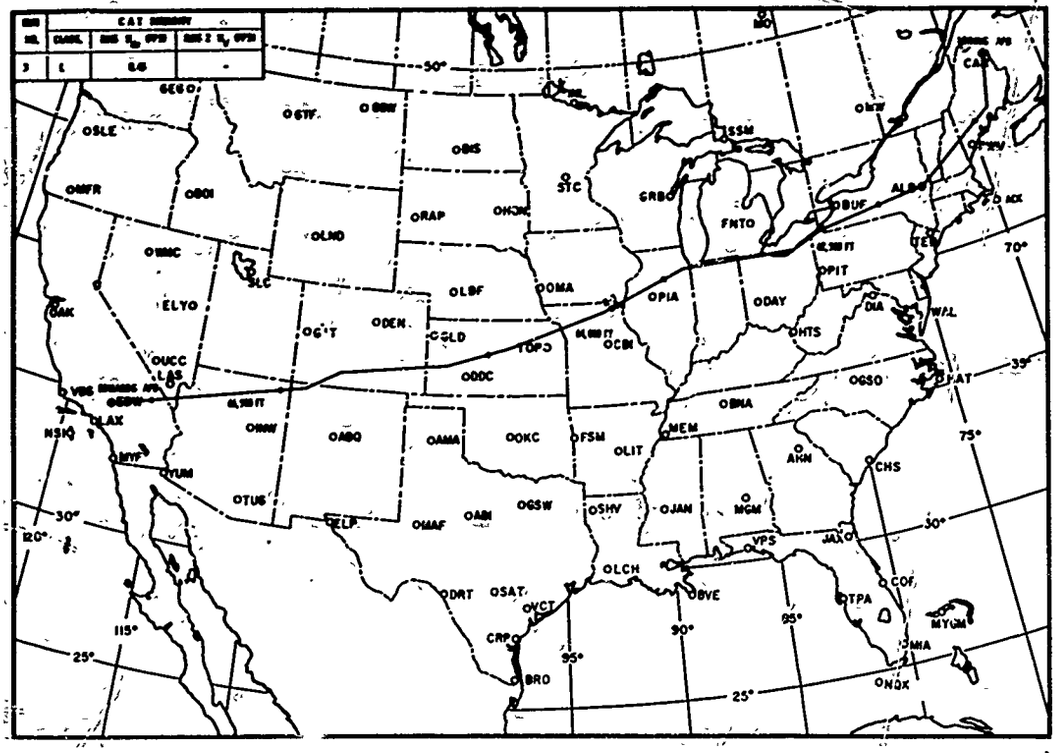
APPENDIX VI

TEST 223

16 July 1967, 1246-1900Z

Ferry flight from Loring AFB, Maine to Edwards AFB, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

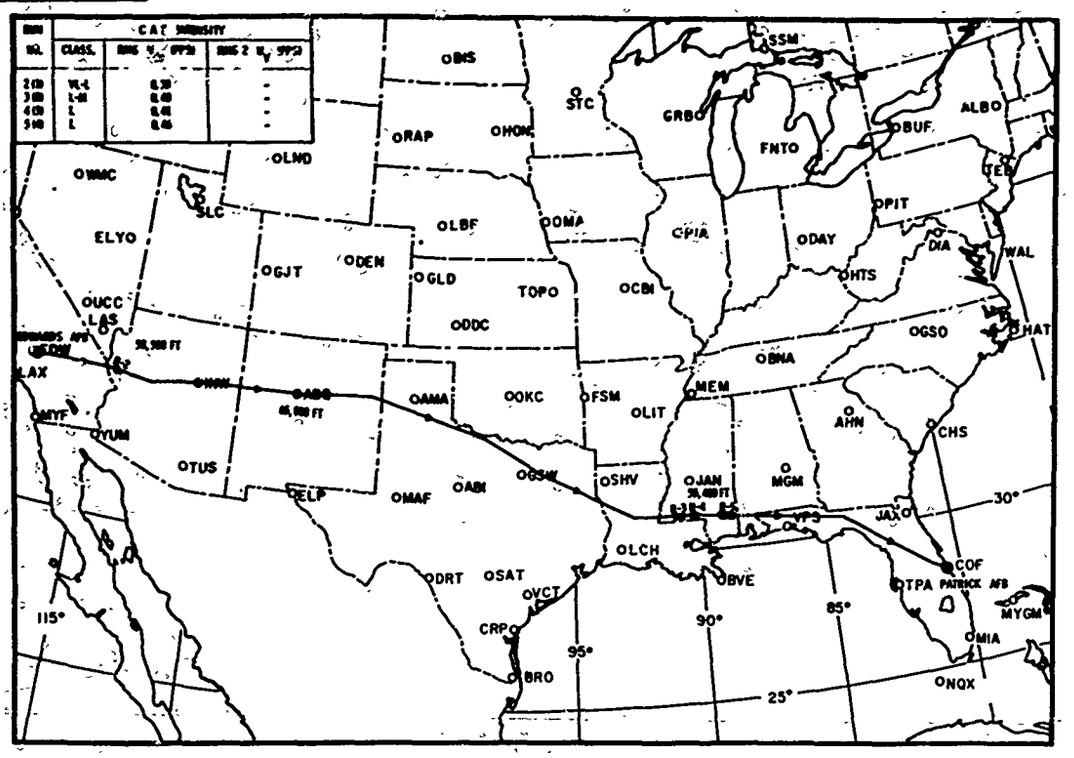
APPENDIX VI

TEST 224

18 July 1967, 1528-2054Z

Ferry flight from Edwards AFB, California to Patrick AFB, Florida, U.S.A.

FLIGHT TRACK



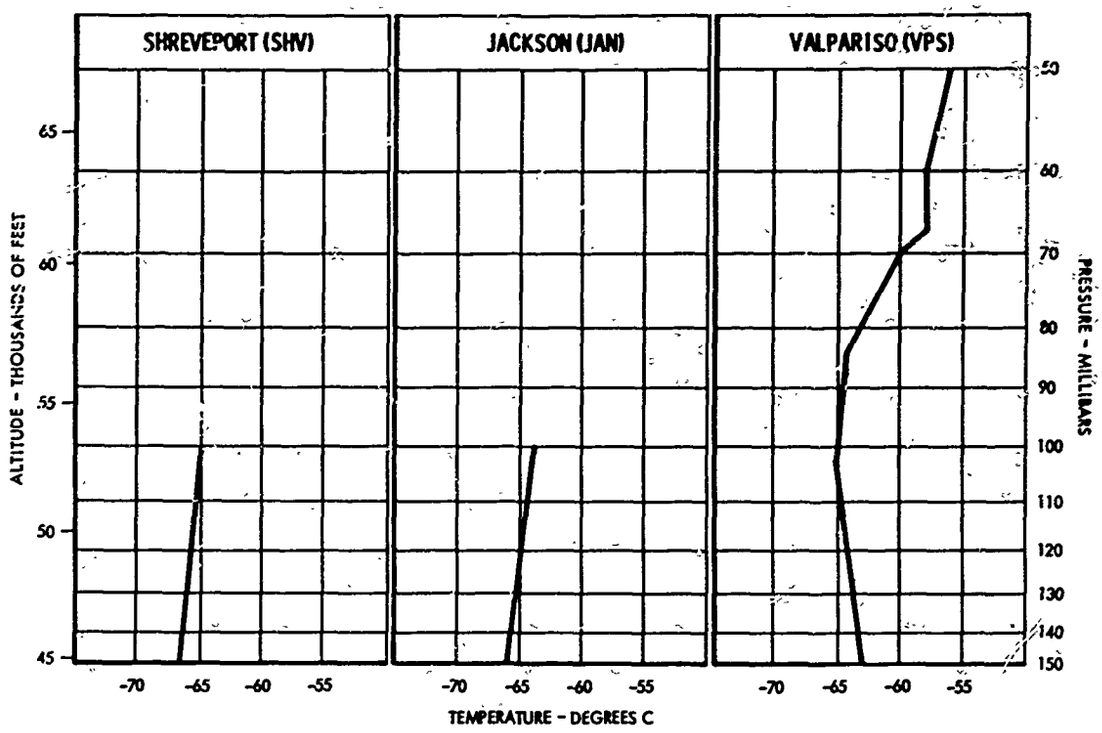
FLIGHT SUMMARY

The surface map for 0000Z, 19 July 1967, (5 hours after the U-2 encountered CAT over the southeastern states) showed a surface front over northern Florida extending along the coasts of Georgia and the Carolinas. A well defined upper level trough was evident at the 500 mb level, with the axis along the Alabama-Georgia border and projecting northward toward the Great Lakes. This upper level trough can also be seen in the 1200Z, 18 July 1967, 100 mb analysis.

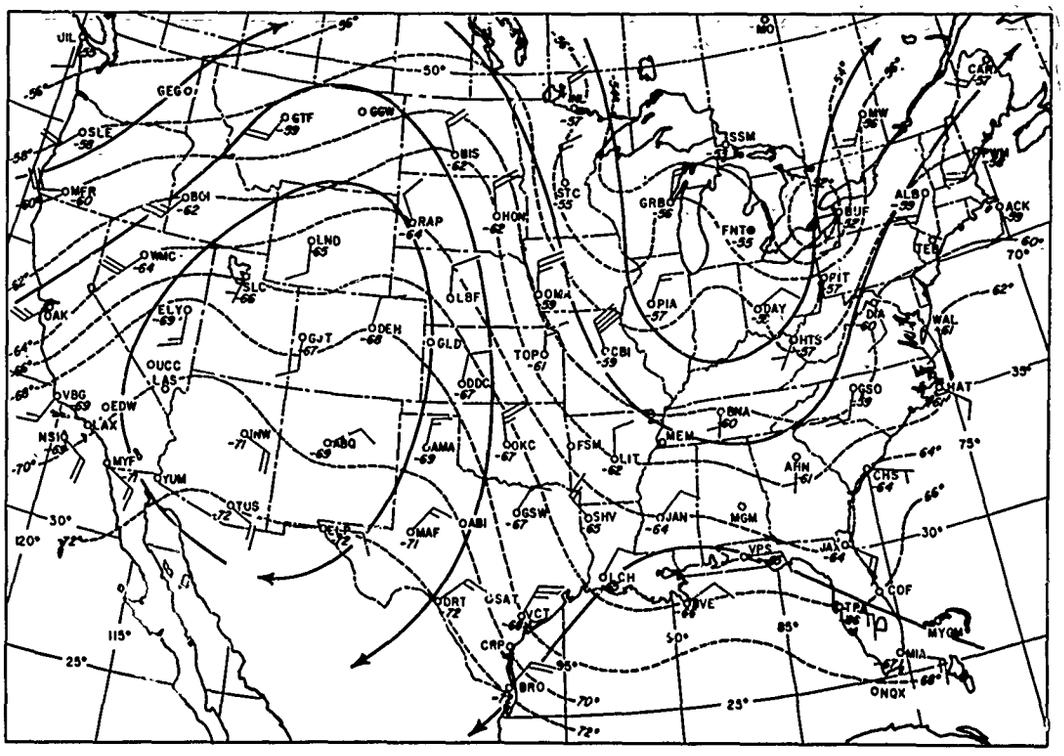
The flight track shows that the turbulence occurred in the area of the upper level trough that was apparent at all wind reporting levels through 100 mb. Notice the wave pattern of the isotherms in the 100 mb trough. The only RAOB above 100 mb for this case was VPS which was in a relatively calm area.

APPENDIX VI

RAOB CHARTS (1200Z, 18 Jul 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 18 Jul 1967)



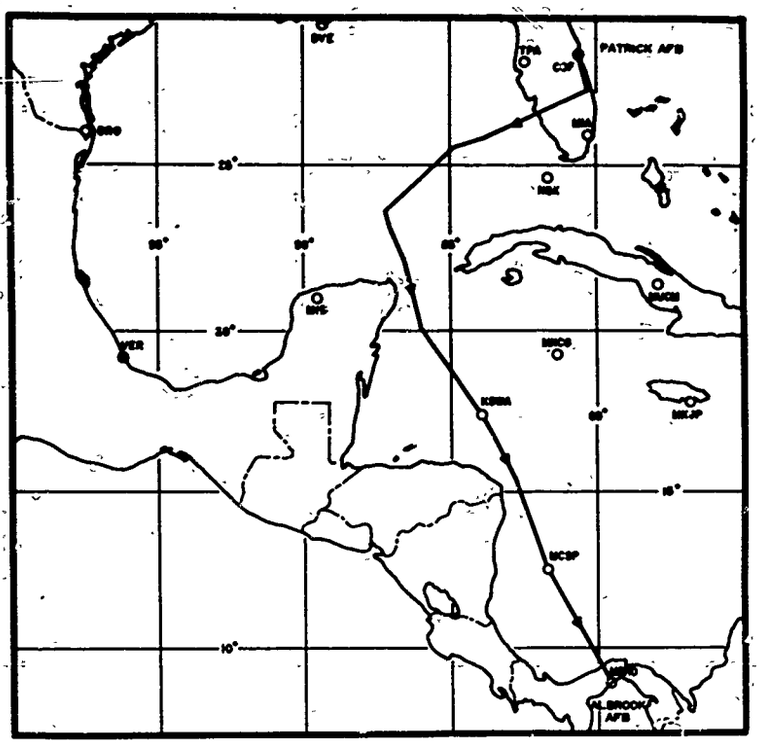
APPENDIX VI

TEST 225

20 July 1967, 0103-0527Z

Ferry flight from Patrick AFB, Florida to Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

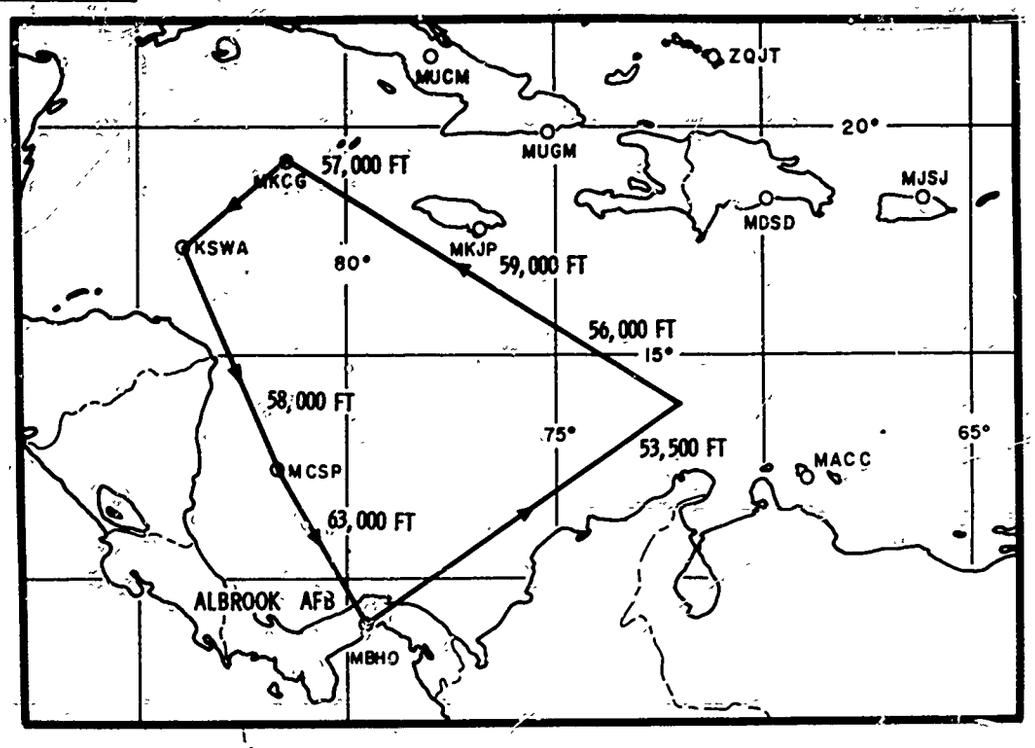
APPENDIX VI

TEST 226

24 July 1967, 1458-2028Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



FLIGHT SUMMARY

This mission was the first of a series of 12 flights investigating turbulence while operating out of Albrook AFB, Panama Canal Zone.

The Intertropical Convergence Zone (ITZ) was well to the south of Panama on this date. The flight route was over a shallow ridge sloping up towards the north.

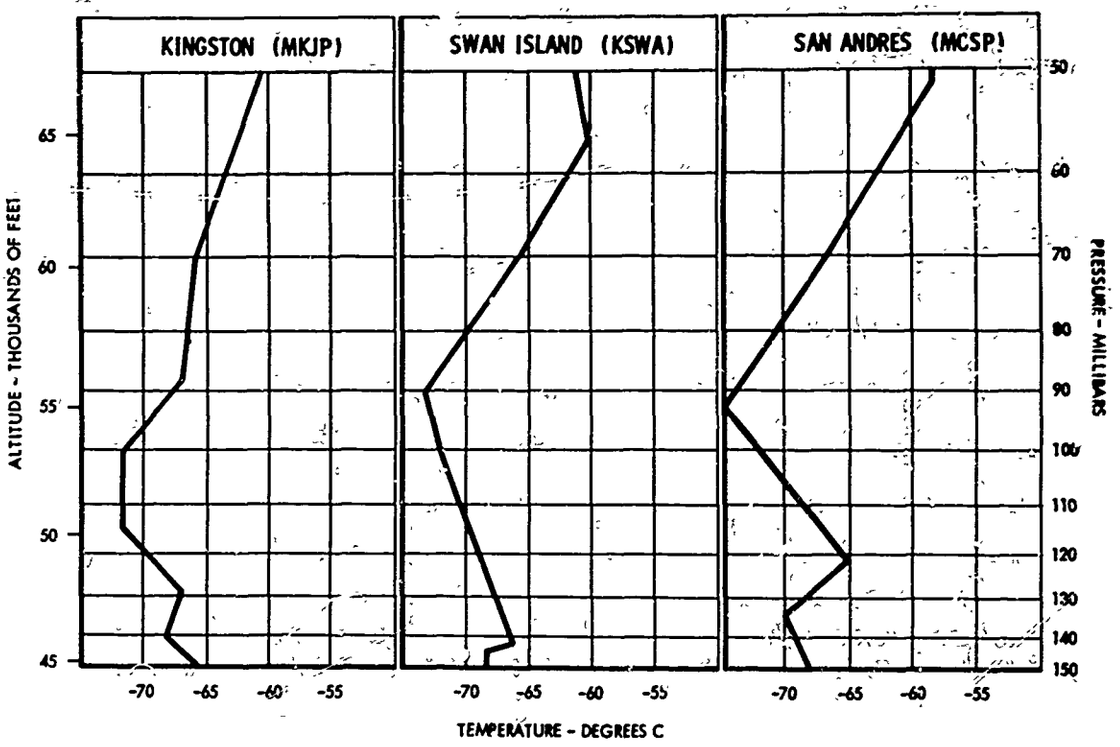
The pilot reported light CAT at 63,000 and 58,000 feet over thunderstorms near 12°N 82°W, as well as numerous patches of very light CAT for the rest of the route. No turbulence runs were processed.

The RAOB chart shows medium changes (~1.5°C/1000 feet) of vertical temperature gradients over MKJP, KSWA and MCSP. These gradients are normally associated with light CAT. (Note time differences of 6-8 hours between RAOB and flight.)

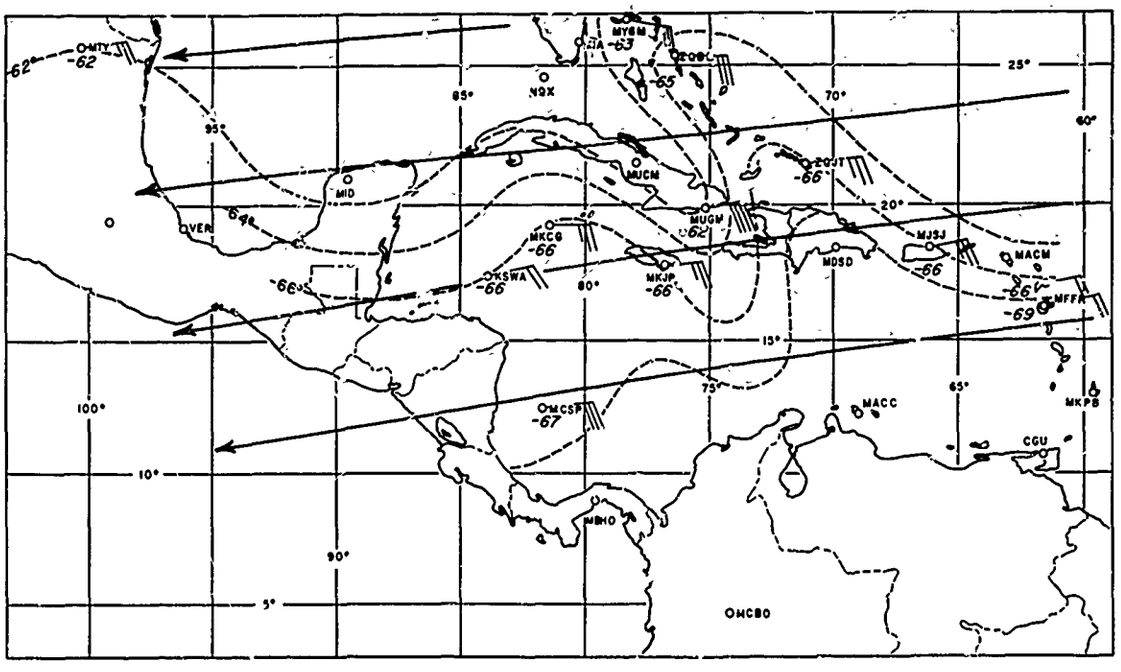
The 70 mb analysis shows small horizontal temperature gradients over flight route area.

APPENDIX VI

RAOB CHARTS (1200Z, 24 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 24 Jul 1967)



APPENDIX VI

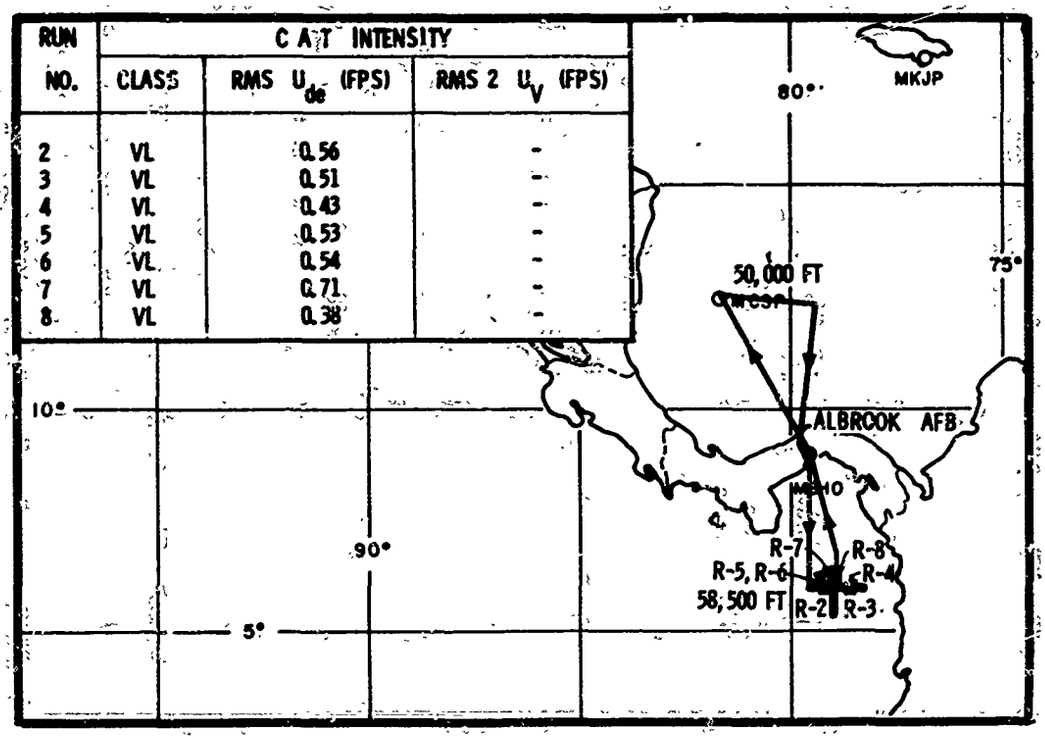
TEST 227

25 July 1967, 1501-1847Z

Albrook AFB, Panama Canal Zone (Panama)

FLIGHT TRACK

RUN NO.	C A T INTENSITY		
	CLASS	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.56	-
3	VL	0.51	-
4	VL	0.43	-
5	VL	0.53	-
6	VL	0.54	-
7	VL	0.71	-
8	VL	0.38	-



FLIGHT SUMMARY

On this date, the ITZ was about 250 nm south of Howard AFB, Canal Zone (Panama). Radar reports depicted scattered thunderstorm activity along the convergence zone.

The flight track route was to MCSP, return to MBHO and then southward to investigate the ITZ.

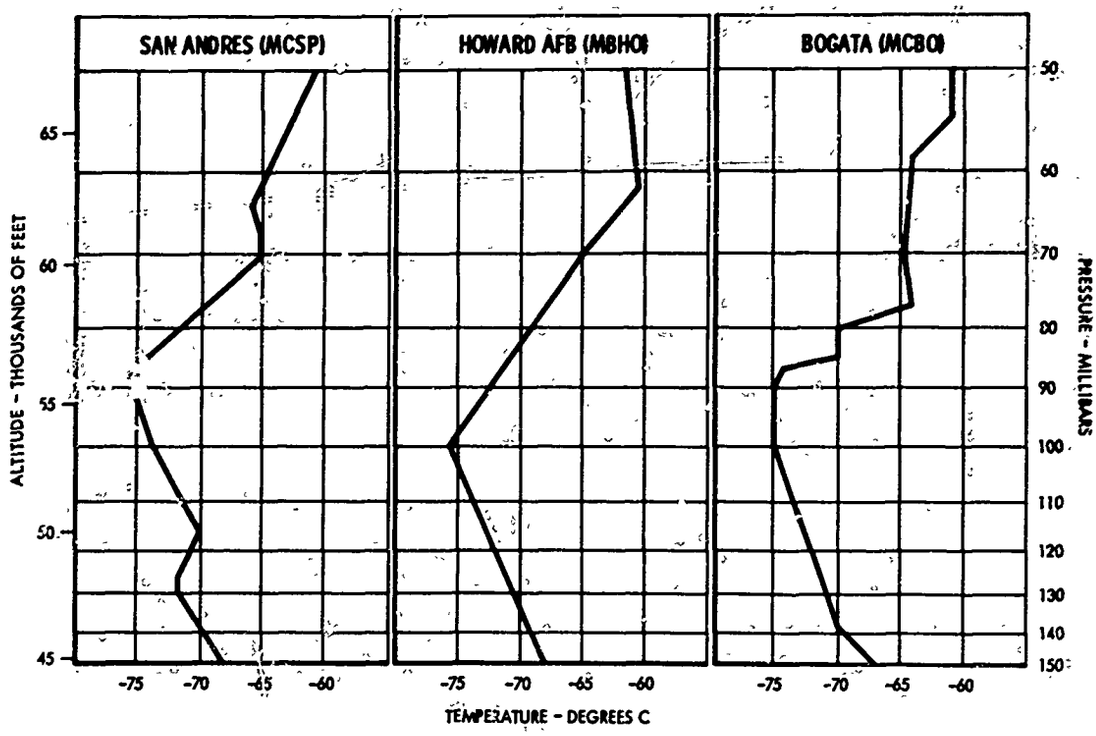
The pilot reported patches of very light CAT over MCSP and abundant light CAT over the ITZ (Runs 2, 3, 4, 5, 6, 7, and 8). The turbulence over the ITZ was above the scattered thunderstorm activity which in turn was topped by a layer of thin cirrus.

The RAOB's show small vertical temperature gradients over MCSP and MBHO and a large gradient over MCBO between 90-78 mb. The MCBO sounding was within the ITZ but about 250 miles east of the sampled area (pilot not authorized to fly over Colombia).

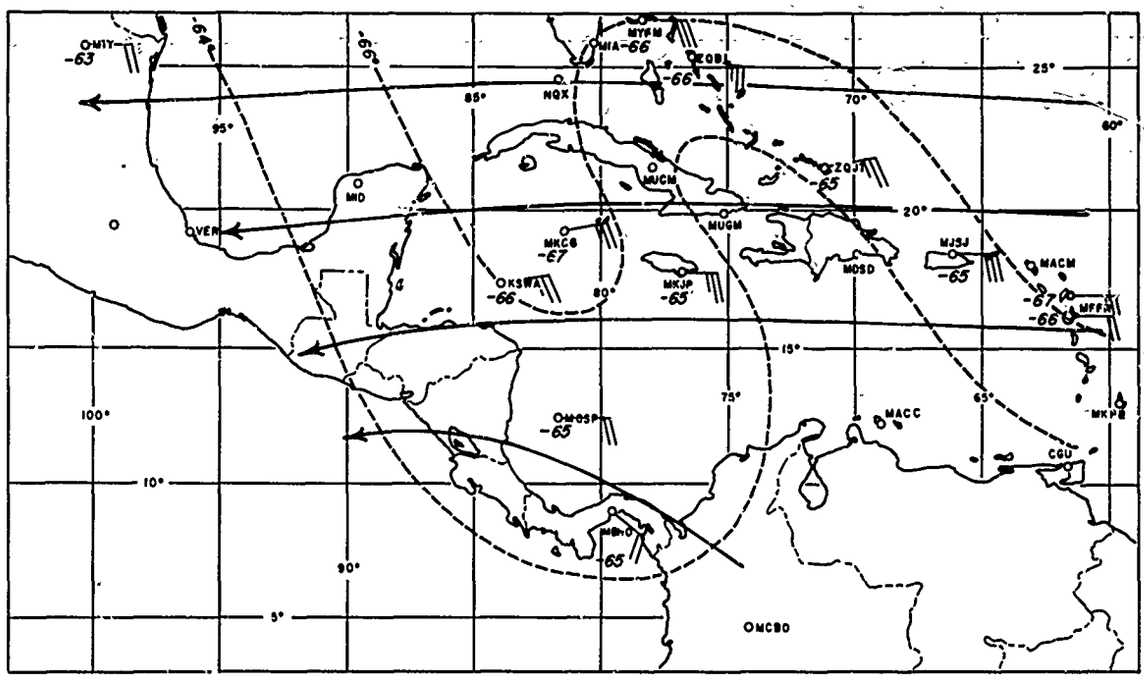
The 70 mb temperature analysis indicates that a wave was present over the Caribbean with the thermal trough positioned along 80°W longitude.

APPENDIX VI

RAOB CHARTS (1200Z, 25 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 25 Jul 1967)



APPENDIX VI

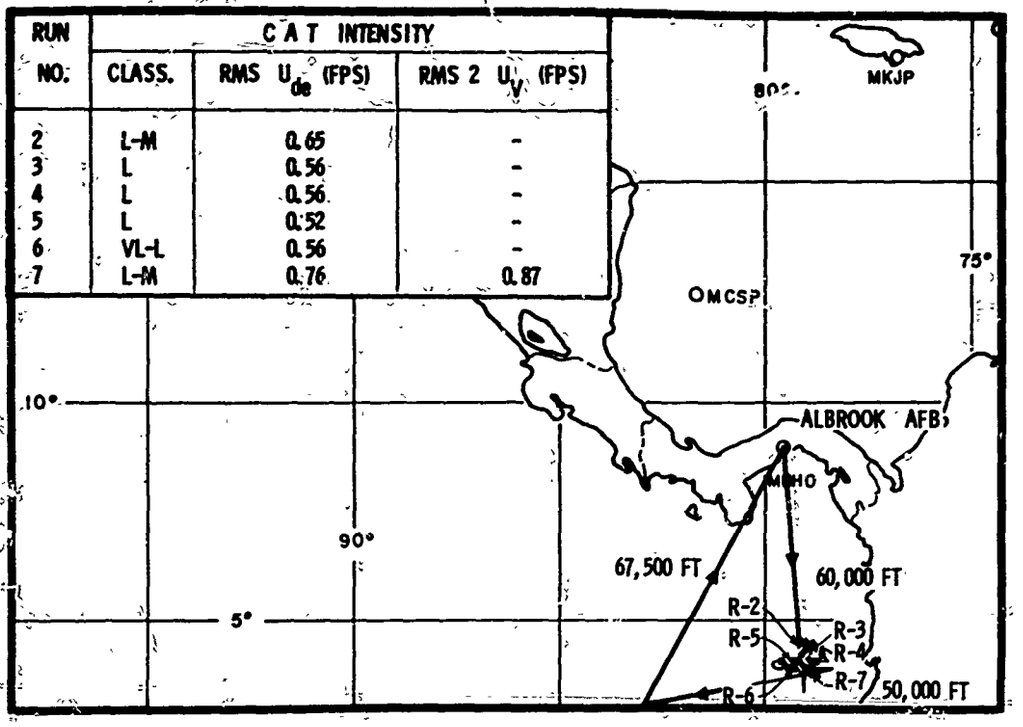
TEST 228

27 July 1967, 1452-1850Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK

RUN NO.	CAT INTENSITY CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	L-M	0.65	-
3	L	0.56	-
4	L	0.56	-
5	L	0.52	-
6	VL-L	0.56	-
7	L-M	0.76	0.87



FLIGHT SUMMARY

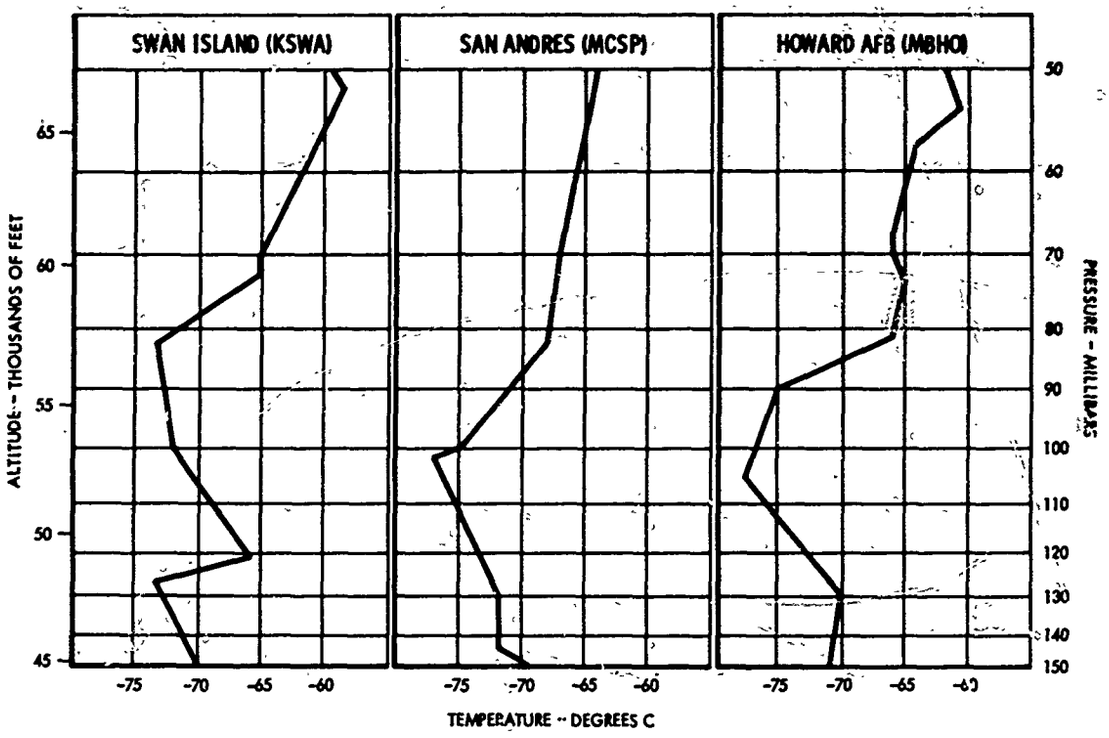
The ITZ was positioned about 300 nm south of Panama on this date. Radar reports indicated scattered thunderstorm activity prevailed in the convergence zone. As was usually the case, the scattered thunderstorms were topped by a layer of cirrus through which occasionally a convective cell would penetrate.

The pilot reported the turbulence above the ITZ to be slightly more intense than that sampled during test 227. Runs 2 through 7 indicate this to be factual.

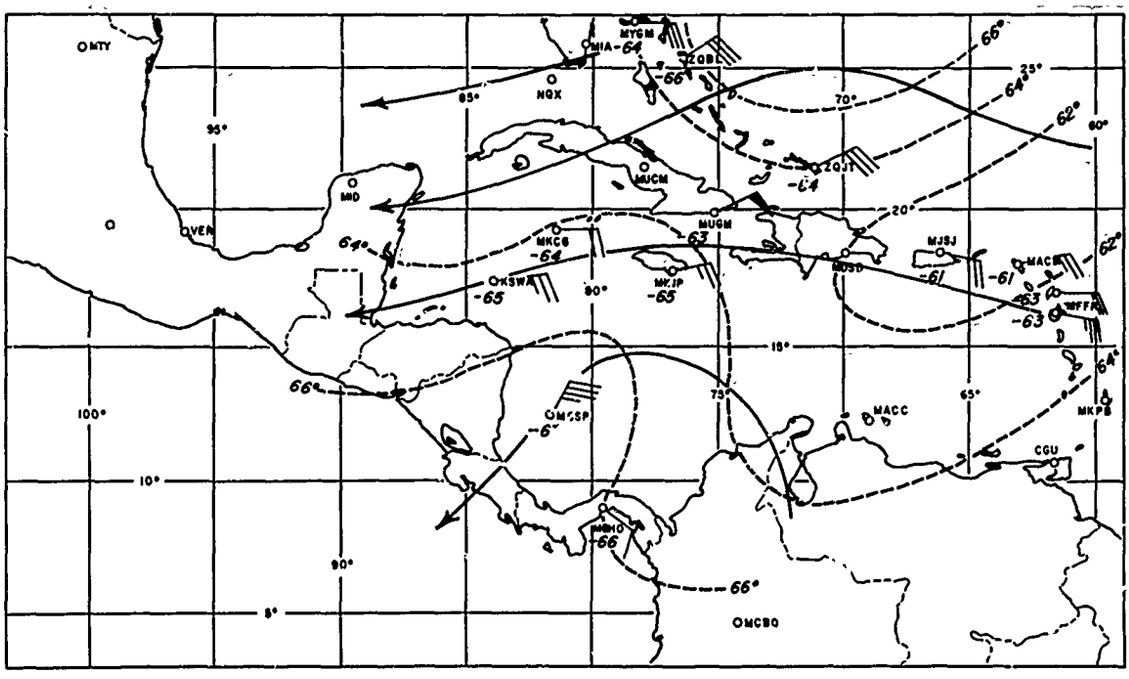
The RAOB's are too distant from the sampled area to be representative. MBHO, the closest, was 300 nm away. Notice however, the large vertical temperature gradients that existed over KSWA and MBHO.

The winds and temperature chart shows a cyclonic wind flow and thermal trough that was present near the sampled area.

RAOB CHARTS (1200Z, 27 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 27 Jul 1967)



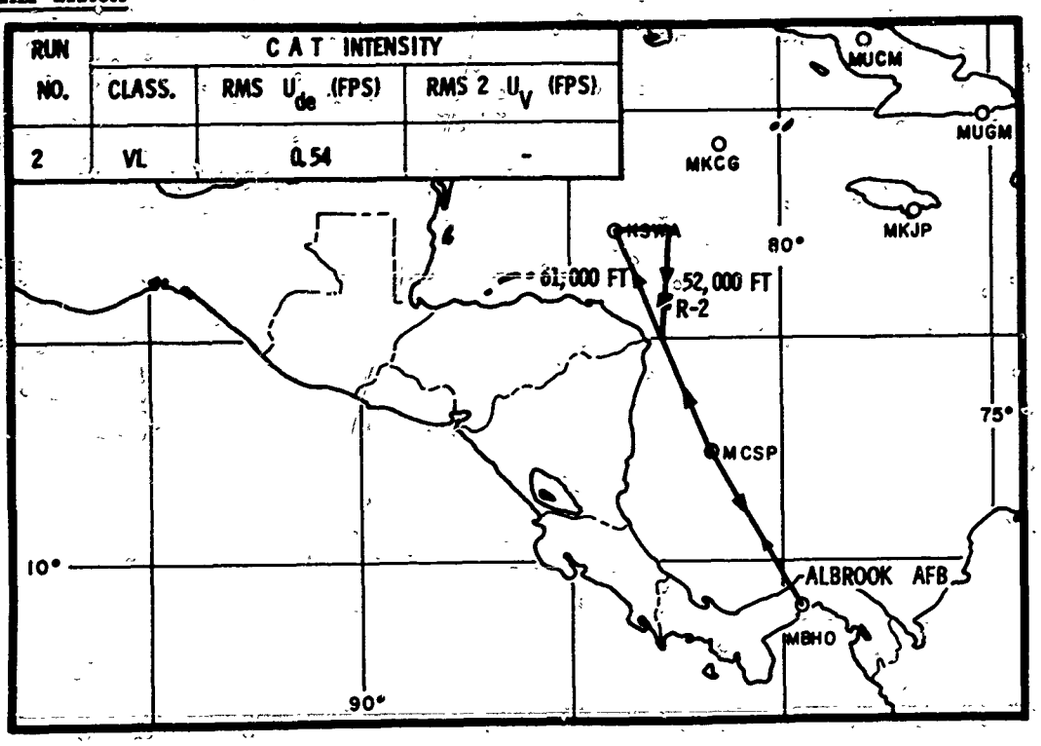
APPENDIX VI

TEST 229

28 July 1967, 1447-1816Z
Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK

RUN NO.	C A T INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.54	-



FLIGHT SUMMARY

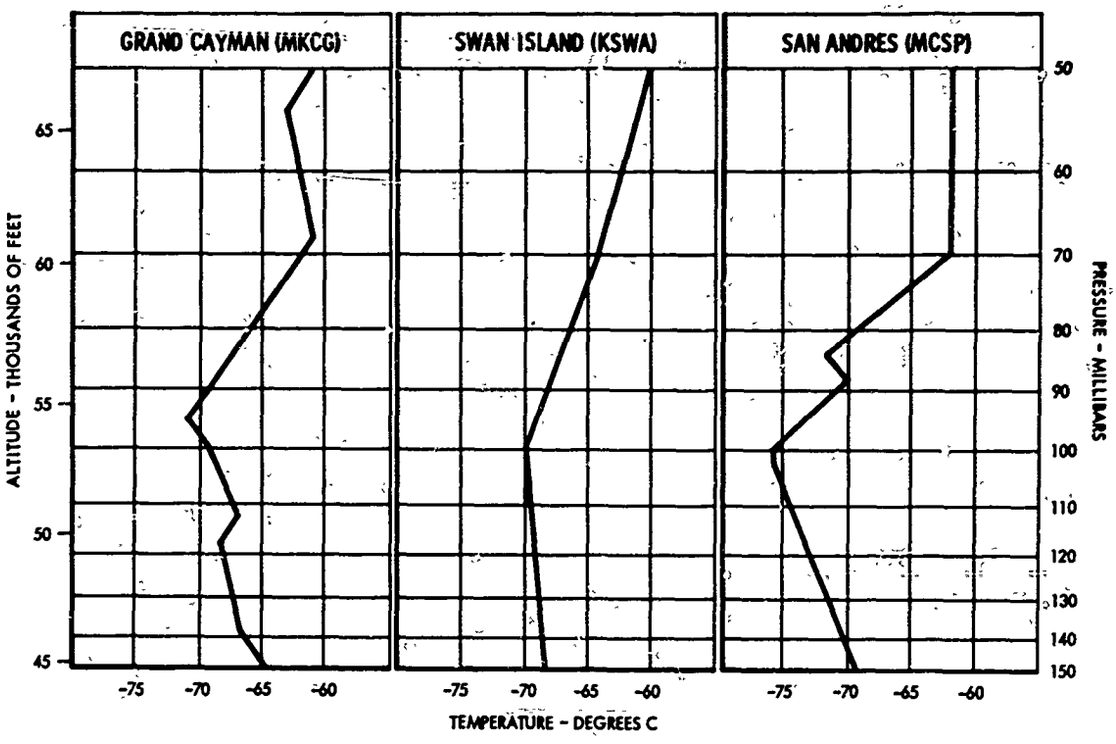
Surface weather on this date was generally good throughout the operating area. Activity in the ITZ was at a minimum.

The pilot reported a fairly widespread area of very light CAT centered over KSWA. Run 2 was processed.

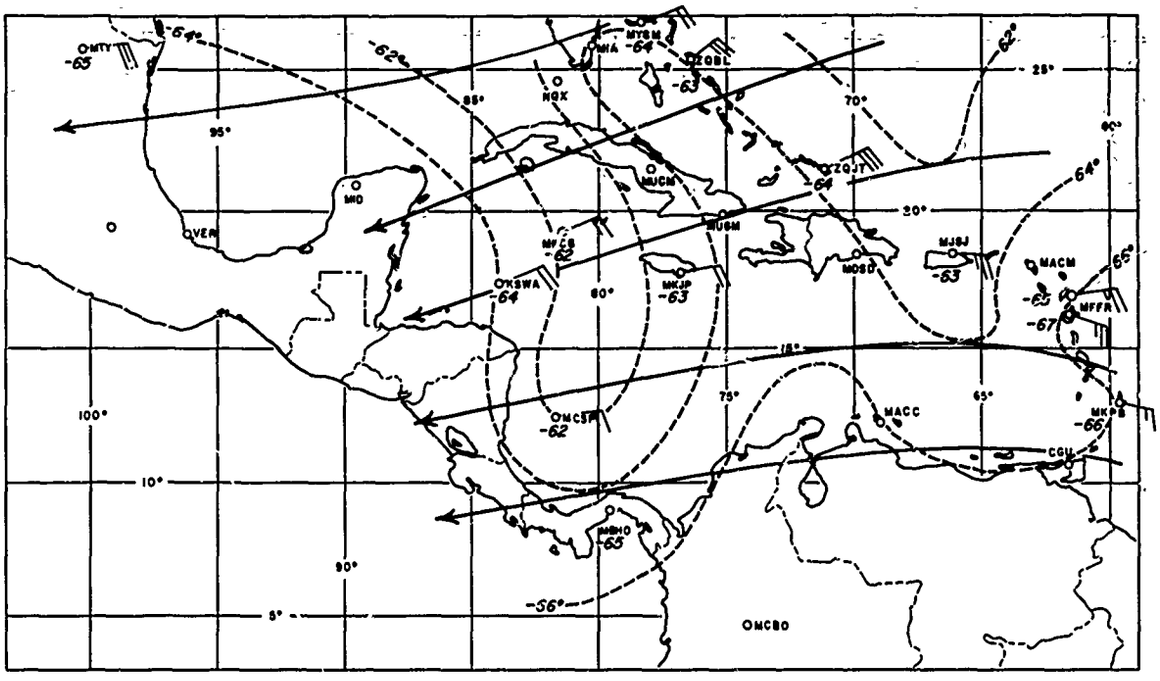
The RAOB chart shows that small vertical temperature gradients prevailed over MKCG, KSWA and MCSP.

Horizontal temperature gradients were also small over the sampled area. Notice the waveform characteristic of the isotherms with the thermal trough along 80°W over the Caribbean.

RAOB CHARTS (1200Z, 28 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 28 Jul 1967)



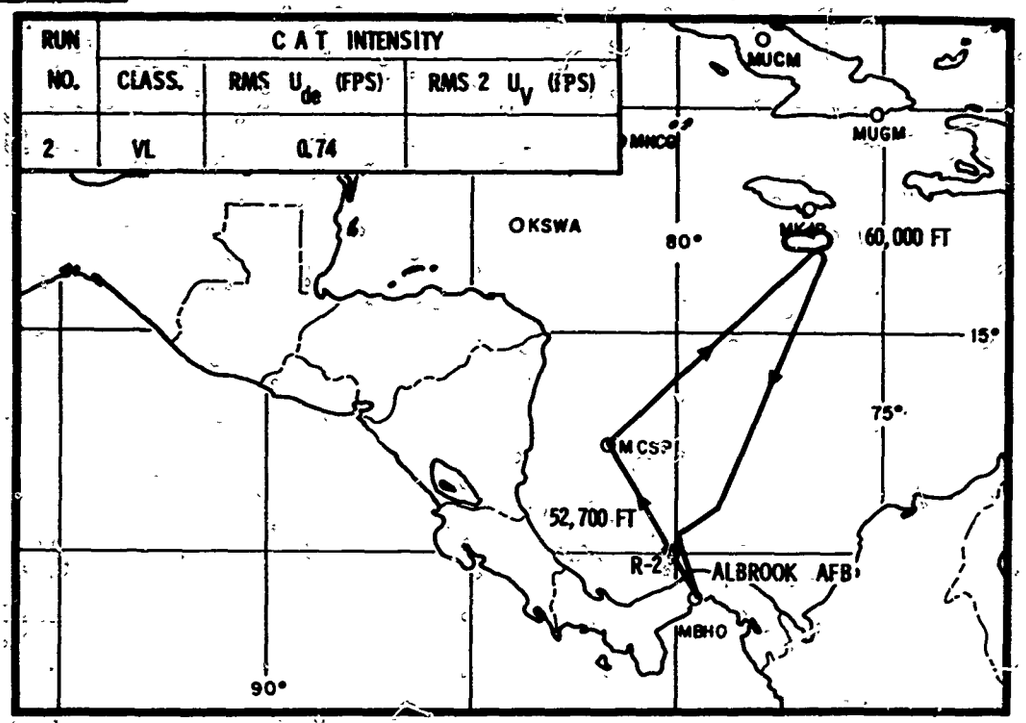
APPENDIX VI

TEST 230

31 July 1967, 1805-2136Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



FLIGHT SUMMARY

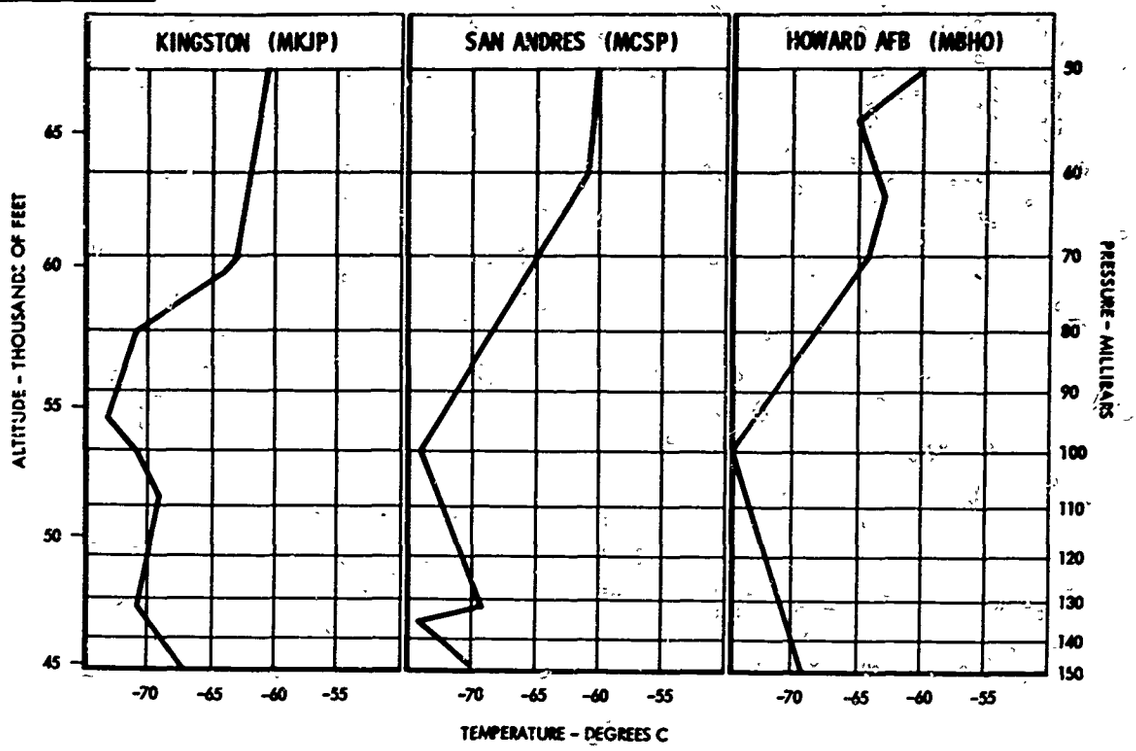
Surface weather conditions were good over the operating area for this date. The ITZ was positioned almost over the Canal Zone but was not active.

The pilot reported very light CAT at 10°N 80°W at flight level 50,100-52,700 feet. Run 2 was processed.

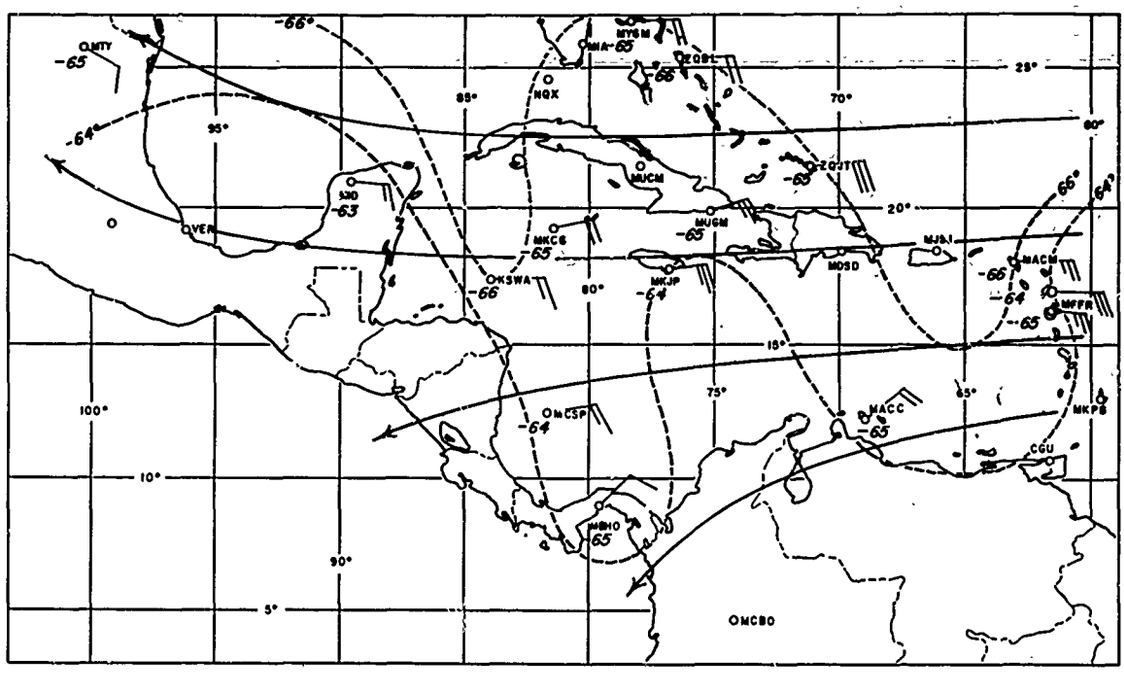
The RAOB analysis shows a rather sharp vertical temperature gradient change near 135 mb over MCSP.

In the winds and temperature chart, notice the small horizontal temperature gradient that was situated over the Caribbean and the thermal trough positioned along 80°W.

RAOB CHARTS (1200Z, 31 Jul 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 31 Jul 1967)



APPENDIX VI

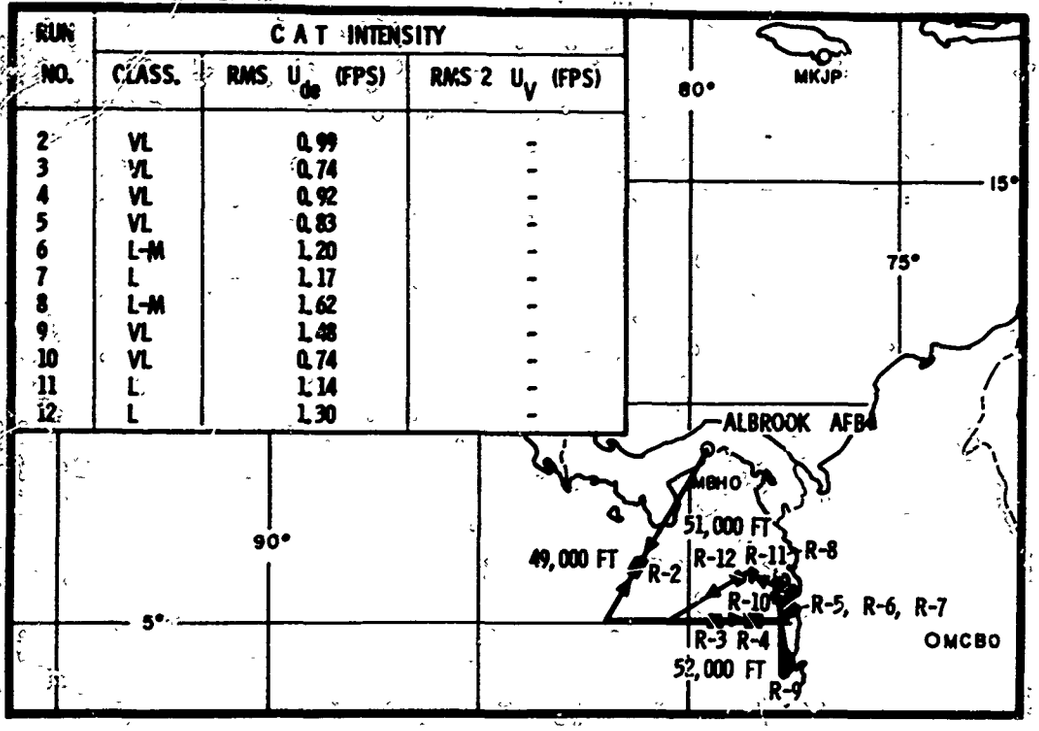
TEST 231

2 August 1967, 1504-1948Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK

RUN NO.	CAT INTENSITY CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.99	-
3	VL	0.74	-
4	VL	0.92	-
5	VL	0.83	-
6	L-M	1.20	-
7	L	1.17	-
8	L-M	1.62	-
9	VL	1.48	-
10	VL	0.74	-
11	L	1.14	-
12	L	1.30	-



FLIGHT SUMMARY

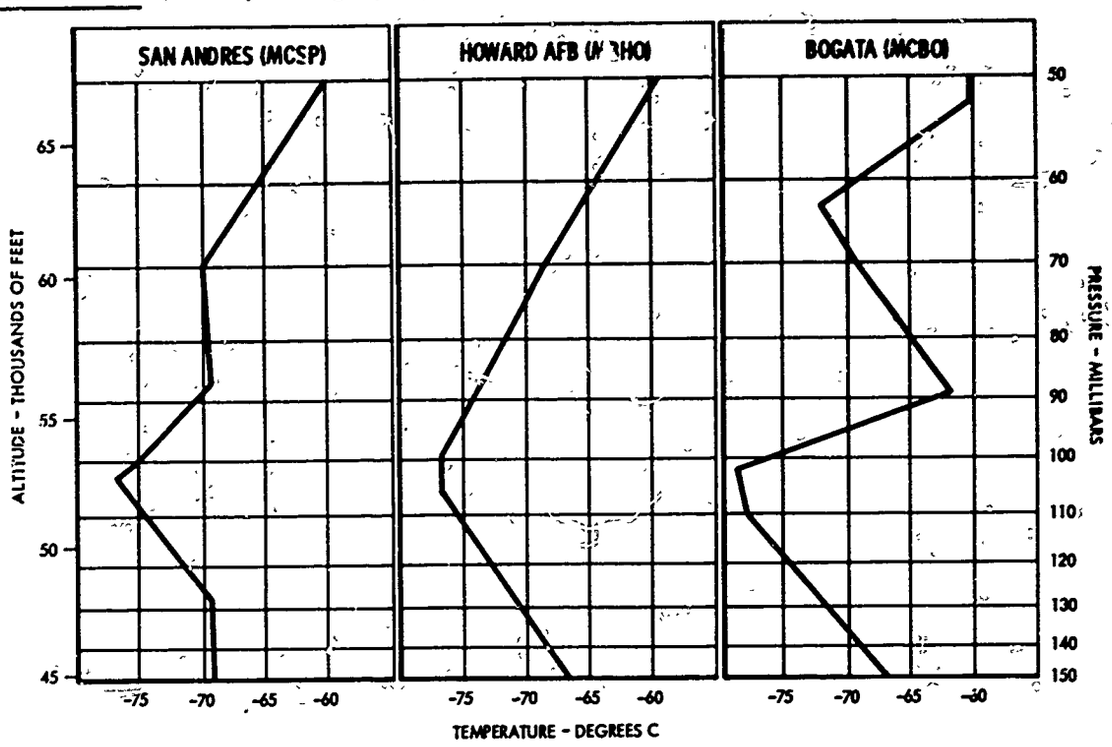
Radar reports on this date indicated considerable convective activity was occurring along the convergence zone which was 100-200 nm south of Albrook AFB.

The pilot reported extensive light-plus CAT at 51,000 to 53,000 feet and also commented that the -70°C temperature at that level was the coldest he had observed. Pilot further reported the most abundant CAT was along the southern edge of the cirrus cloud band that marked the ITZ. Runs 2 through 12 were processed.

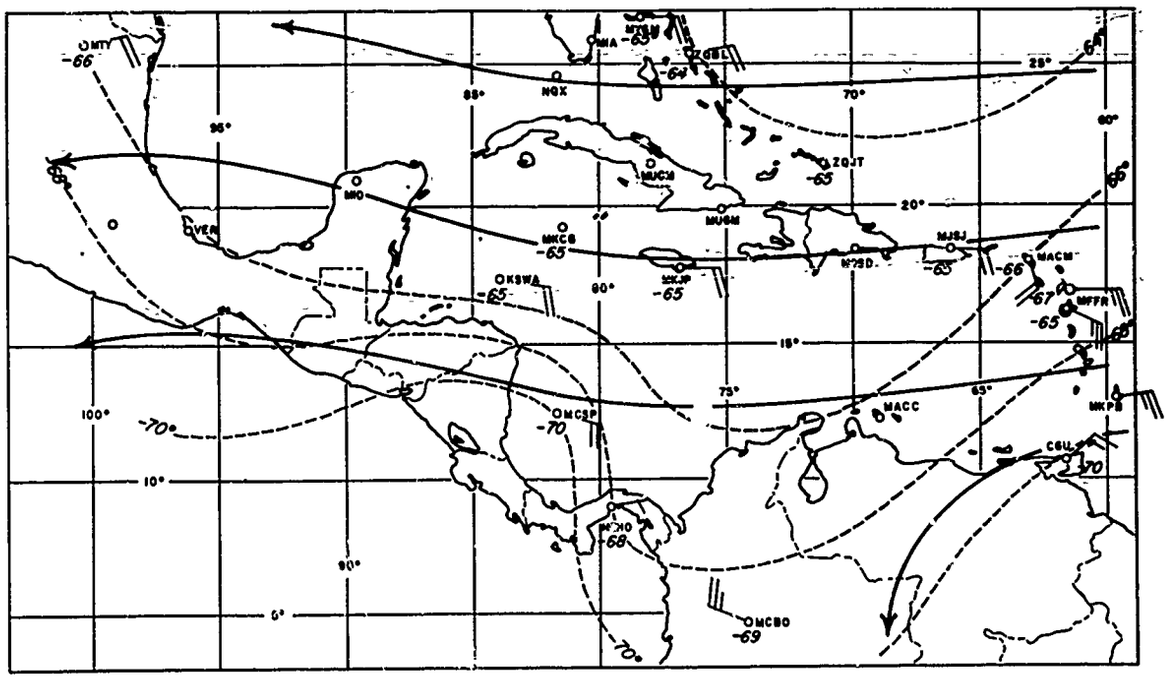
In the RAOB chart, notice the cold layer is evident at about 52,000 feet over MCSP, MBHO and MCBO.

In the 70 mb analysis, notice the broad thermal trough along 75°W.

RAOB CHARTS (1200Z, 2 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 2 Aug 1967)



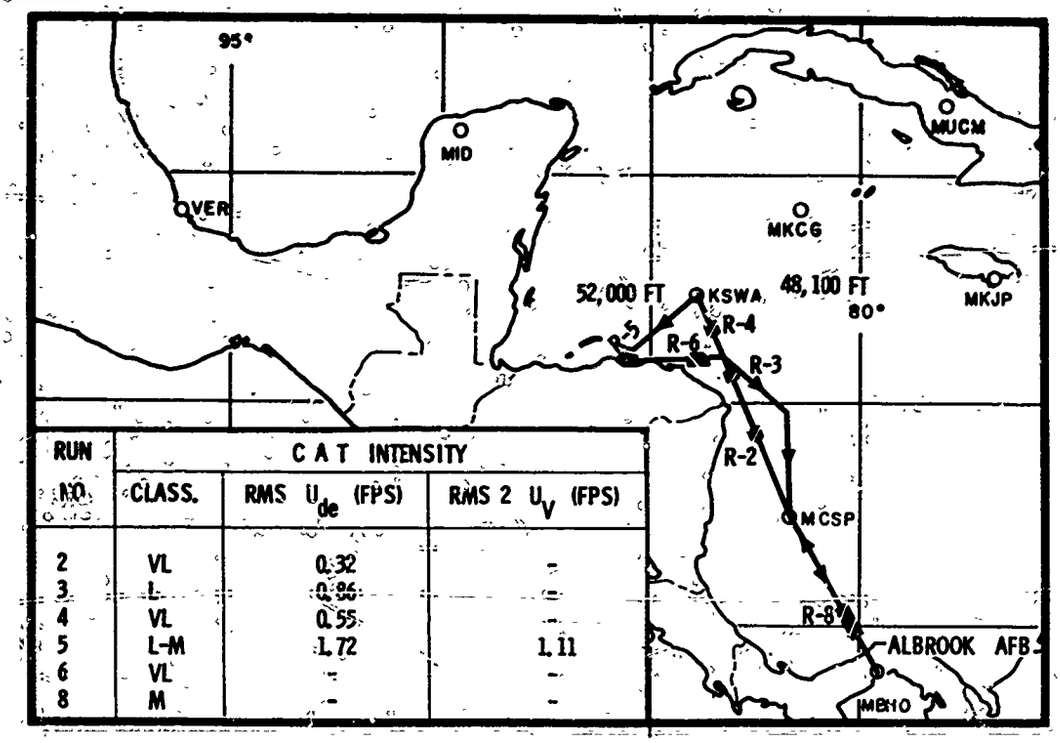
APPENDIX VI

TEST 232

4 August 1967, 1458-1856Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



RUN NO.	CAT INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.32	-
3	L	0.96	-
4	VL	0.55	-
5	L-M	1.72	1.11
6	VL	-	-
8	M	-	-

FLIGHT SUMMARY

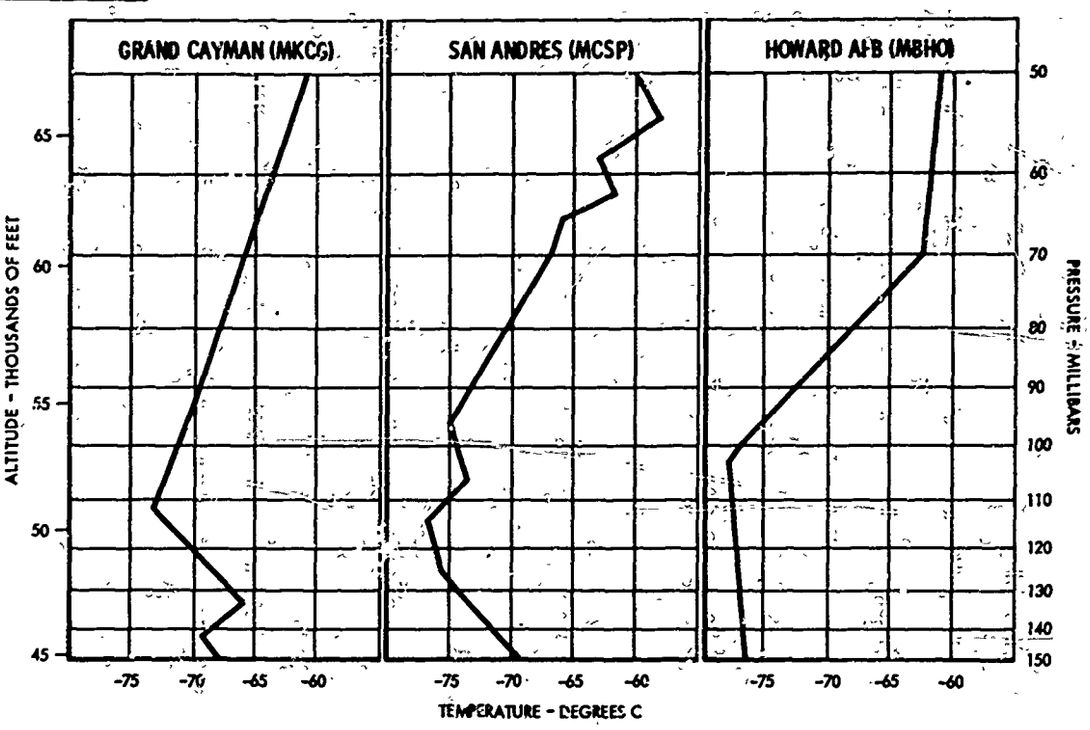
The 0000Z meteorological parameters normally checked for turbulence forecasts indicated abundant CAT was present in the operating area this date. The largest vertical and horizontal temperature gradients were over MBHO and to the north. The ITZ was about 200 miles to the south of Panama.

The pilot reported abundant light CAT at flight levels 49,000 to 54,000 feet. Runs 2, 3, 4, 5, 6 and 8 were processed.

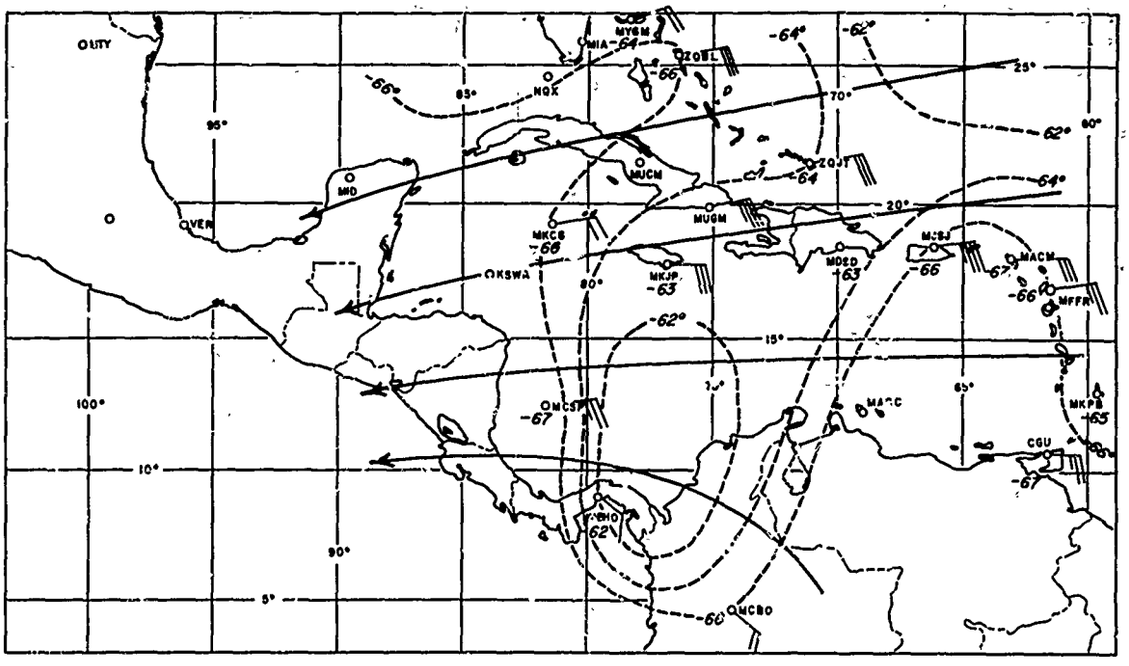
The 1200Z, 4 August 1967, RAOB's show medium (1.5°-2.5°C/1000 feet) amounts of vertical temperature gradients.

In the temperatures and winds chart notice the well defined thermal trough over MBHO.

RAOB CHARTS (1200Z, 4 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 4 Aug 1967)



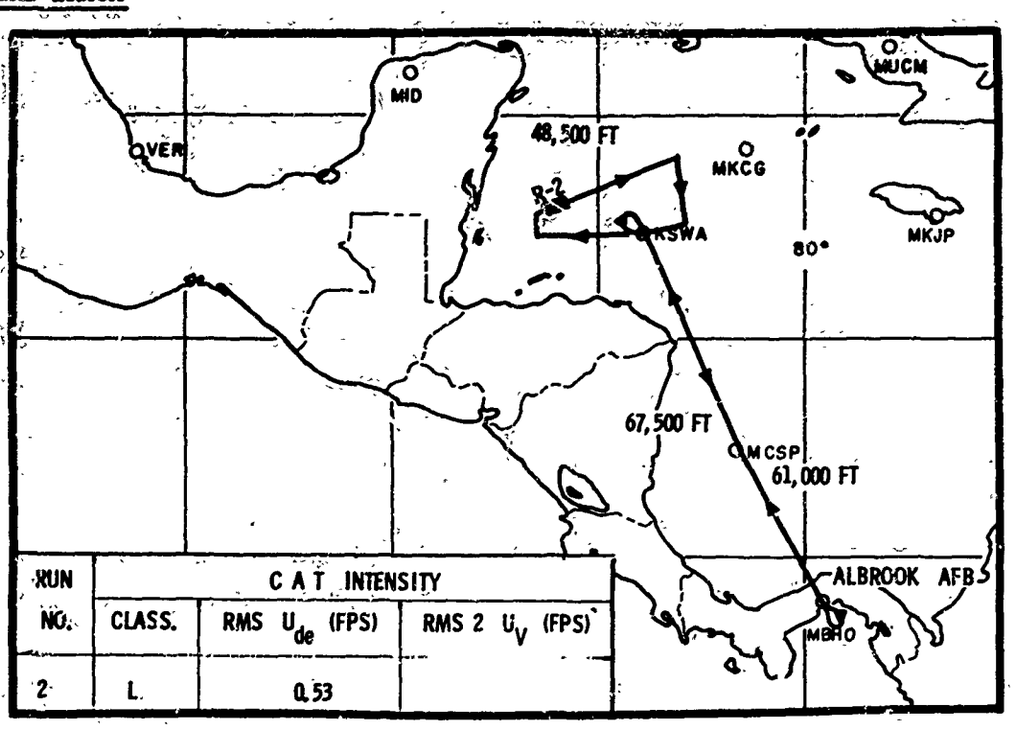
APPENDIX VI

TEST 234

8 August 1967, 1456-1925Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



RUN NO.	C A T INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	L.	0.53	

FLIGHT SUMMARY

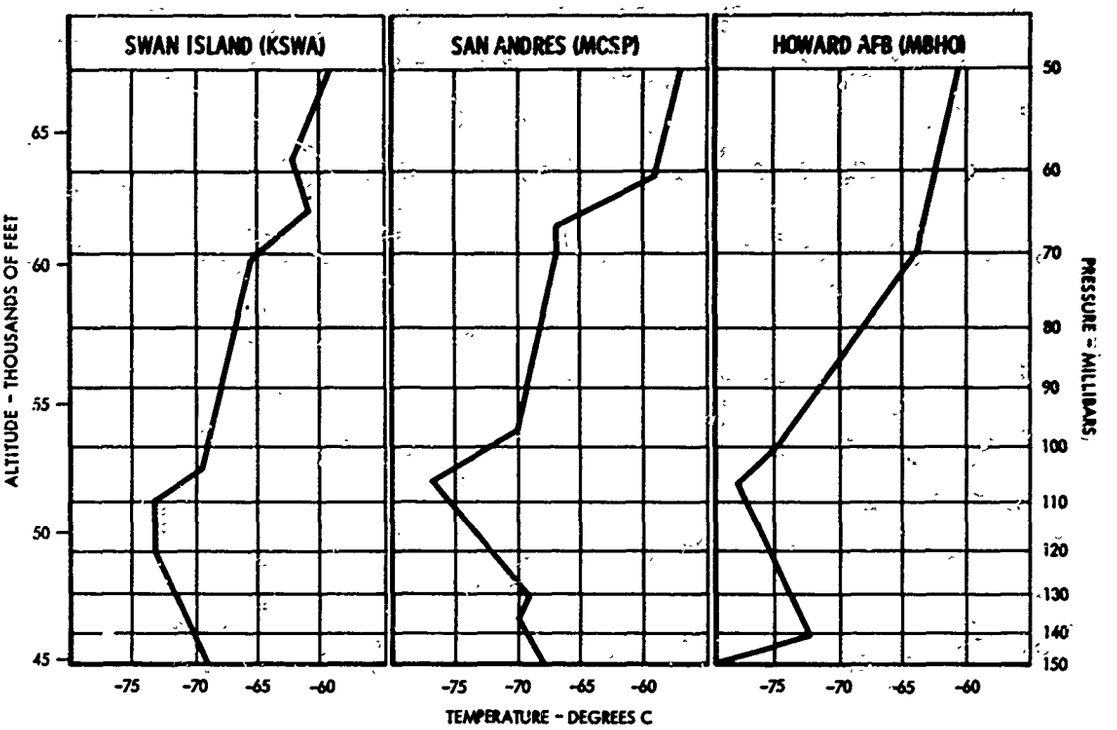
The ITZ was well to the south on this date. Turbulent conditions seemed more favorable to the north and a flight route as indicated in the flight track was flown.

The pilot reported numerous patches of very light CAT with a few "good bumps" over some convective activity in the area of KSWA. Run 2 was processed.

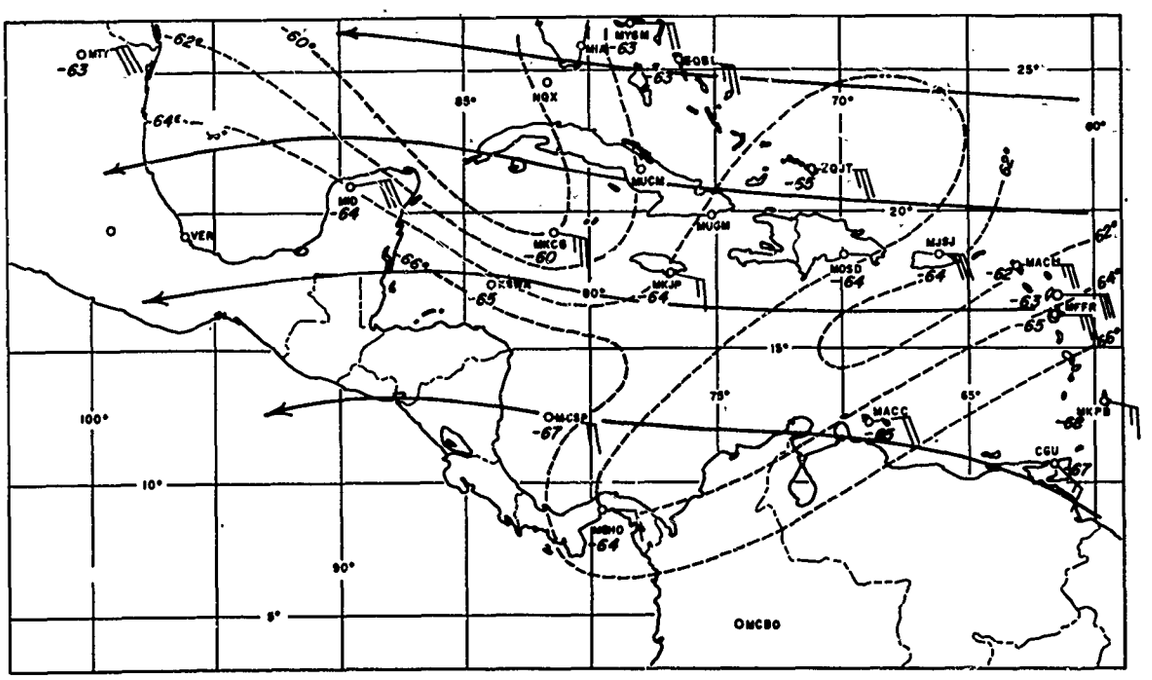
The vertical temperature gradients and character of the RAOB's (changing gradients) in the RAOB chart are indicative of more CAT than was detected. Notice the very cold layer (-72°C, -74°C) at 50,000 to 52,000 feet over KSWA, MCSP and MBHO.

In the temperatures and wind chart, observe the warm thermal trough over MBHO.

RAOB CHARTS (1200Z, 8 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 8 Aug 1967)



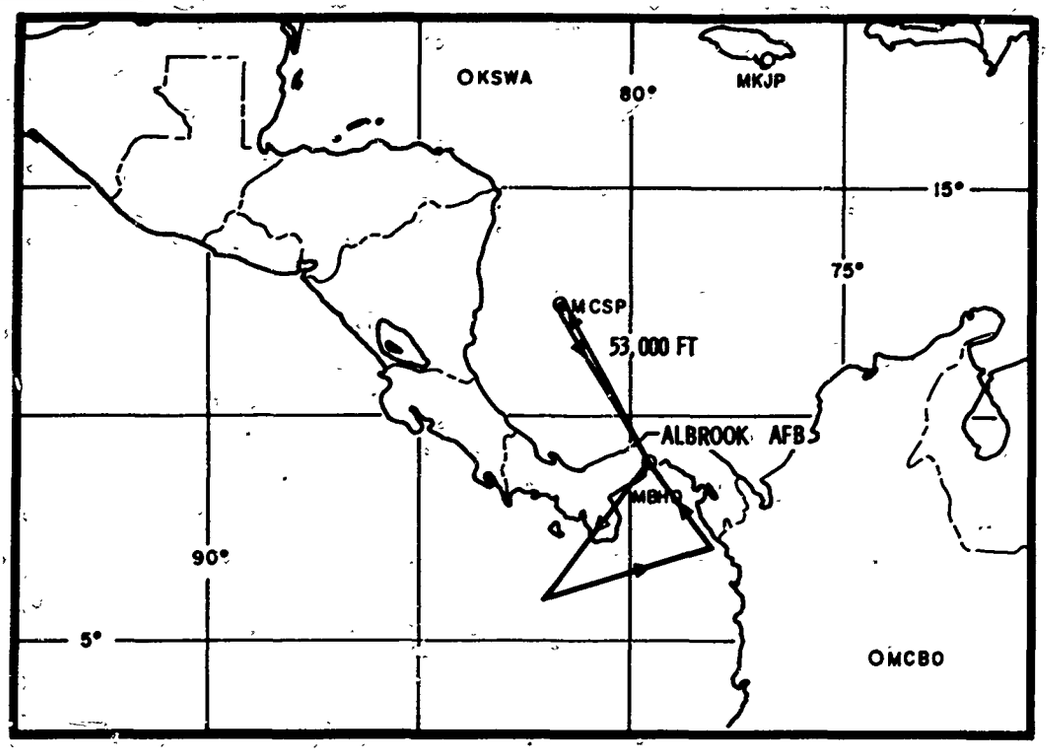
APPENDIX VI

TEST 235

10 August 1967, 1445-1815Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



FLIGHT SUMMARY

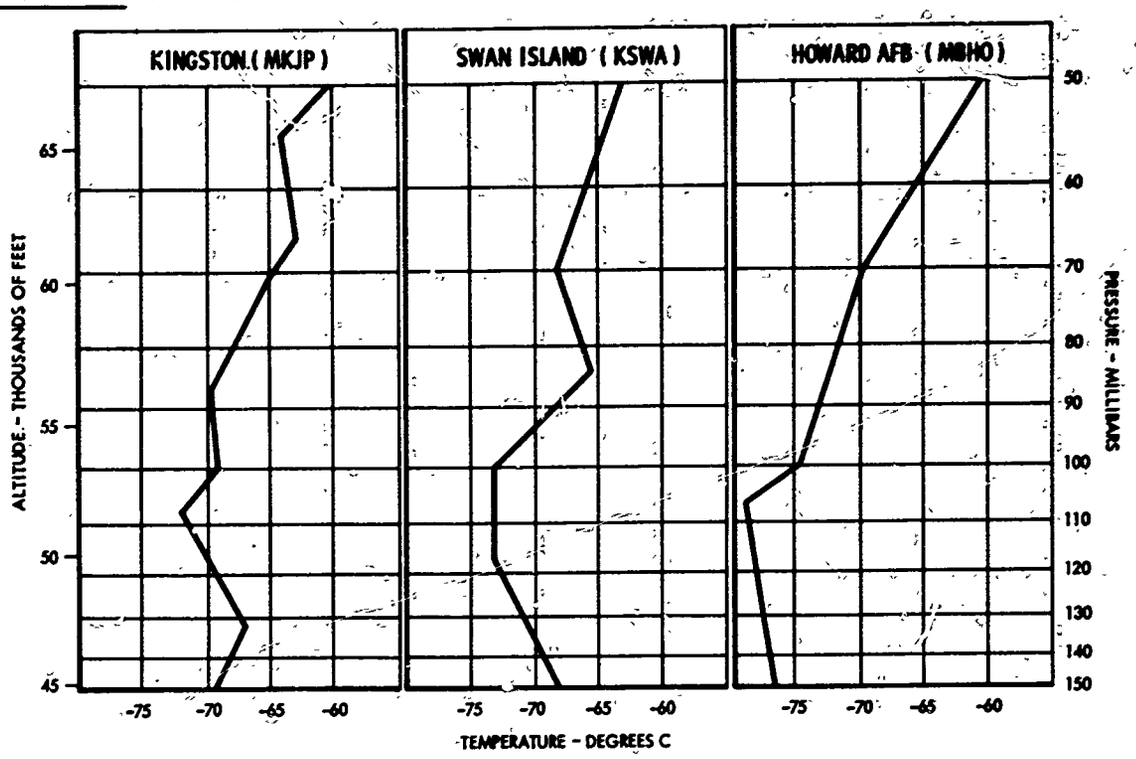
The ITZ was relatively inactive for this date and meteorological parameters were not favorable for the production of CAT.

The pilot reported a few patches of very light CAT over the flight route shown on the flight track. One run was processed for light CAT at flight level 53,000 feet over MCSP.

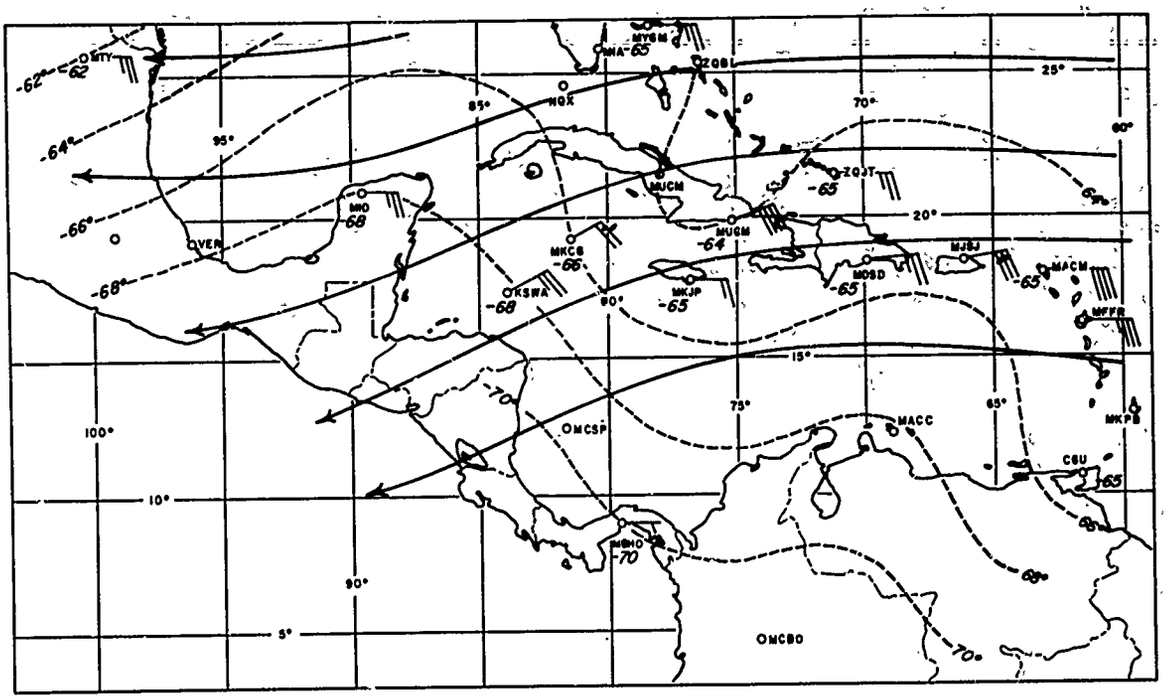
The MCSP RAOB was not available, however the MBHO RAOB shows a slight vertical gradient change at 52,000 - 53,000 feet.

The temperatures and winds chart shows the shallow thermal trough over the sampling area.

RAOB CHARTS (1200Z, 10 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 10 Aug 1967)



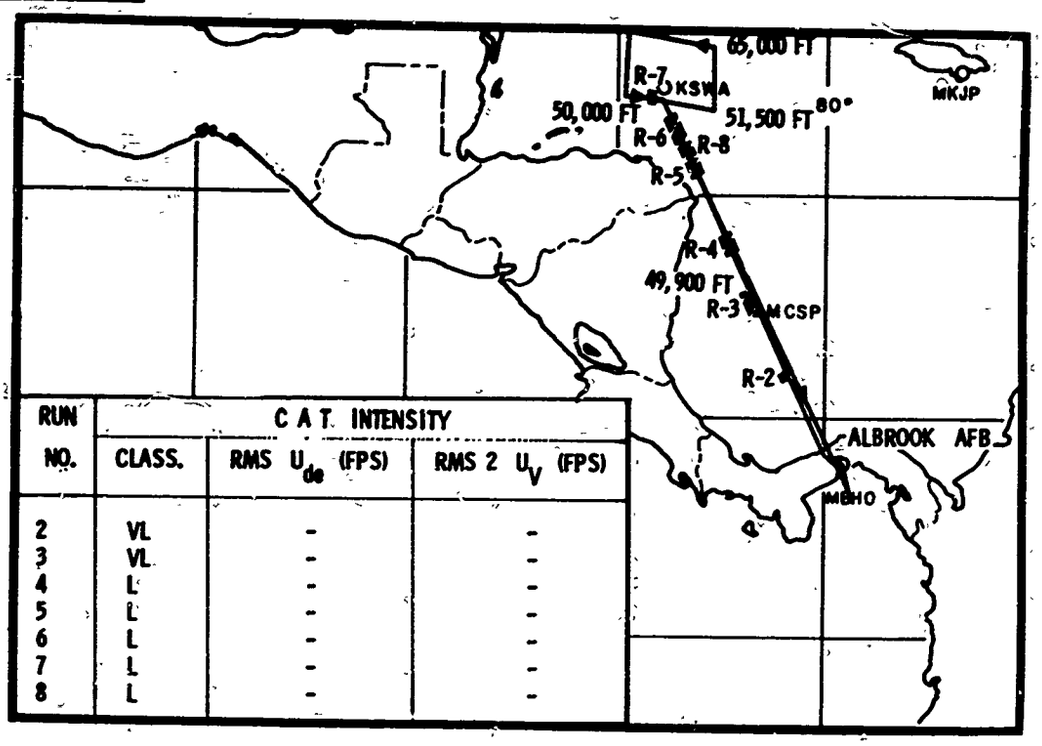
APPENDIX VI

TEST 236

11 August 1967, 1457-1928Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



RUN NO.	C A T. INTENSITY		
	CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	-	-
3	VL	-	-
4	L	-	-
5	L	-	-
6	L	-	-
7	L	-	-
8	L	-	-

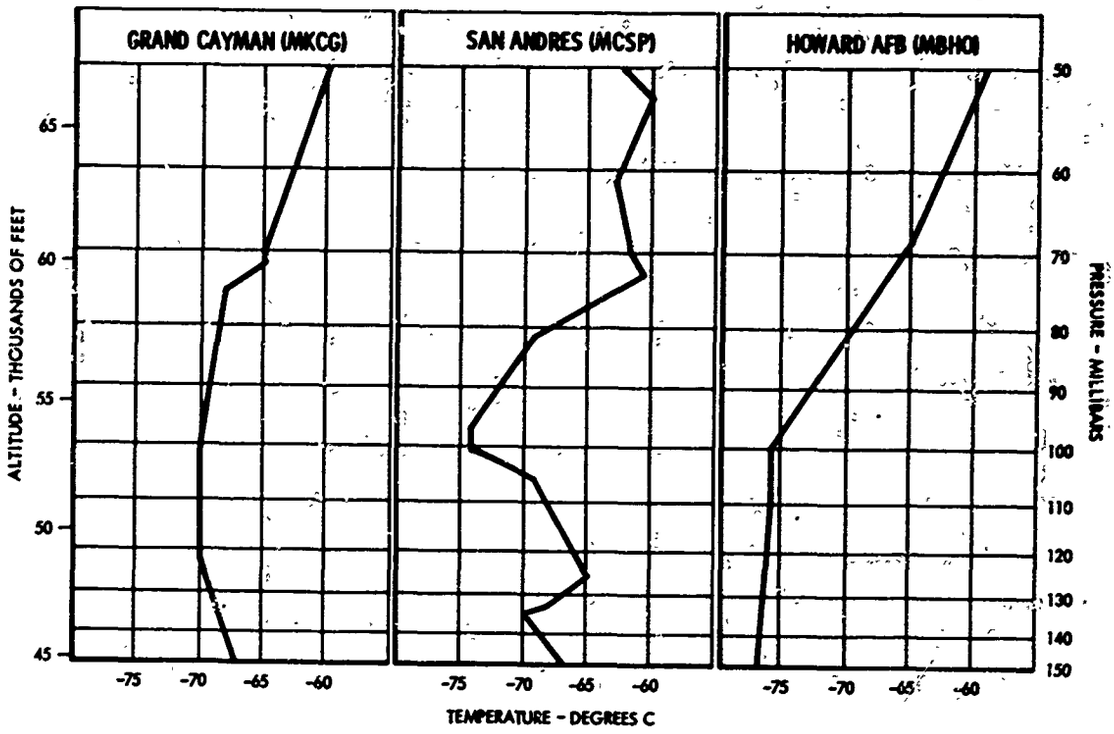
FLIGHT SUMMARY

The ITZ was centered about 100 nm south on this date and was marked by weak convective activity. A large area of height change, between 15° — 20°N, was evident on the 70 mb ΔZ chart.

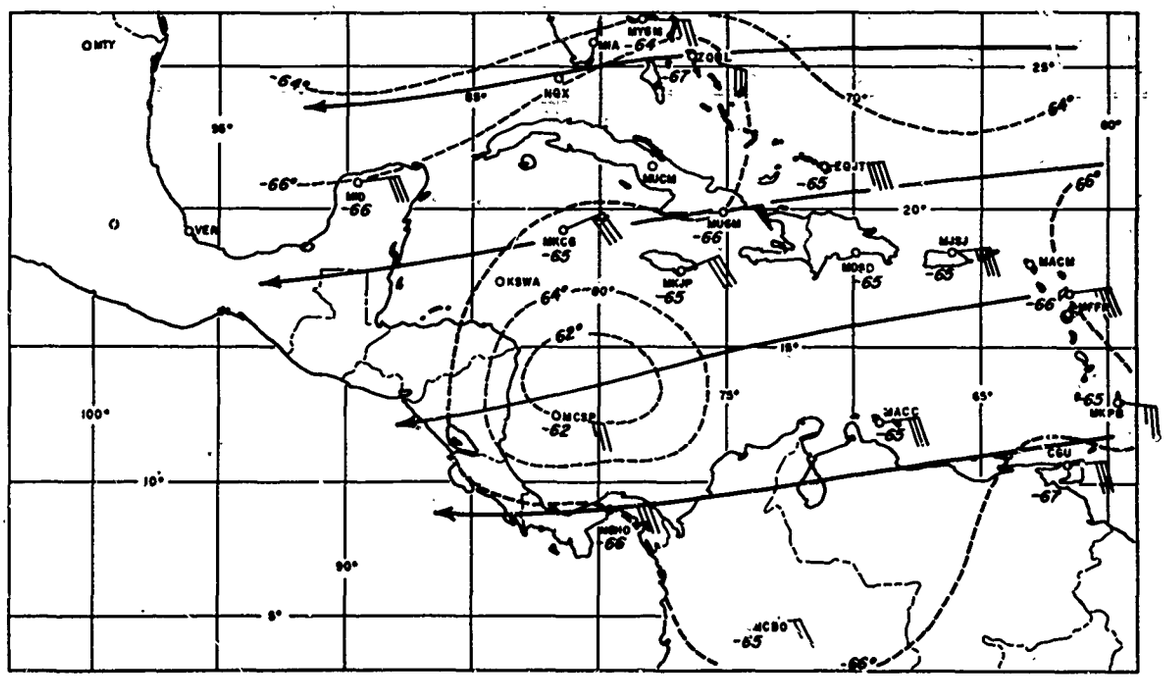
The pilot was directed to sample this region and encountered considerable very light to light CAT most of which was in the vicinity of MCSP.

Notice that a vertical temperature gradient of 1.8°C/1000 feet with a characteristic waveform existed over MCSP between 45,000 - 60,000 feet (RAOB chart). In the 70 mb analysis, note the warm thermal trough at 70 mb over MCSP.

RAOB CHARTS (1200Z, 11 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 11 Aug 1967)



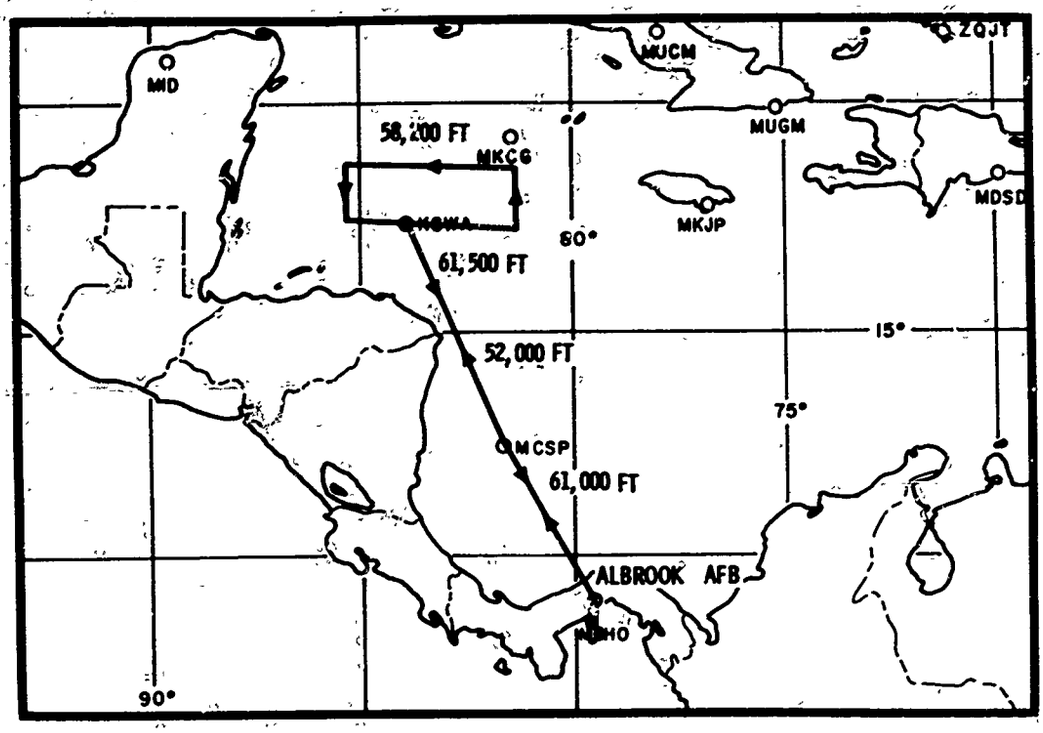
APPENDIX VI

TEST 237

14 August 1967, 1453-1956Z

Albrook AFB, Canal Zone (Panama)

FLIGHT TRACK



FLIGHT SUMMARY

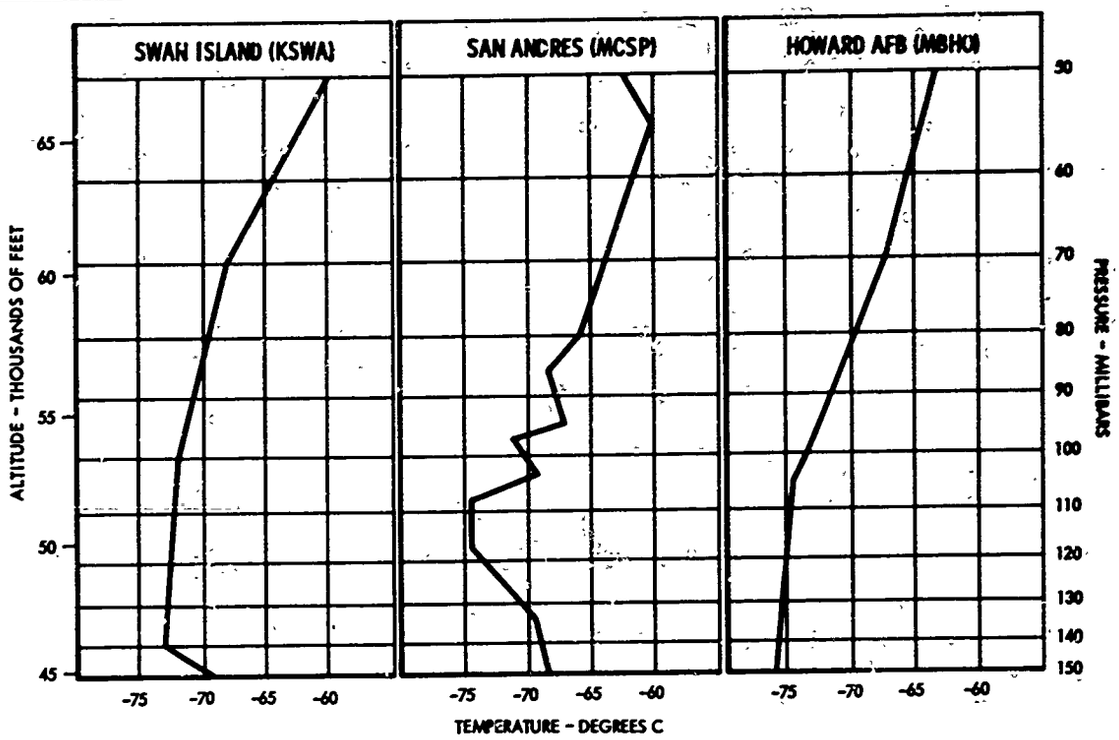
The ITZ activity was very light for this date. The 0000Z ΔZ analysis had indicated a significant drop of the 70 mb surface over an area KSWA to MKJP.

The flight route was to KSWA and return to sample that area.

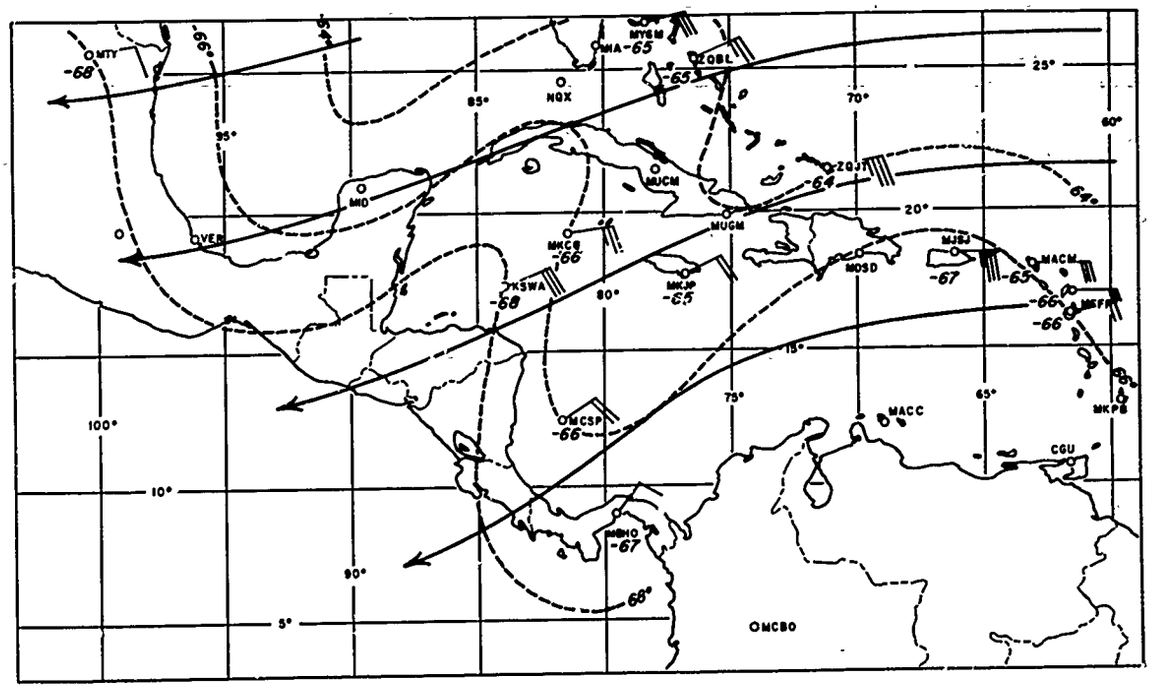
The pilot reported patches of very light to light CAT at wide intervals along the route.

The 1200Z RAOB between 51,500 - 53,000 feet for MCSP is typical of that associated with moderate to severe CAT. The vertical temperature gradient was 3.6°C/1000 feet. It appeared the pilot flew across this area at about 60,000 feet and missed the turbulence although the time difference of 6 hours is a factor also. Notice the well defined thermal trough at 70 mb that was located over MCSP.

RAOB CHARTS (1200Z, 14 Aug 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 14 Aug 1967)



APPENDIX VI

TEST 238

17 August 1967, 1253-1937Z

Ferry flight from Albrook AFB, Canal Zone (Panama) to Edwards AFB, California, U.S.A.

FLIGHT TRACK

FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

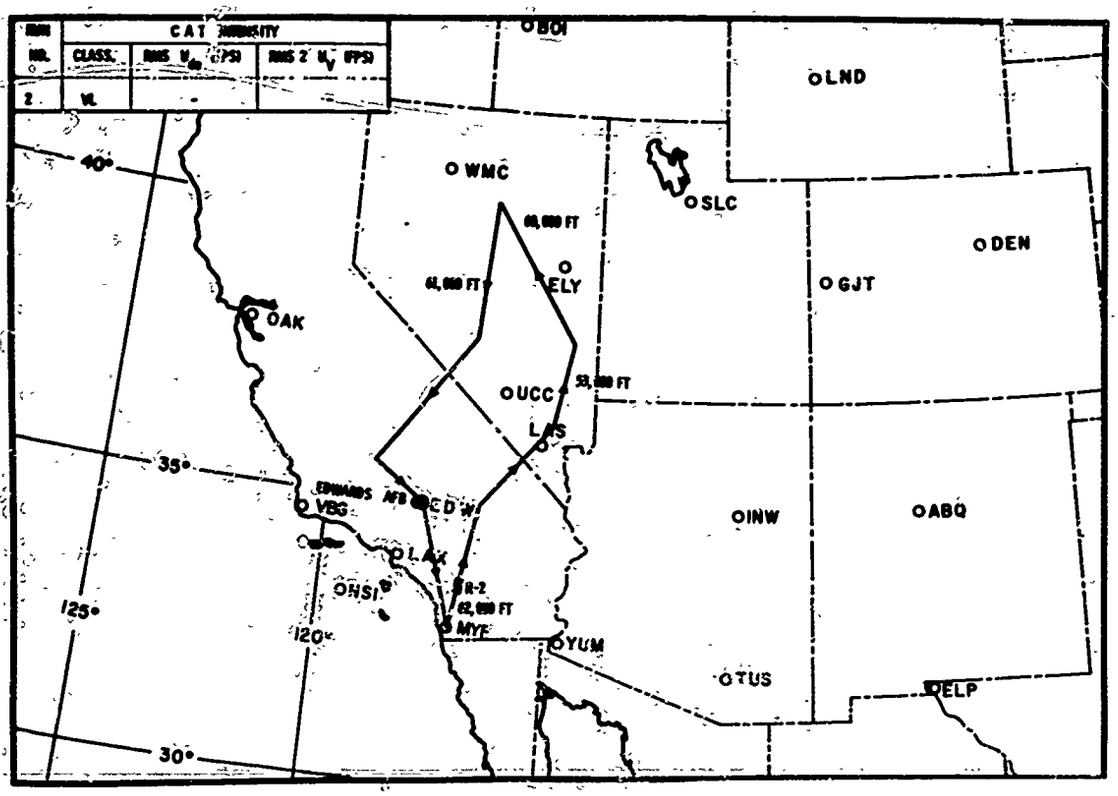
APPENDIX VI

TEST 239

5 September 1967, 1733-2056Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



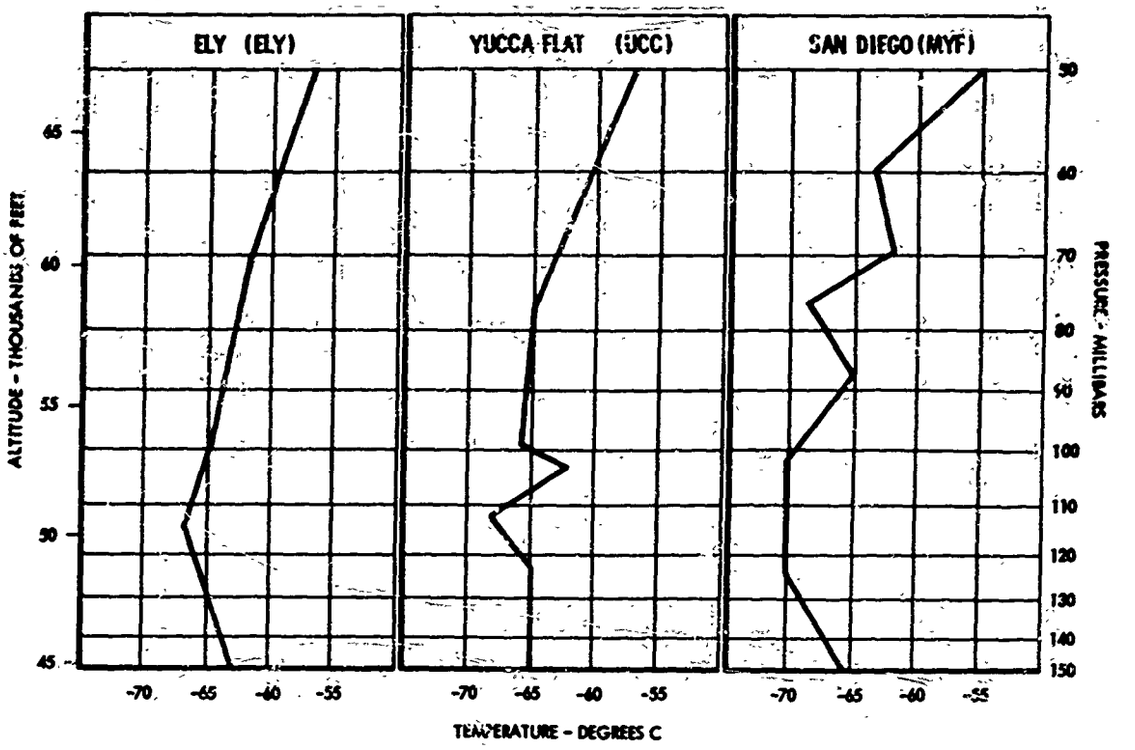
FLIGHT SUMMARY

The flight was out of Edwards AFB during a layover period between excursions to the Canal Zone (Panama) and Patrick AFB.

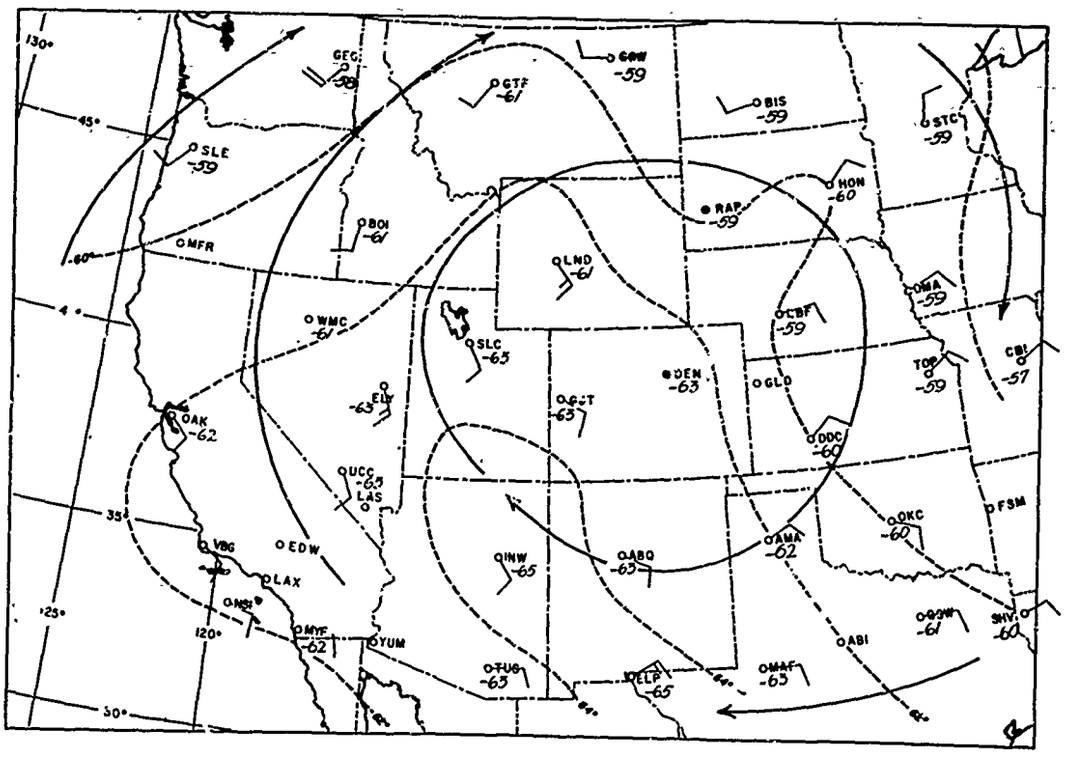
The 0900Z surface analysis showed a weak trough extending from the Gulf of California through central California and a high pressure (1017 mb) centered over Nevada. A 500 mb ridge covered most of the western U.S. and persisted well up into the troposphere. A rather weak temperature gradient existed at 70 mb. The skies were mostly clear at all levels except for a line of cumulonimbus between UCC and WMC and a cirrus overcast east of ELY.

Only very light turbulence was reported except for a thin layer of light CAT at 60,000 feet about 65 miles southeast of WMC and a brief period of light CAT at 54,500 feet 100 miles north of EDW.

RAOB CHARTS (1200Z, 5 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 5 Sep 1967)



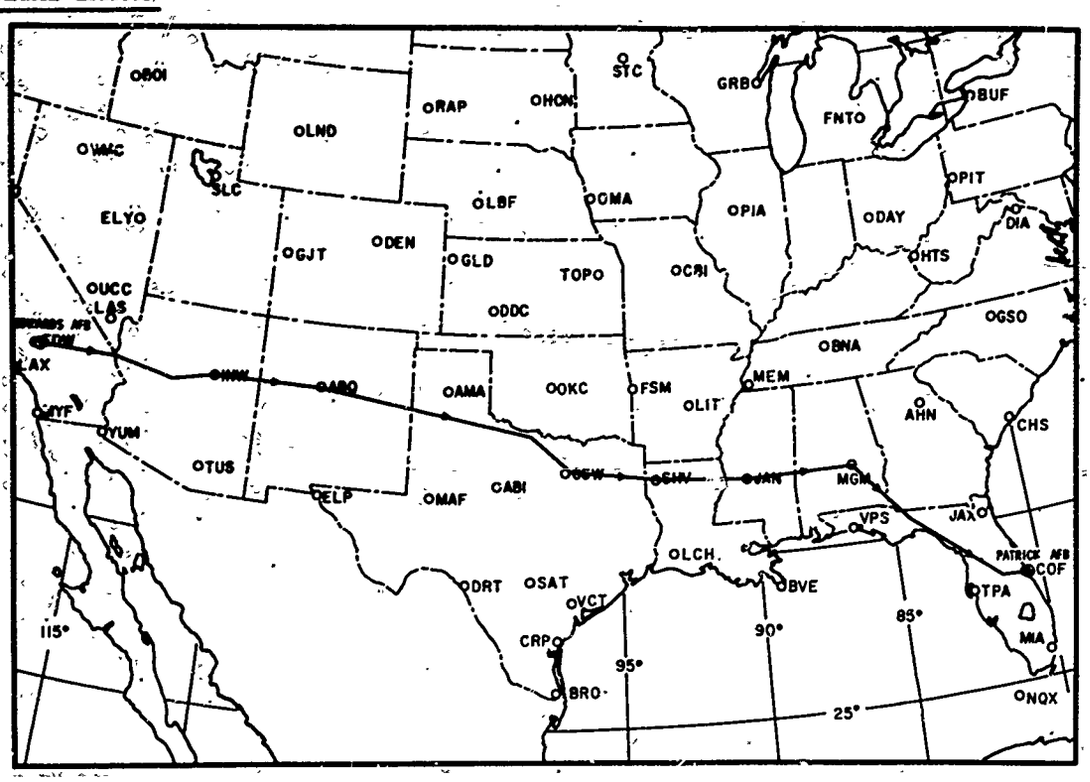
APPENDIX VI

TEST 240

8 September 1967, 1537-2058Z

Ferry flight from Edwards AFB, California to Patrick AFB, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

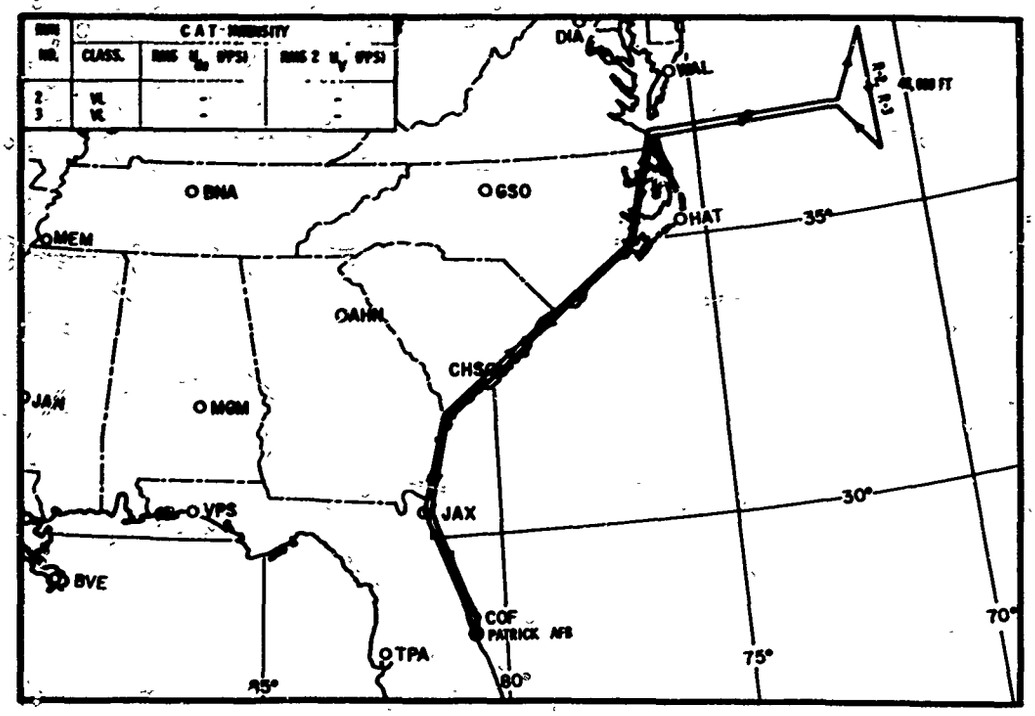
APPENDIX VI

TEST 241

11 September 1967, 1410-1946Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

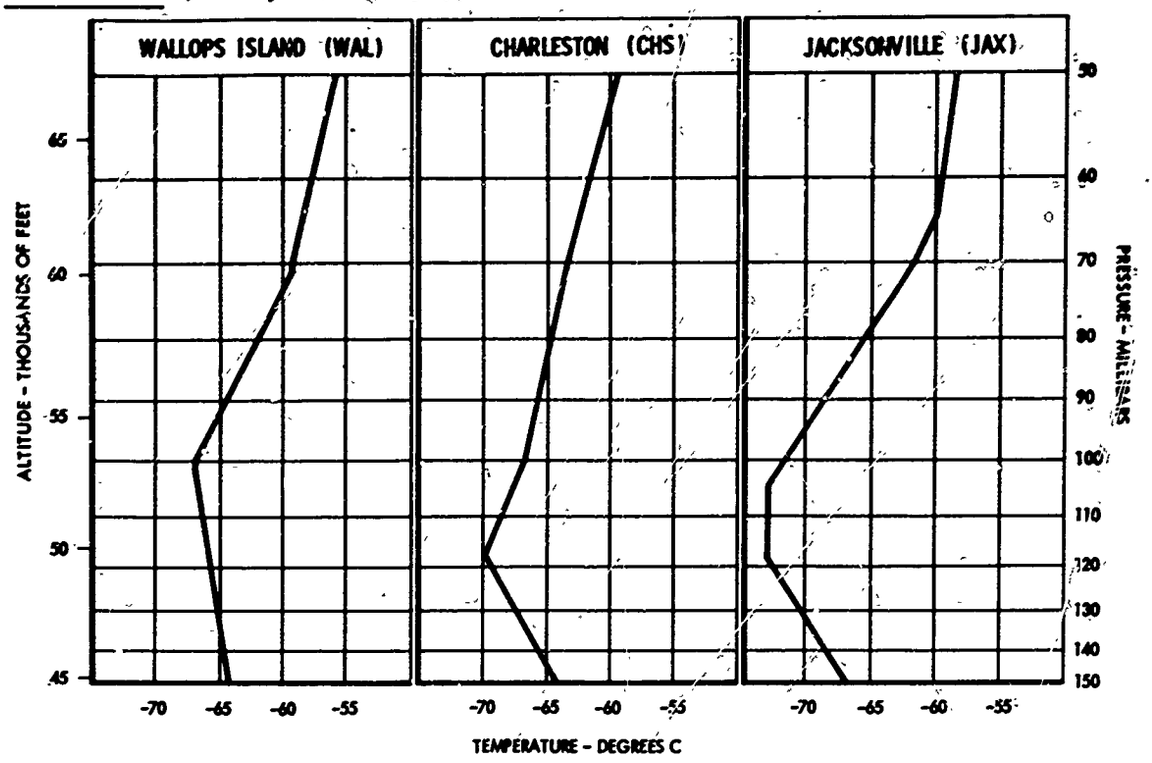
This mission was flown to sample for turbulence over Hurricane Doria. During the time of this flight Doria was centered near 37°N, 71°W and about 300 nm east of Norfolk, Virginia.

RAOB's, of course, were not available in the sampled area. The RAOB observations shown are along the route to and from the hurricane. The pilot reported no CAT along this route.

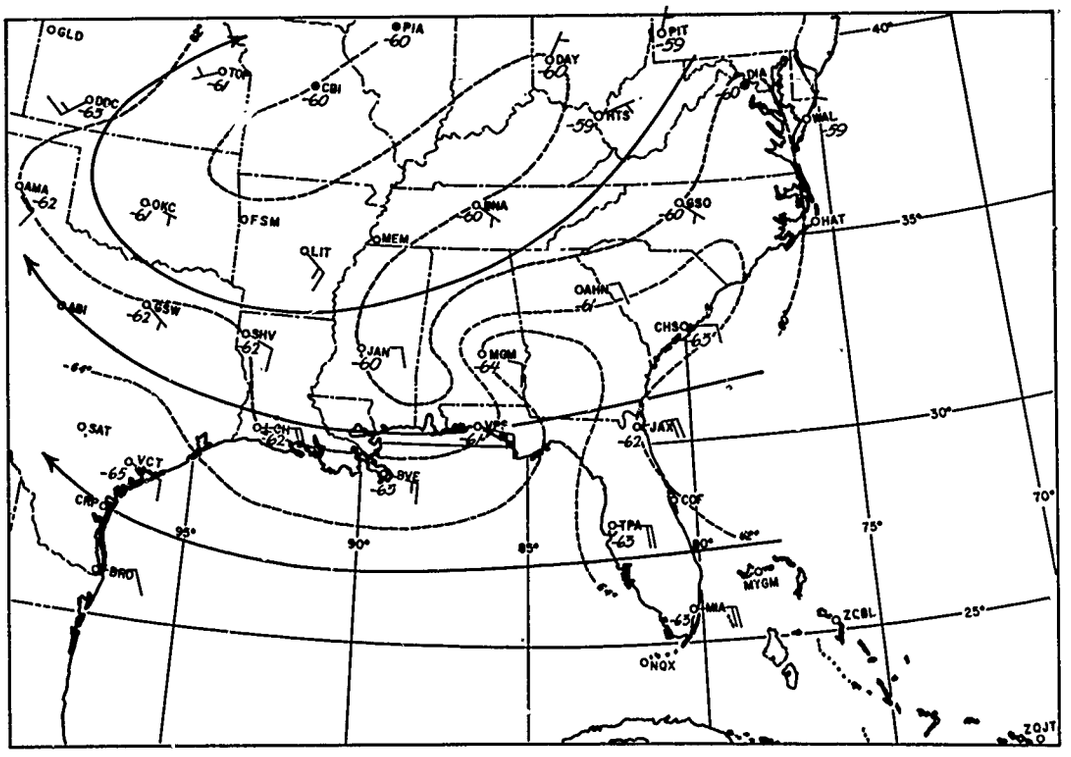
As he approached the hurricane from the west at 60,000 feet he described the bands of clouds that could be seen spiraling towards the center. The west outside wall of Doria was almost vertical. Eastward a layer of cirrus extended as far as he could see. Cloud tops over Doria were 48,000 feet indicated. Very light CAT was detected. Runs 2 and 3 were processed.

The 70 mb analysis does not include the region over which Doria was positioned. However, it appears the hurricane would have been under a thermal trough.

RAOB CHARTS (1200Z, 11 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 11 Sep 1967)



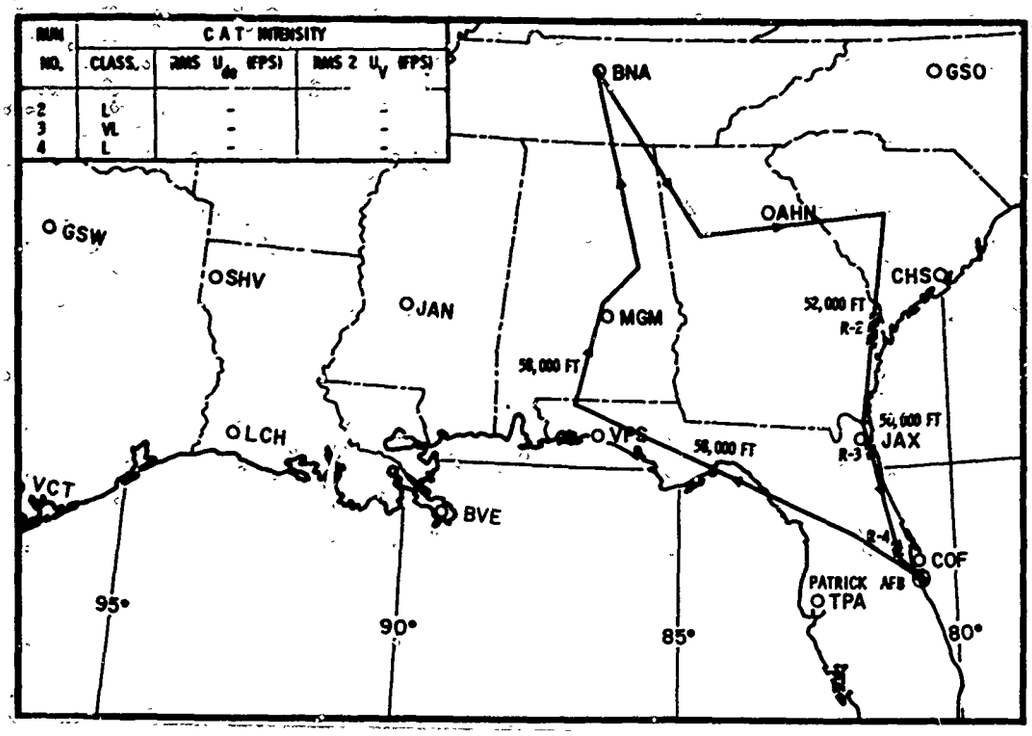
APPENDIX VI

TEST 242

12 September 1965, 1718-1813Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

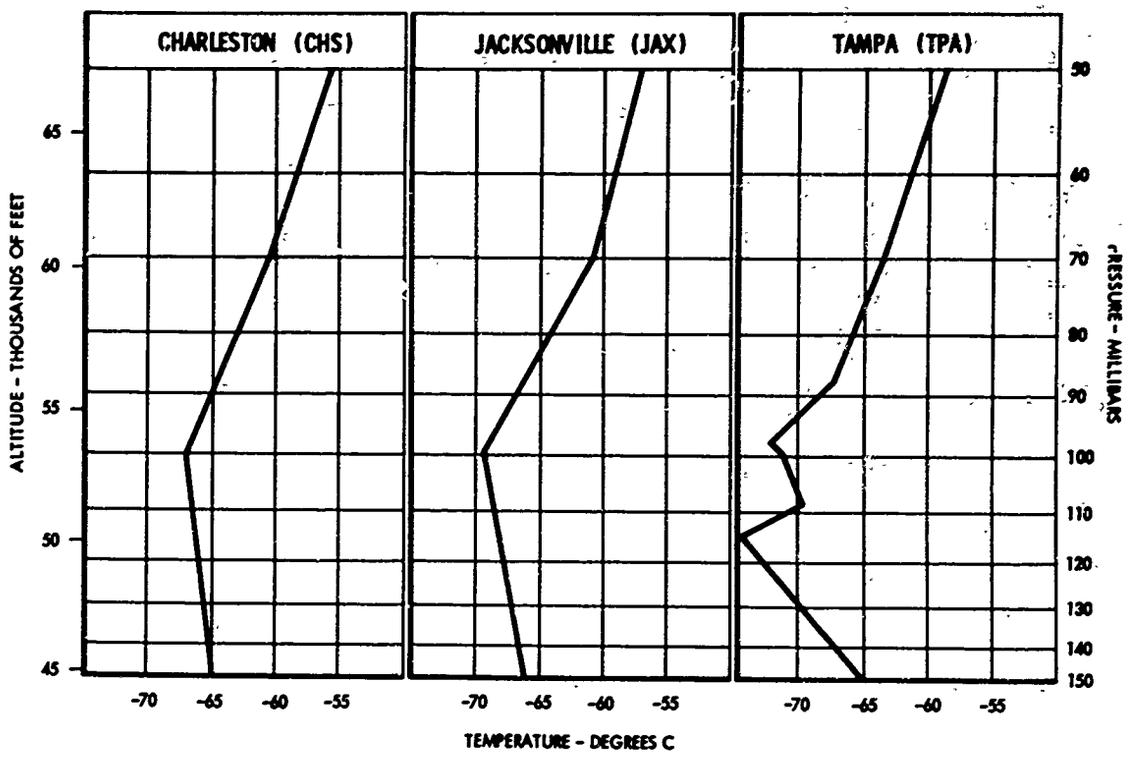
The 1200Z surface chart for this date showed the eastern third of the nation to be under the influence of a high pressure system centered over New England. The large ridge extended southwards to cover the southeastern states and the sampled area.

At 200 mb, a trough was aligned with the Louisiana–Mississippi border. Winds were southwesterly 10-20 knots over the sampled area.

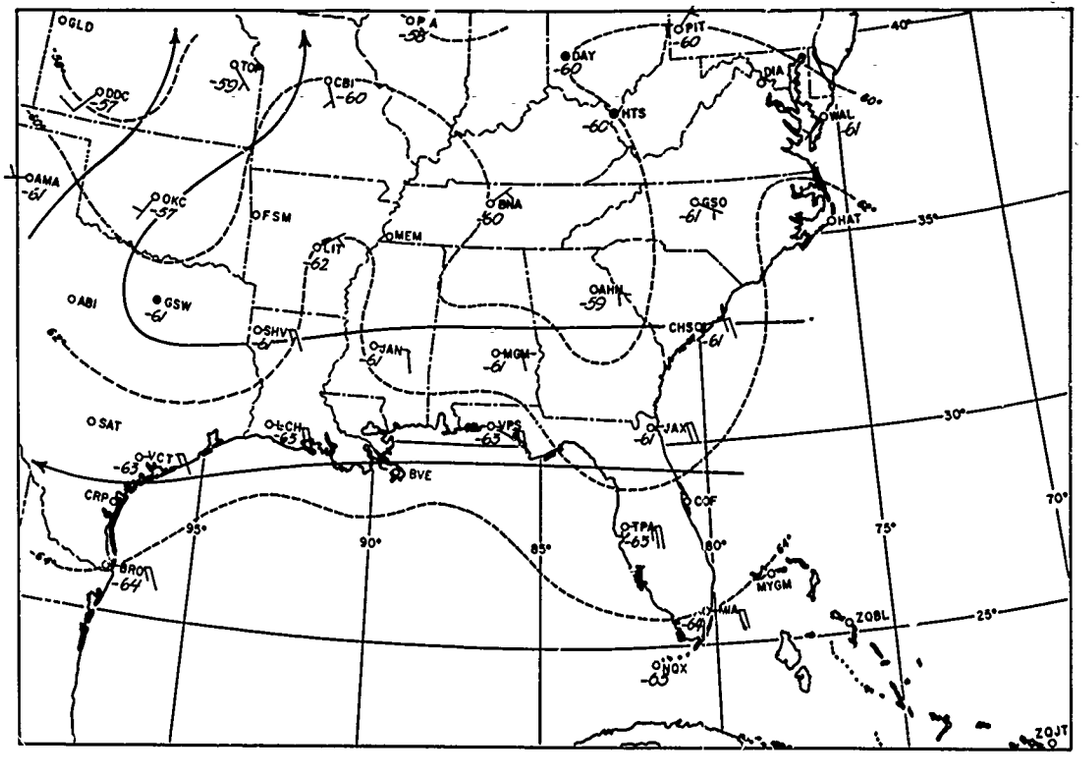
The RAOB'S show small vertical temperature gradients over CHS and JAX, but a gradient change is evident at 53,000 feet which is near the level of CAT sampled in Run 2.

A small horizontal temperature gradient over sampled area is indicated.

RAOB CHARTS (1200Z, 12 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 12 Sep 1967)



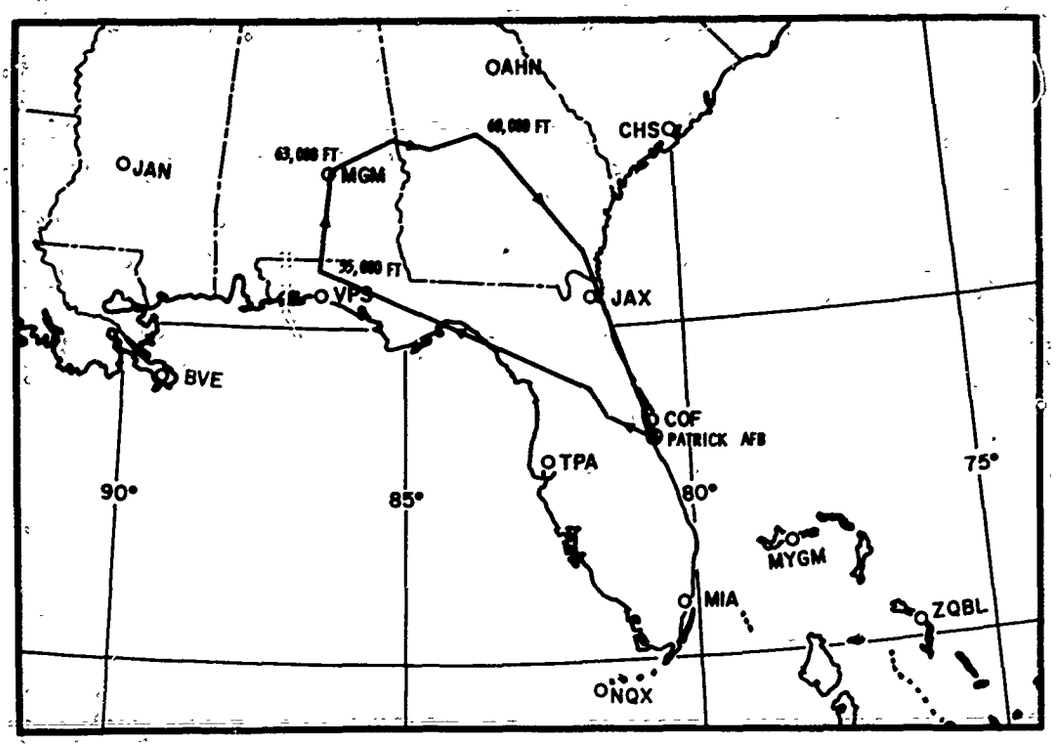
APPENDIX VI

TEST 243

14 September 1967, 1525-1817Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At the surface on this date, the southeastern states were dominated by the southern half of a large high pressure system covering the eastern seaboard. Skies were clear to scattered.

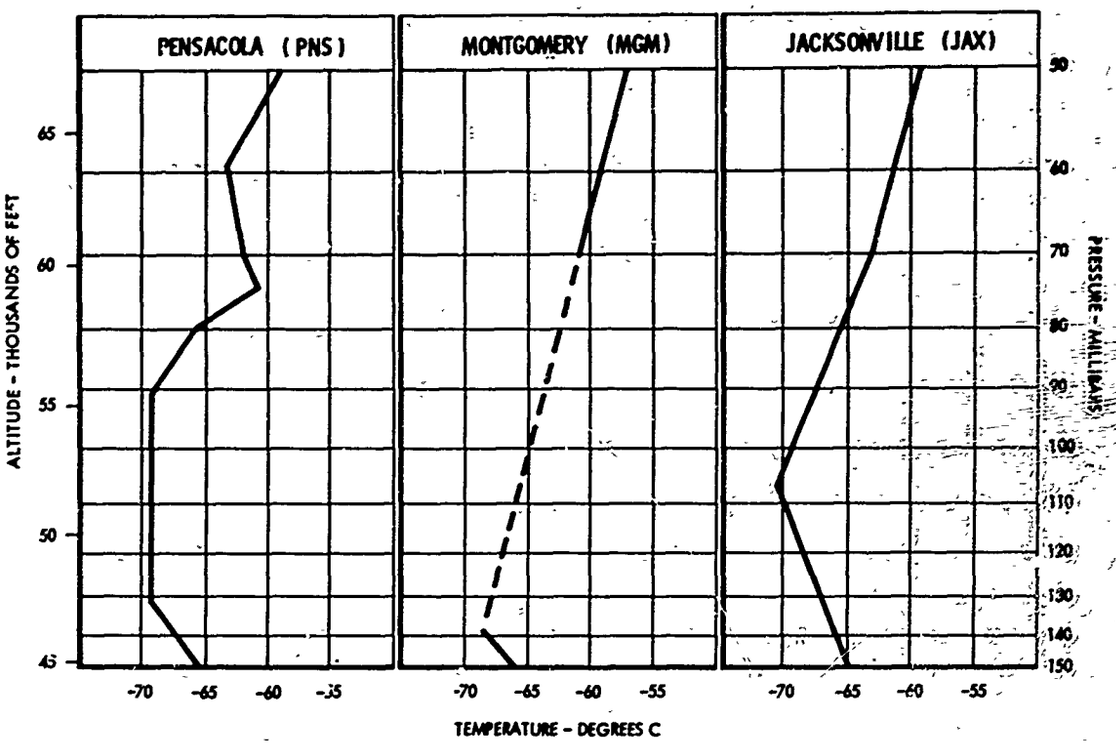
At the 200 mb level the 1200Z analysis showed a weak ridge over the operating area. Winds were 10 knots and westerly.

The pilot reported one very light patch of turbulence at 60,000 feet over central Georgia. No runs were processed.

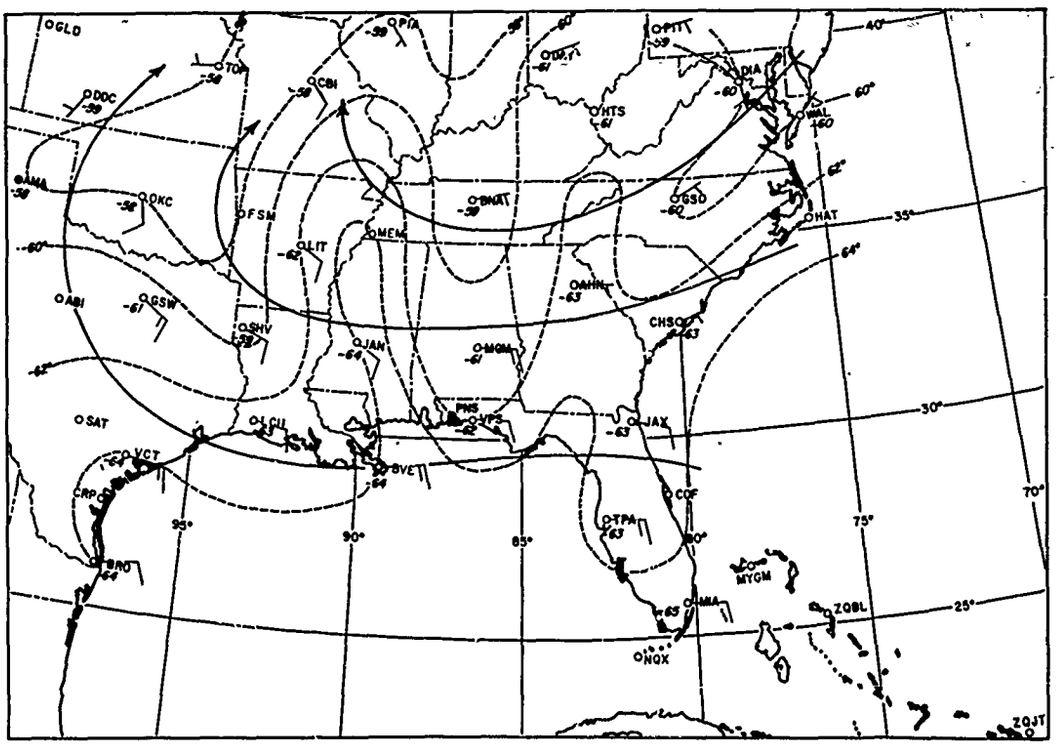
The 1200Z RAOB analysis indicated the vertical temperature gradients over PNS, MGM and JAX were very small.

The 1200Z, 70 mb analysis shows a thermal trough over the Florida coast but a very small horizontal temperature gradient.

RAOB CHARTS (1200Z, 14 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 14 Sep 1967)



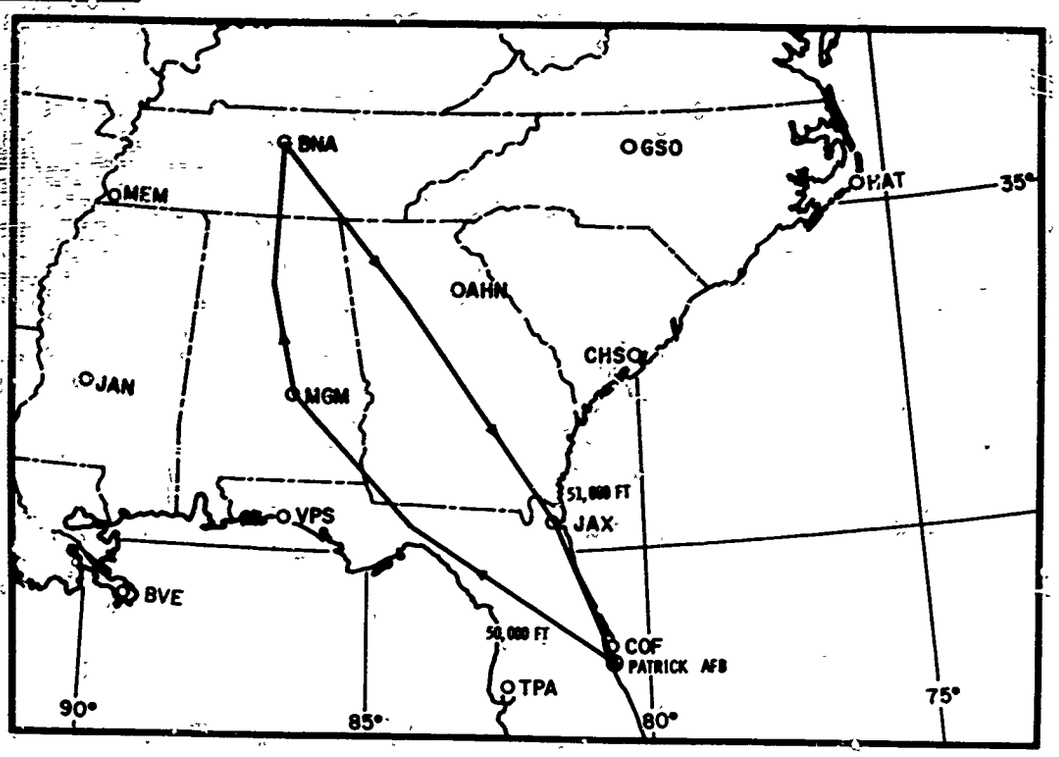
APPENDIX VI

TEST 244

15 September 1967, 1444-1847Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

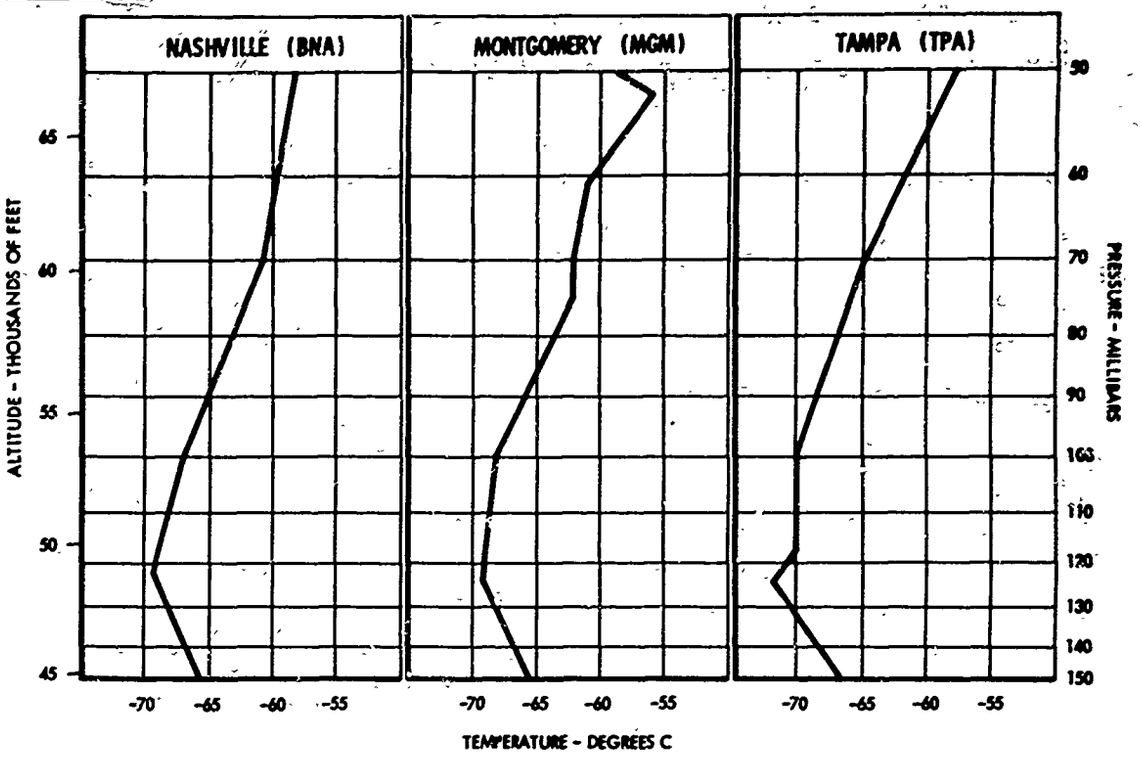
The surface high pressure ridge described in Tests 242 and 243 that had dominated the synoptic weather pattern over the eastern third of the nation 12 through 14 September 1967 continued to prevail on this date. Light winds and increased moisture in the lower levels caused fog and haze to form over the southeastern states.

Aloft, the 1200Z, 200 mb analysis showed a weak ridge positioned over Mississippi. Winds were north-northwest at 10-15 knots.

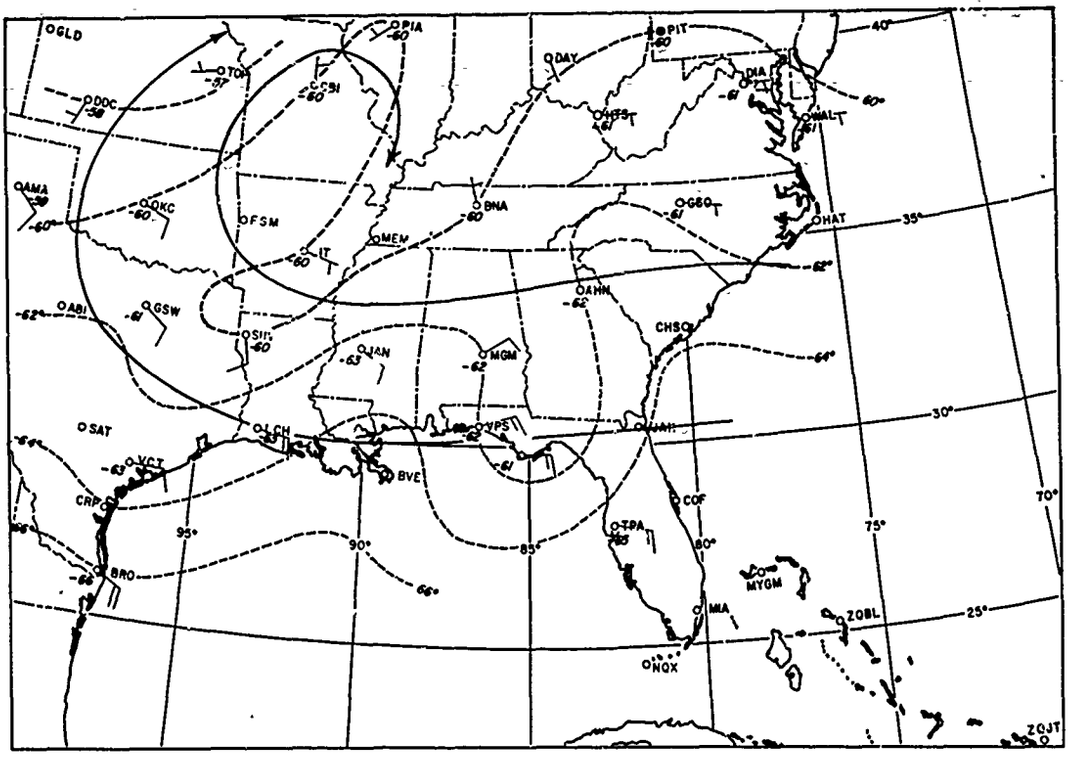
The pilot reported a few patches of very light CAT at 51,000 feet near JAX. No runs were processed.

Notice the small vertical and horizontal temperature gradients on the RAOB and temperatures and winds charts.

RAOB CHARTS (1200Z, 15 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 15 Sep 1967)



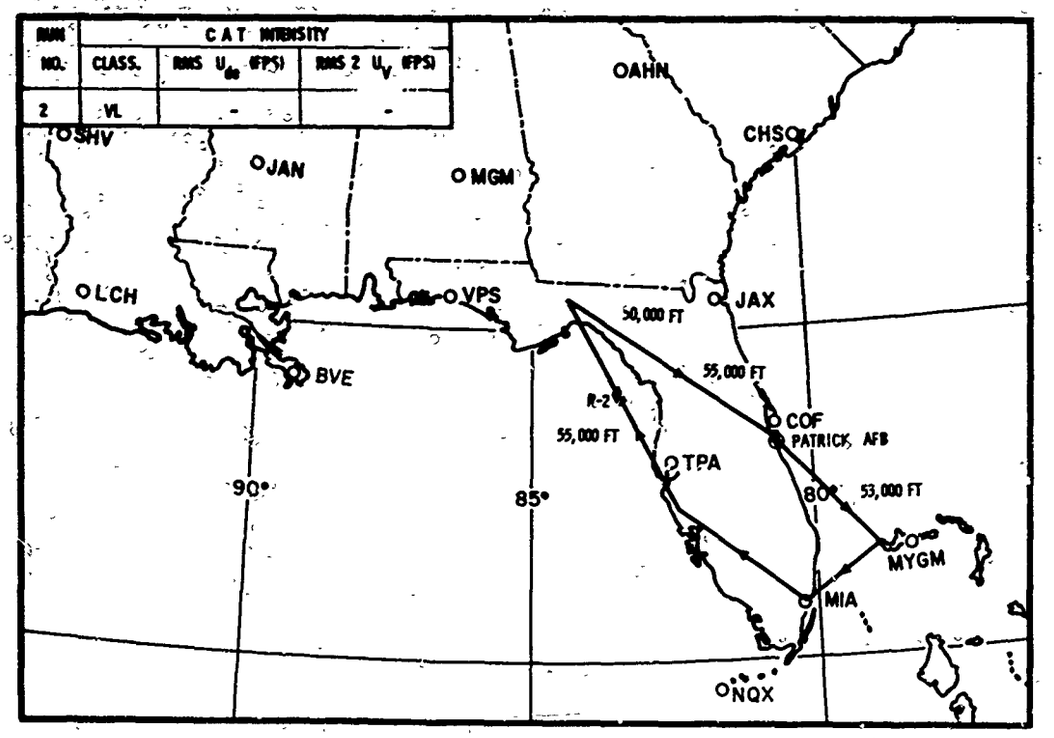
APPENDIX VI

TEST 245

18 September 1967, 1351-1656Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

A flat, semi-stationary, high pressure system prevailed over the southeastern states region on this date; at 1200Z, Hurricane Beulah was positioned near 22°N 93°W in the Gulf of Mexico.

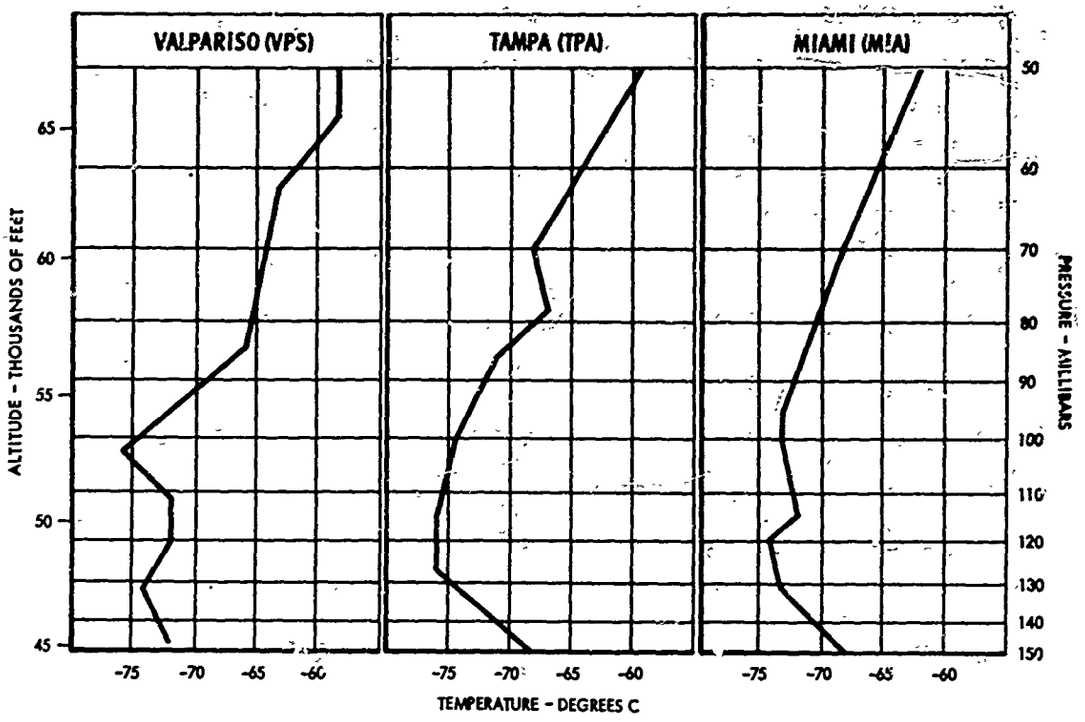
Aloft, the 1200Z, 200 mb analysis showed an elongated ridge from Texas to Florida. Winds were west to northwest at 10-15 knots.

The pilot reported a few patches of very light CAT over Tallahassee, Florida, at flight level 52,000 - 55,000 feet. Run 2 was processed.

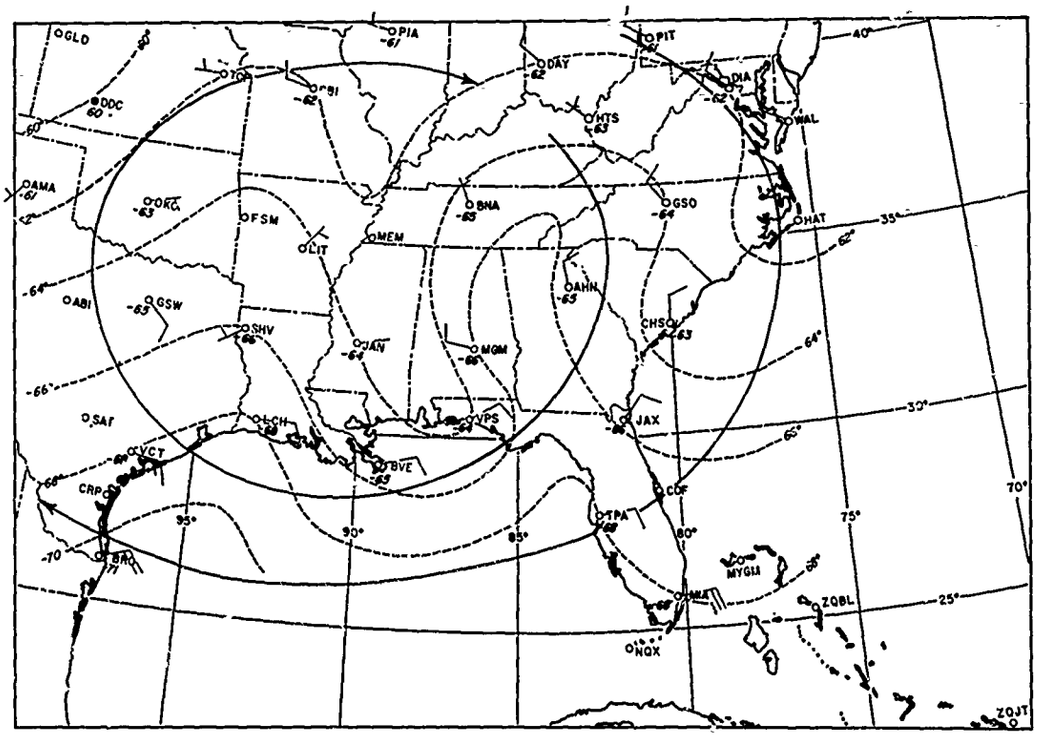
The RAOB analysis shows a vertical gradient change at 53,000 feet over VPS which is near Tallahassee.

Notice the well defined thermal trough over VPS.

RAOB CHARTS (1200Z, 18 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 18 Sep 1967)



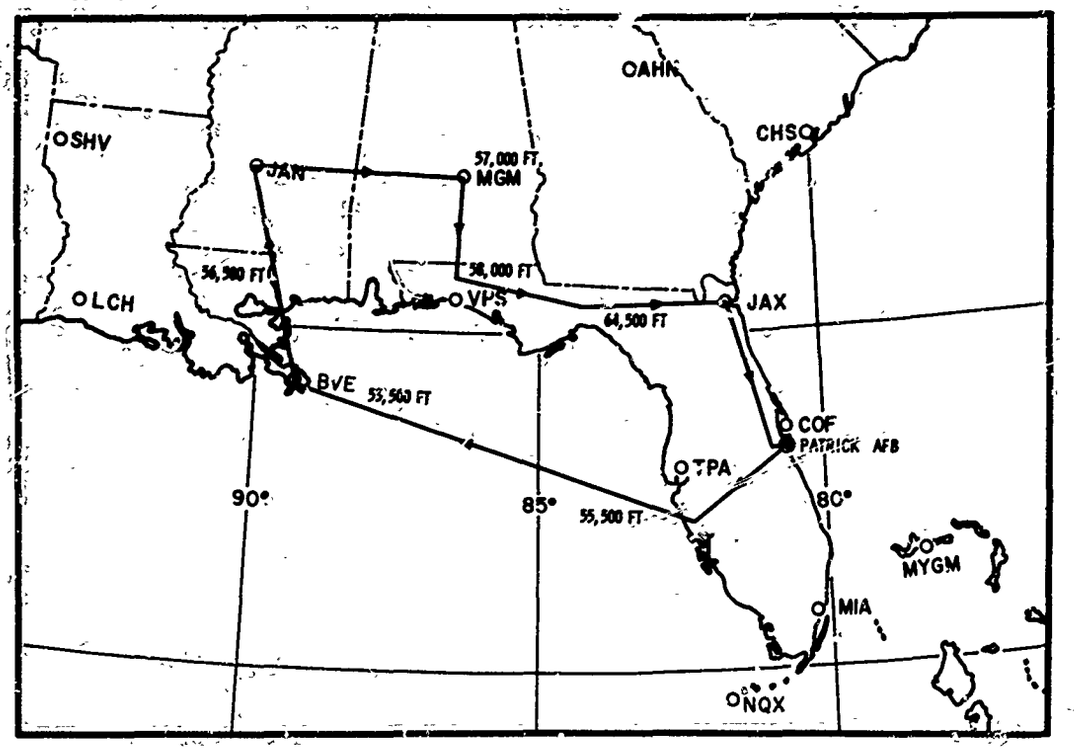
APPENDIX VI

TEST 246

19 September 1967, 1407-1816Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At 1200Z, a surface ridge that had dominated the synoptic pattern over the southeastern states since 12 September 1967 was still evident.

Fog and haze prevailed in the lower levels. Hurricane Beulah was positioned near 23.4°N, 95.8°W at 1200Z.

The flight track took the HURCAT airplane within 480 nm of the storm center.

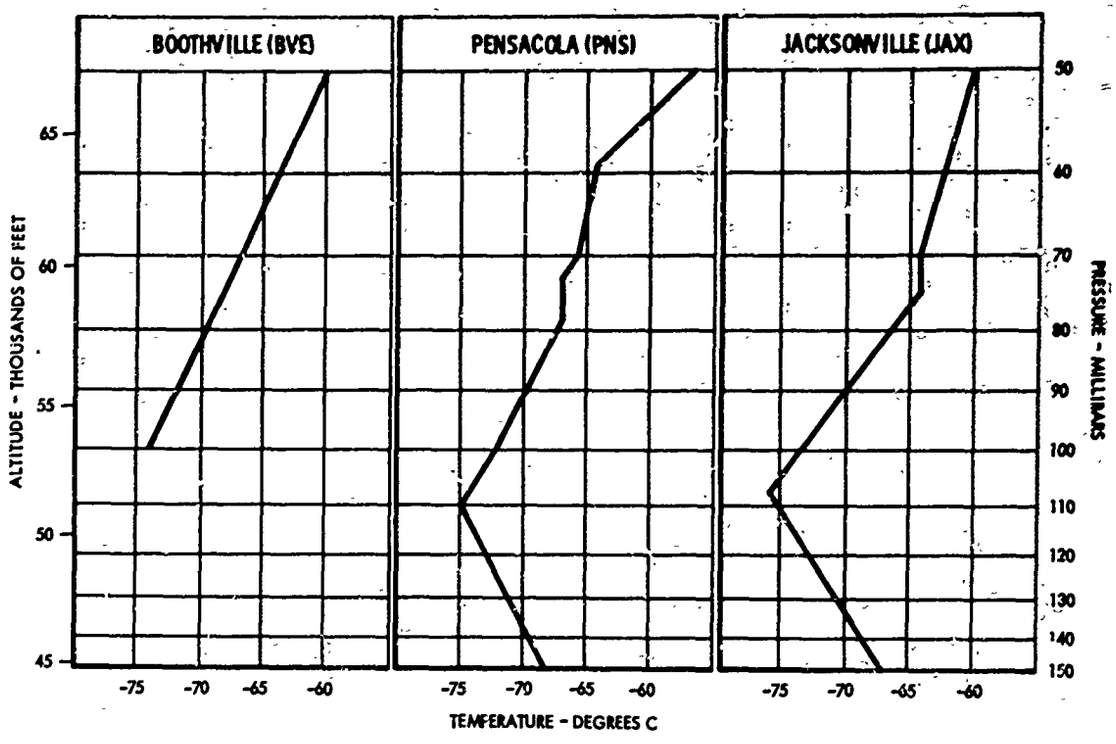
Aloft, the 1200Z tropopause analysis showed a well defined ridge with the axis over Alabama. An 80 knot jetstream extended from Oklahoma to Tennessee and Georgia and curved southward towards Cuba.

The pilot reported abundant very light CAT at flight levels 53,000 - 58,000 feet. No runs were processed. The pilot also described the turbulence as having an unusual frequency of about two cycles per second.

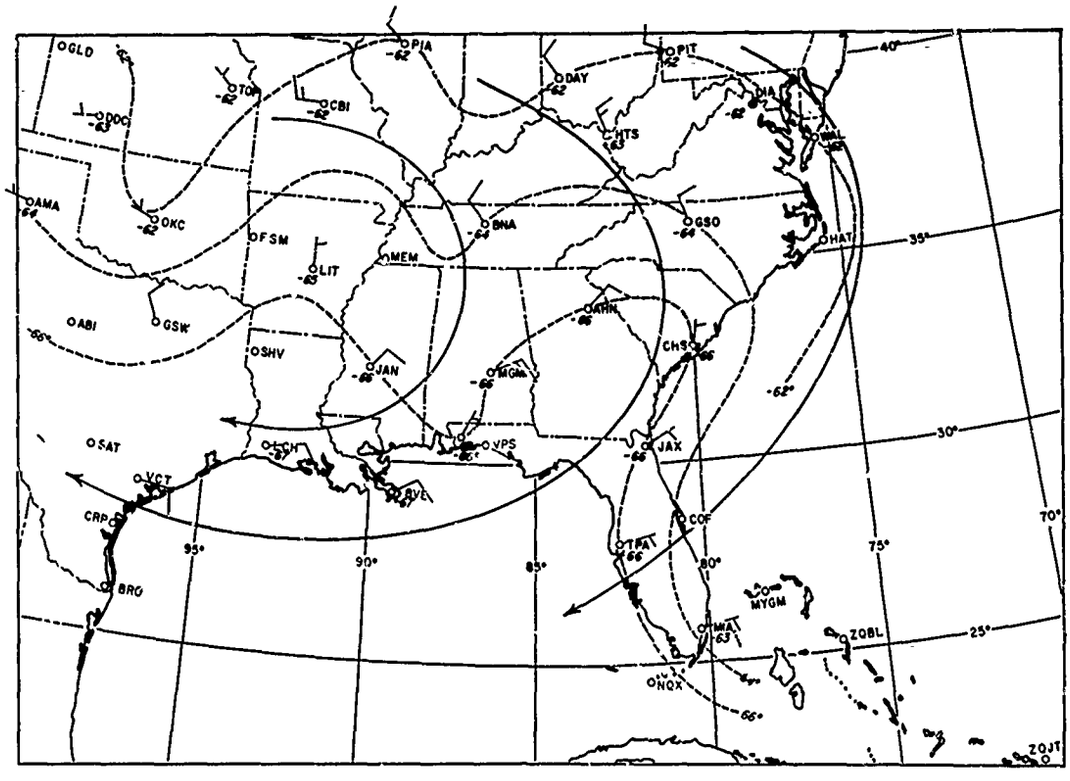
Notice the quite cold layer of air near 52,000 feet depicted by the 1200Z RAOB analysis for BVE, PNS, and JAX.

The 1200Z, 70 mb analysis shows the anticyclonic wind flow at that level over the southeastern states. Notice the sampled area was in a thermal ridge and CAT was extremely light.

RAOB CHARTS (1200Z, 19 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 19 Sep 1967)



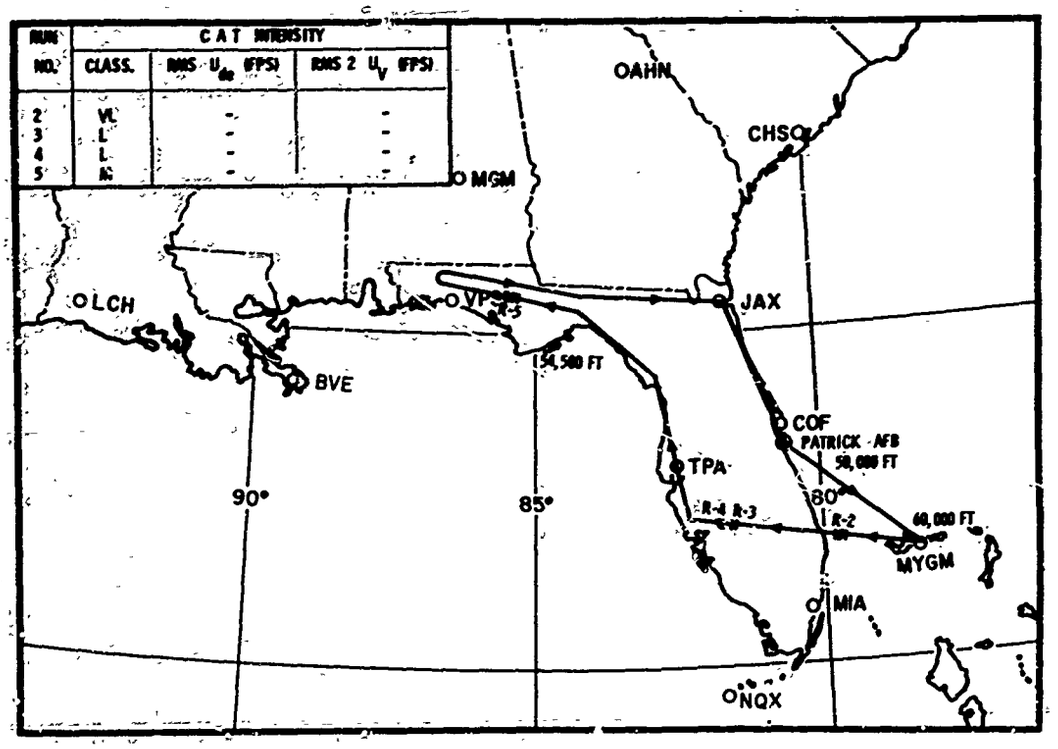
APPENDIX VI

TEST 248

21 September 1967, 1411-1734Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The stationary surface high pressure system that had first moved over the southeastern states 12 September 1967 still prevailed at the time of this flight. A cold front was moving steadily southeastward, however, and at 1200Z was positioned over southern Oklahoma and extending northeastward to Lake Michigan.

Aloft, at 1200Z, 200 mb analysis showed a weak high pressure system centered over the Gulf of Mexico. Winds at this level were north-northwest at 10-40 knots over the sampled area.

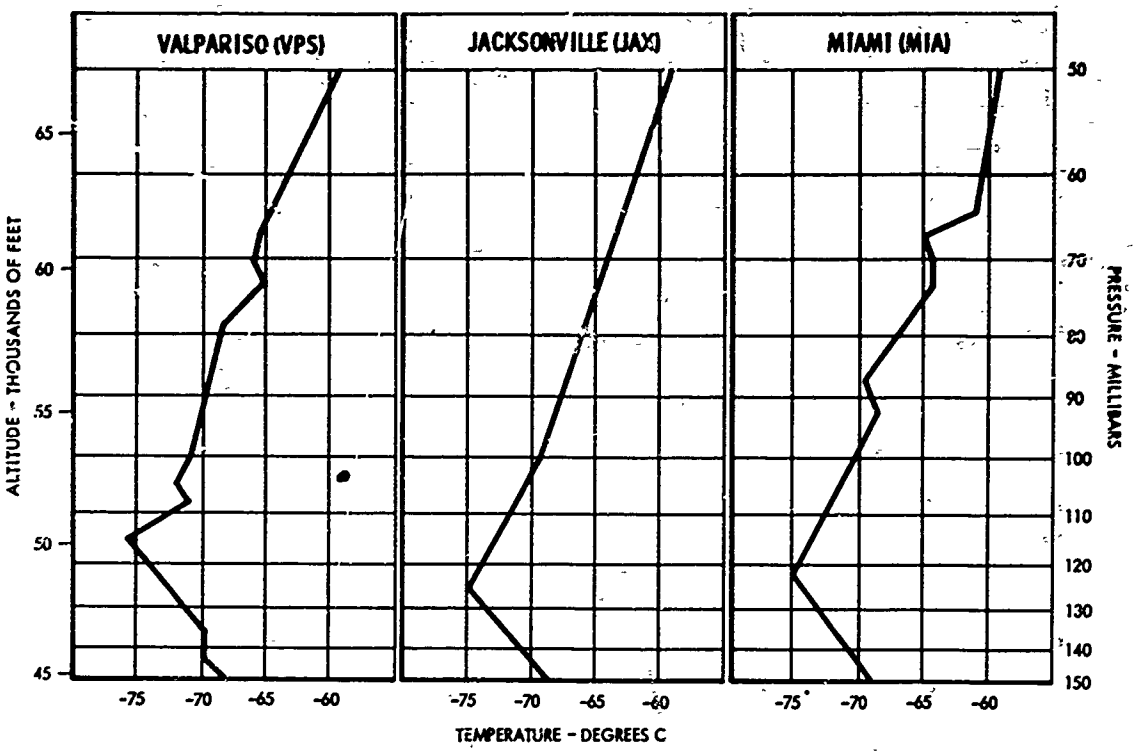
The pilot reported two areas of turbulence, one over southeastern Florida (Runs 2, 3, and 4), and the other over extreme western Florida (Run 5).

Notice the turbulence at 59,000 feet in Runs 2, 3, and 4 was first below the inversion at 61,000 feet indicated on the MIA sounding RAOB chart.

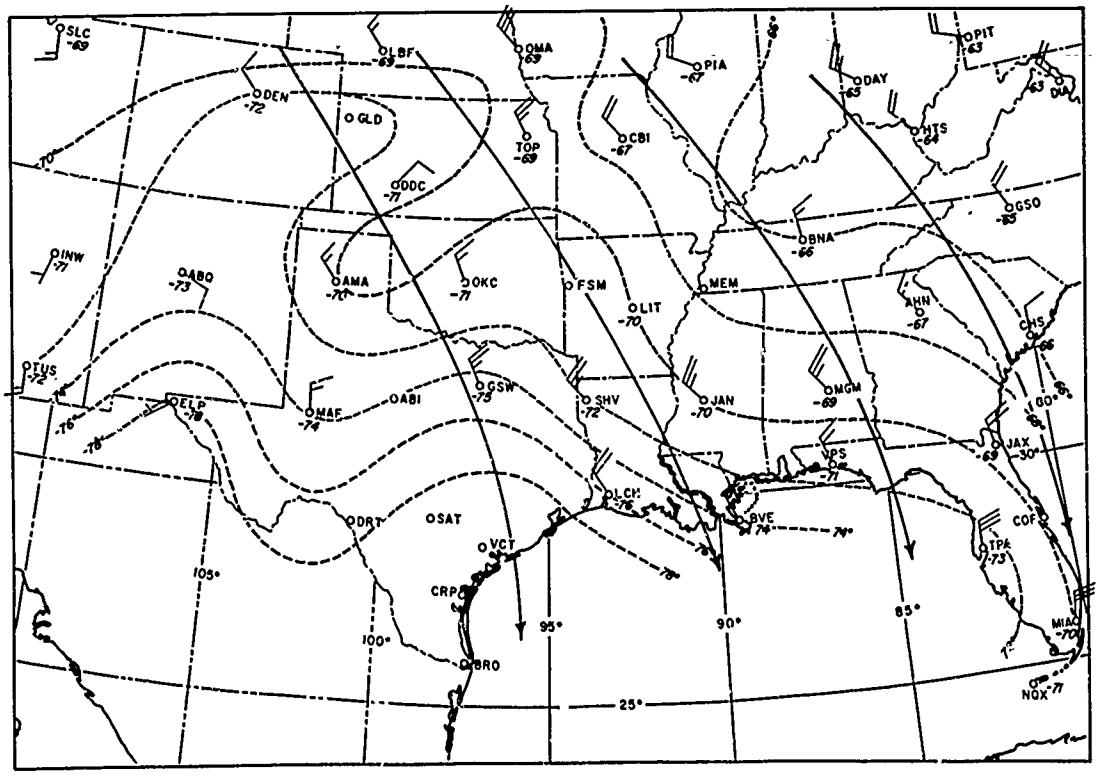
The turbulence at 48,300 feet in Run 5 was below the inversion at 50,000 feet over VPS.

The 100 mb analysis does not show any outstanding indications of thermal waves but the horizontal temperature gradient had increased considerably since the analysis 12 hours earlier.

RAOB CHARTS (1200Z, 21 Sep 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 21 Sep 1967)



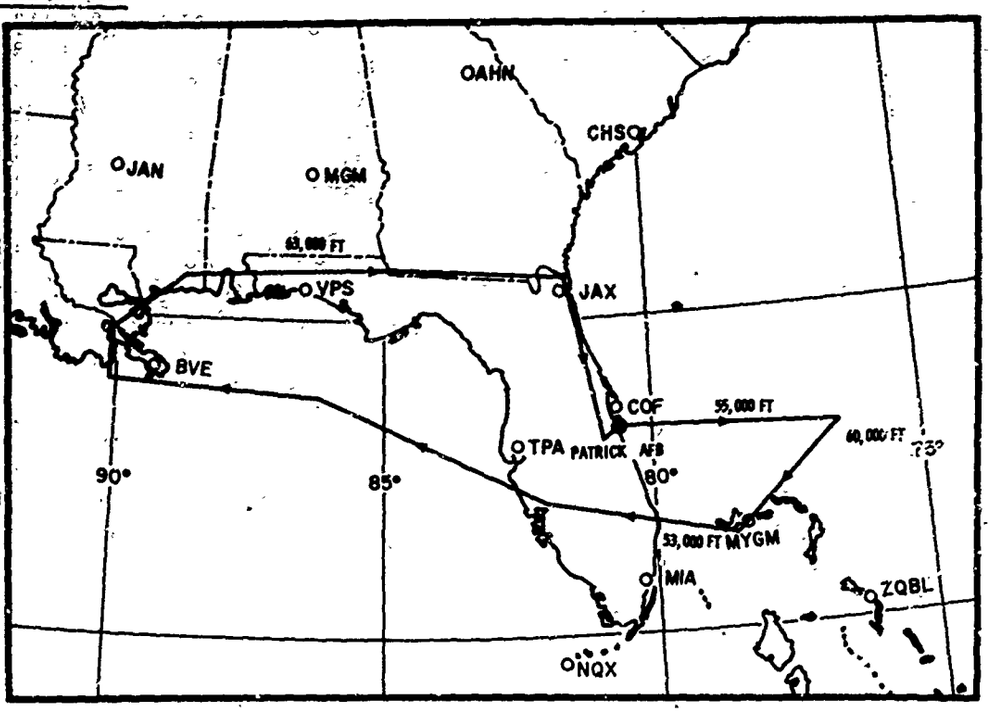
APPENDIX VI

TEST 249

25 September 1967, 1411-1844Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The 1200Z surface analysis for this date depicted a stationary cool front positioned west to east over central Louisiana, Mississippi, Alabama and Georgia. Early during the day, low stratus, fog and haze prevailed over the southeastern states. Later in the day, weak convective activity occurred.

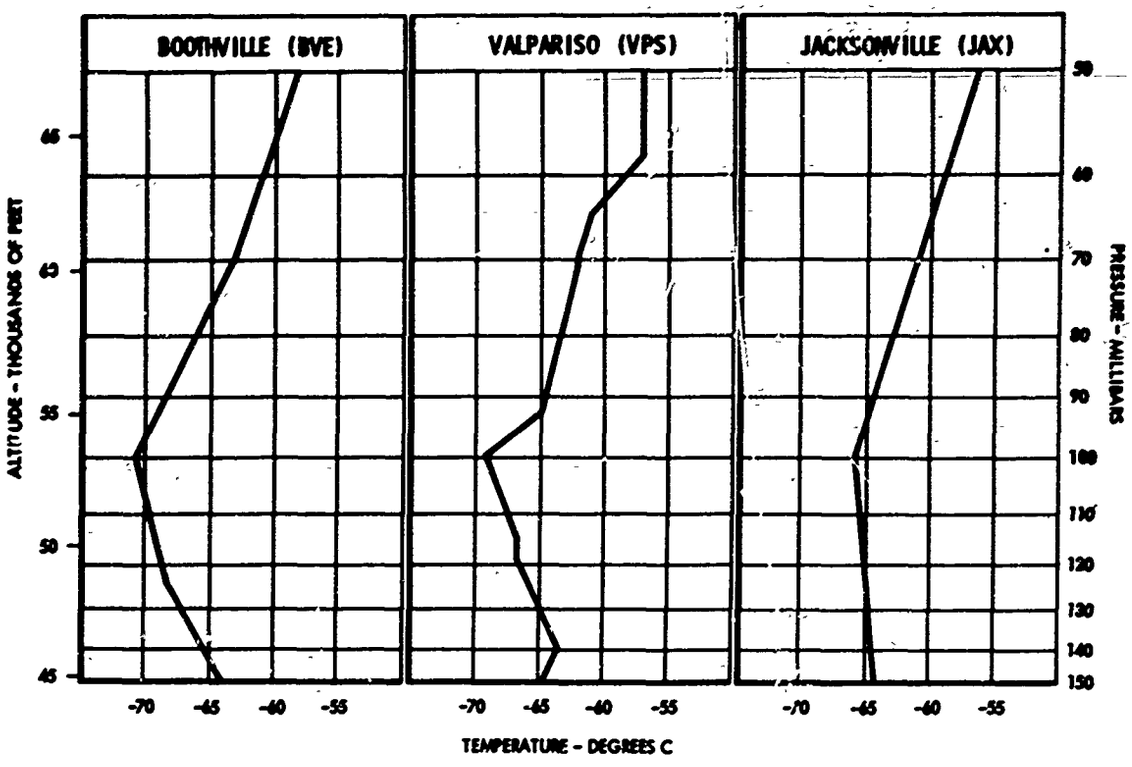
Aloft, the 1200Z, 200 mb analysis showed a ridge over Louisiana and Arkansas with northwest winds 10-15 knots over the sampling area.

The pilot reported very light to light CAT. Runs 2, 3, and 4 were processed.

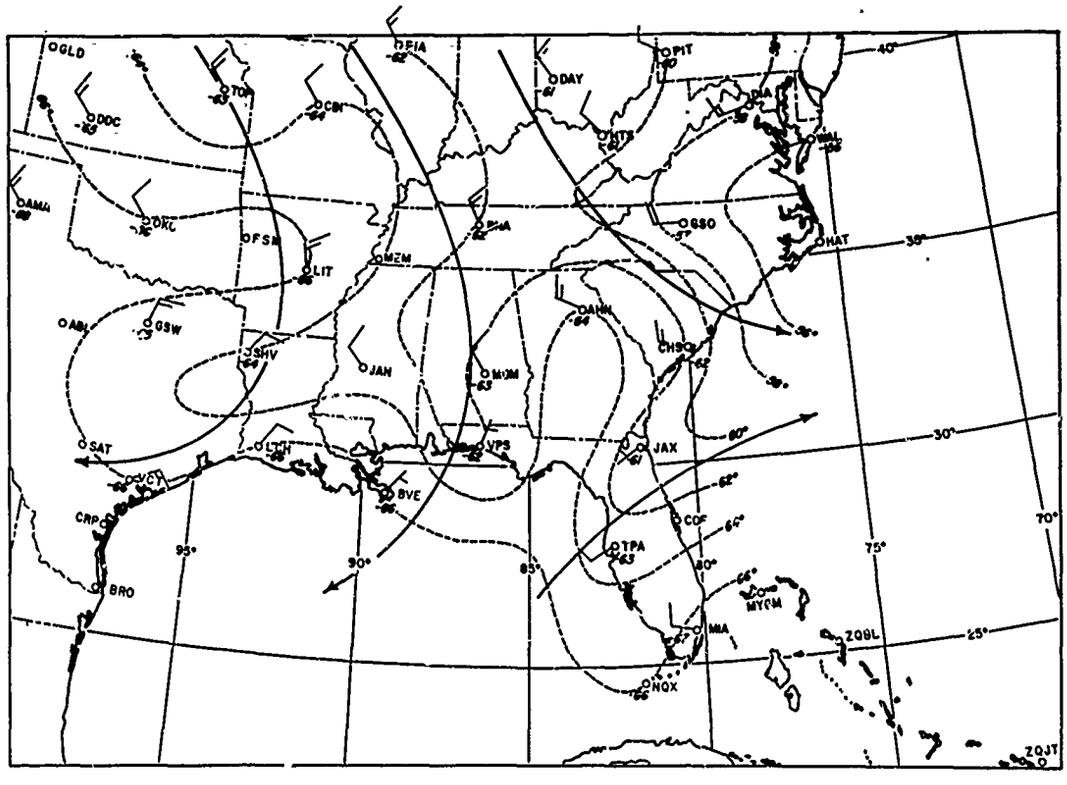
The RAOB chart shows small vertical temperature gradients over VPS and very small over BVE and JAX, two to six hours prior to sampling time.

The 70 mb analysis shows two well defined thermal troughs which correlate well spatially with the turbulent areas if the time adjustment is made.

RAOB CHARTS (1200Z, 25 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 25 Sep 1967)



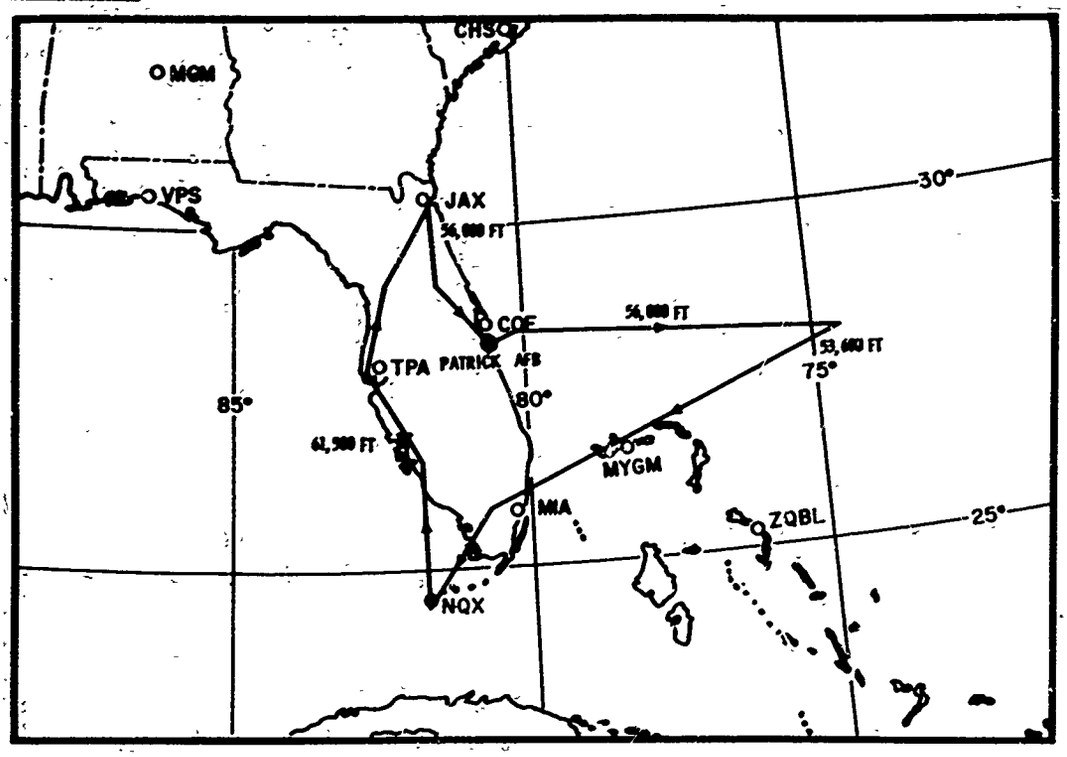
APPENDIX VI

TEST 250

26 September 1967, 1353-1743Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The 1200Z surface chart for this date showed an extensive high pressure system centered near Norfolk, Virginia and extending southwestward to Texas. A wide band of thunderstorms was located in the northern Gulf of Mexico and eastward across the southern peninsula of Florida.

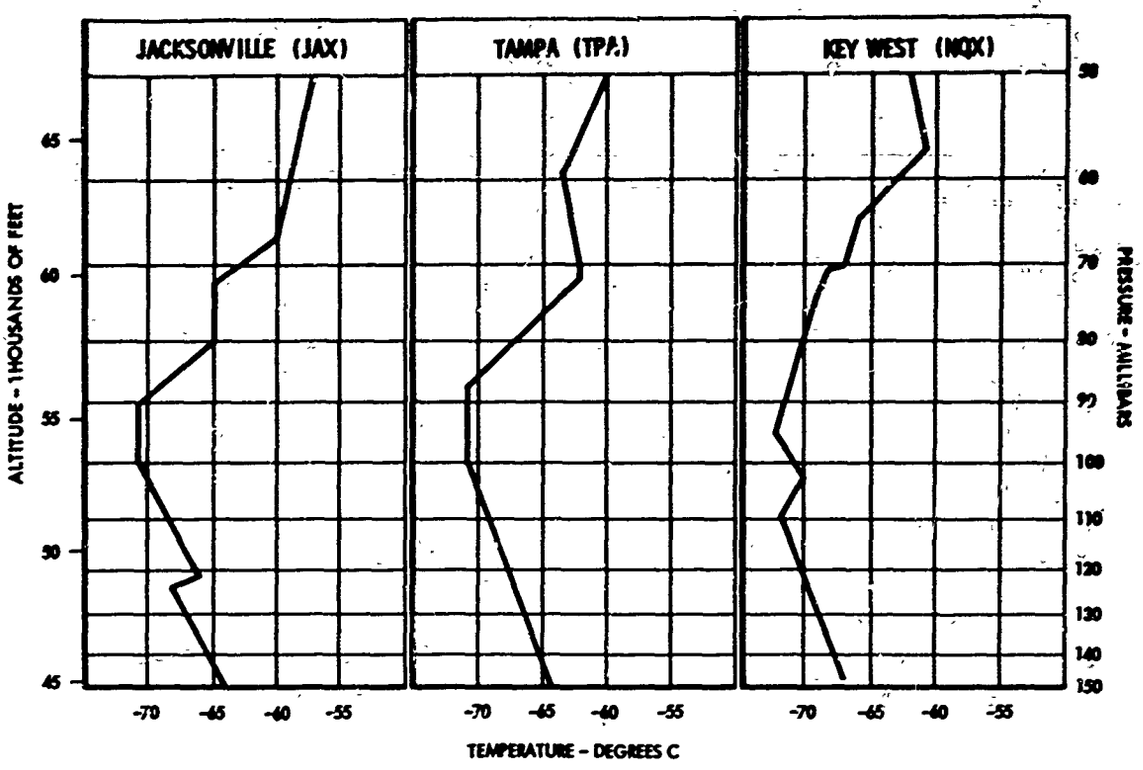
Aloft the 1200Z tropopause analysis showed the sampled area was in a divergent wind flow zone at 45,000 feet.

The pilot encountered abundant very light CAT over most of the route. No runs were processed.

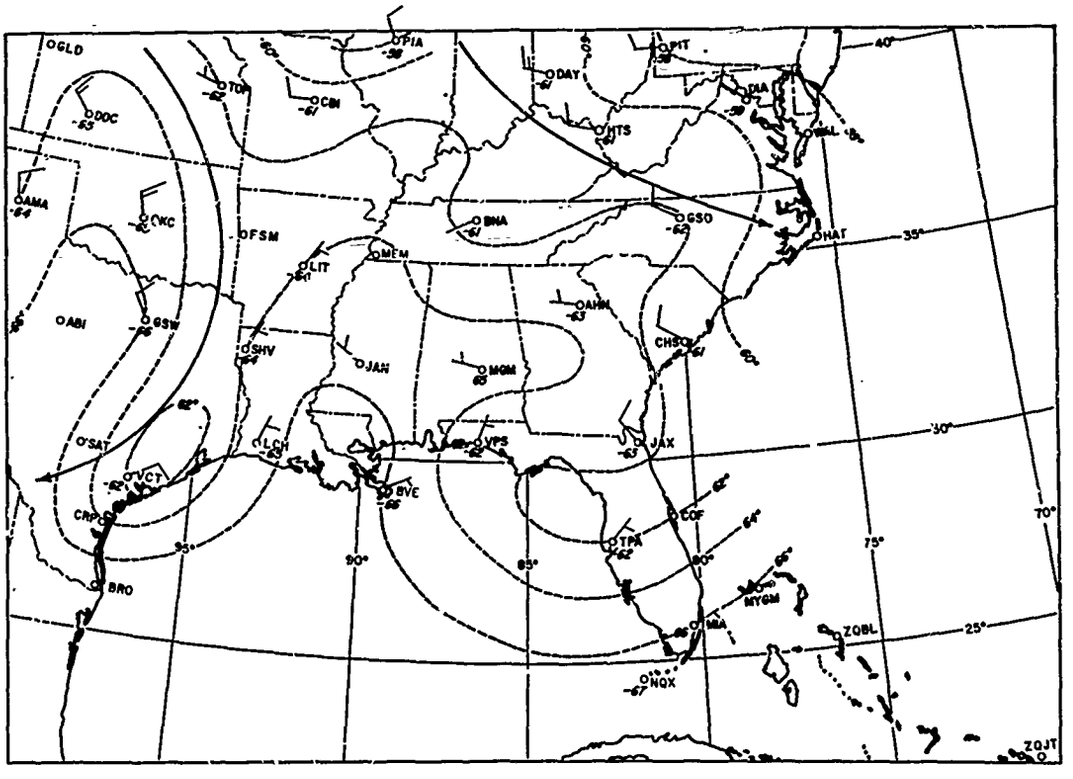
The RAOB analysis indicates there was small vertical temperature gradients but numerous gradient changes over JAX, TPA, and NQX.

The 70 mb analysis shows a thermal trough across north central Florida. At 70 mb the horizontal temperature gradient (1°C/45 nm) is small (< 1°C/25 nm).

RAOB CHARTS (1200Z, 26 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 26 Sep 1967)



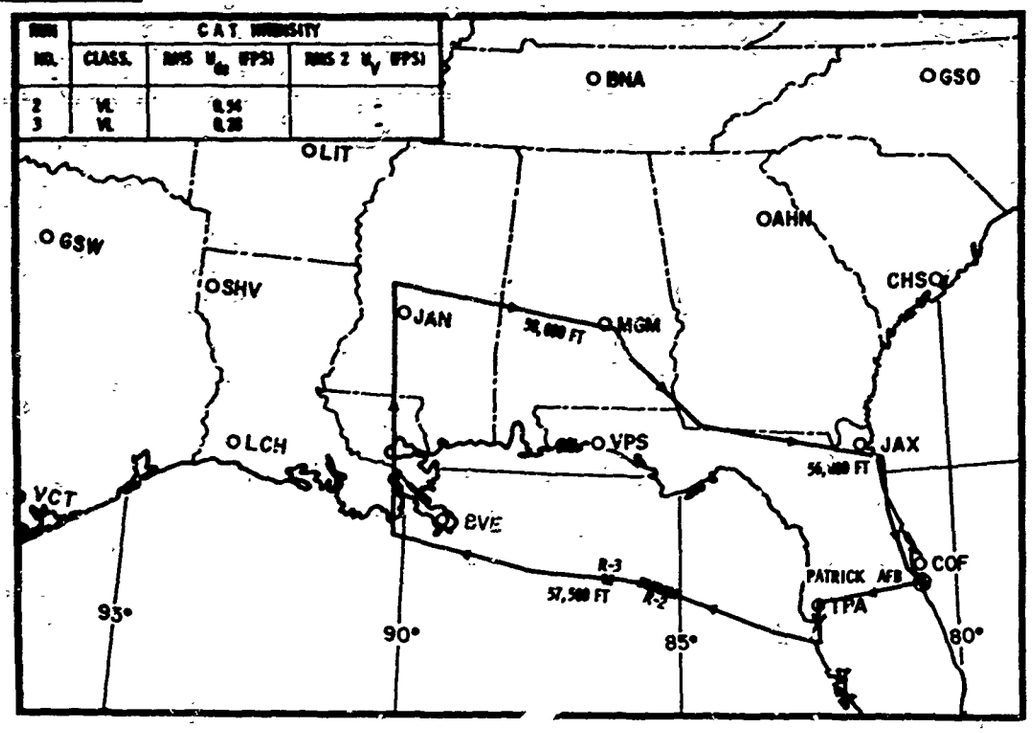
APPENDIX VI

TEST 251

27 September 1967, 1349-1757Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

At the surface on 27 September 1967, the 1200Z chart depicted an active cold front over south Texas and extending northeastward to western New York. The front was moving eastward at about 15 knots and creating considerable showers and thunderstorms along its path. Aloft, the 1200Z, 200 mb analysis showed a well defined trough with the axis, north-south, centered over Oklahoma.

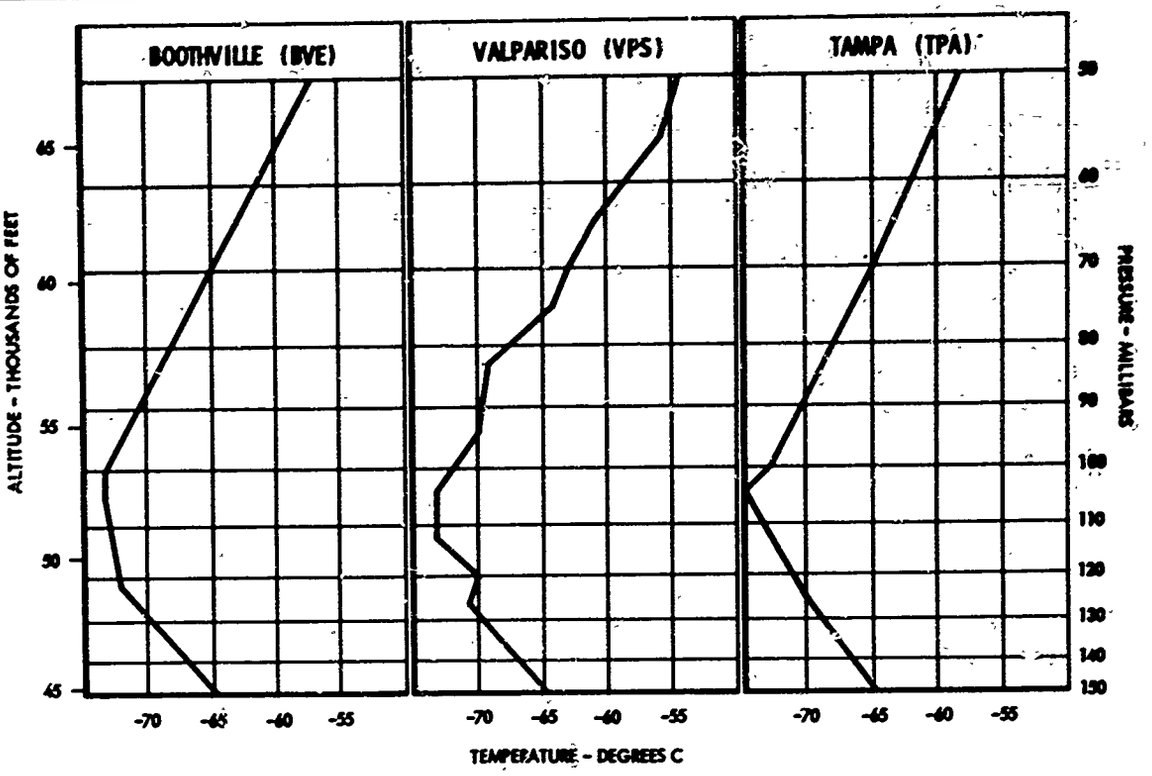
The pilot reported abundant very light to light CAT over the route of flight. Runs 2 and 3 were processed.

The RAOB analysis shows a cold layer of air over BVE, VPS and TPA near the 53,000 feet level. Vertical temperature gradients were small but VPS indicated numerous gradient changes in the vertical.

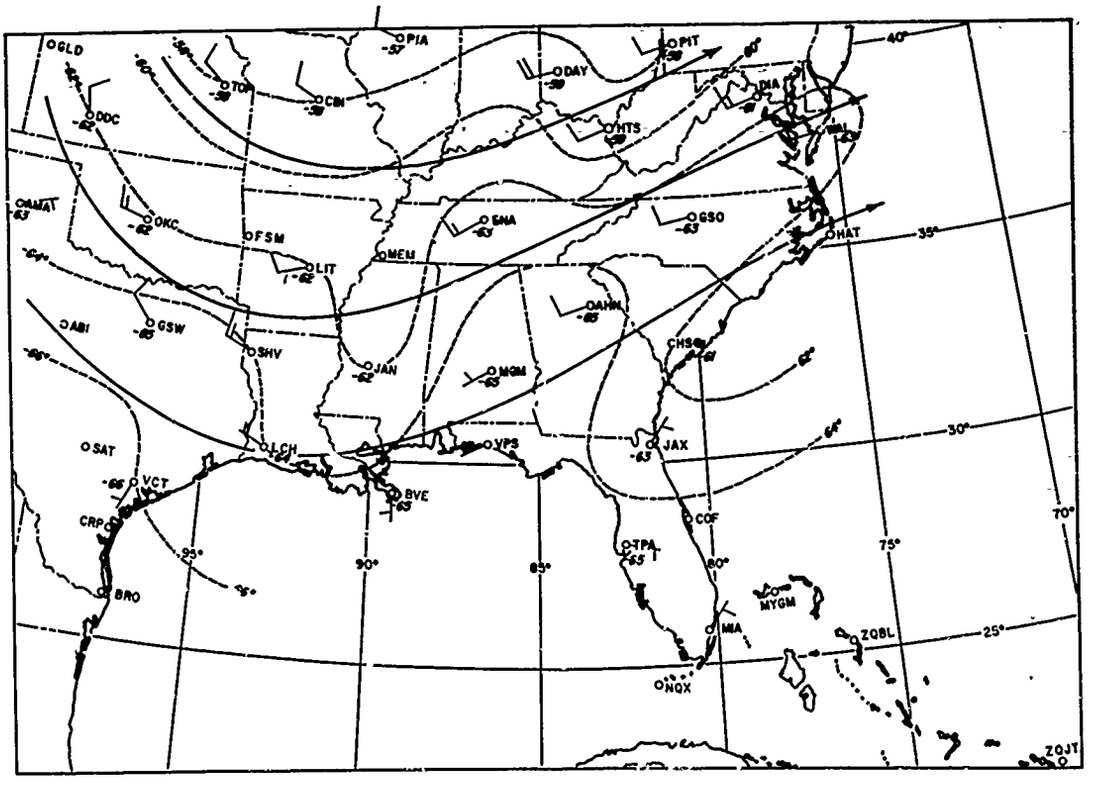
The 1200Z, 70 mb analysis shows a waveform in the horizontal isotherms with a wave length of about 450 nm between JAN and JAX.

The horizontal temperature gradient is considered small (<1°C/25 nm).

RAOB CHARTS (1200Z, 27 Sep 1967)

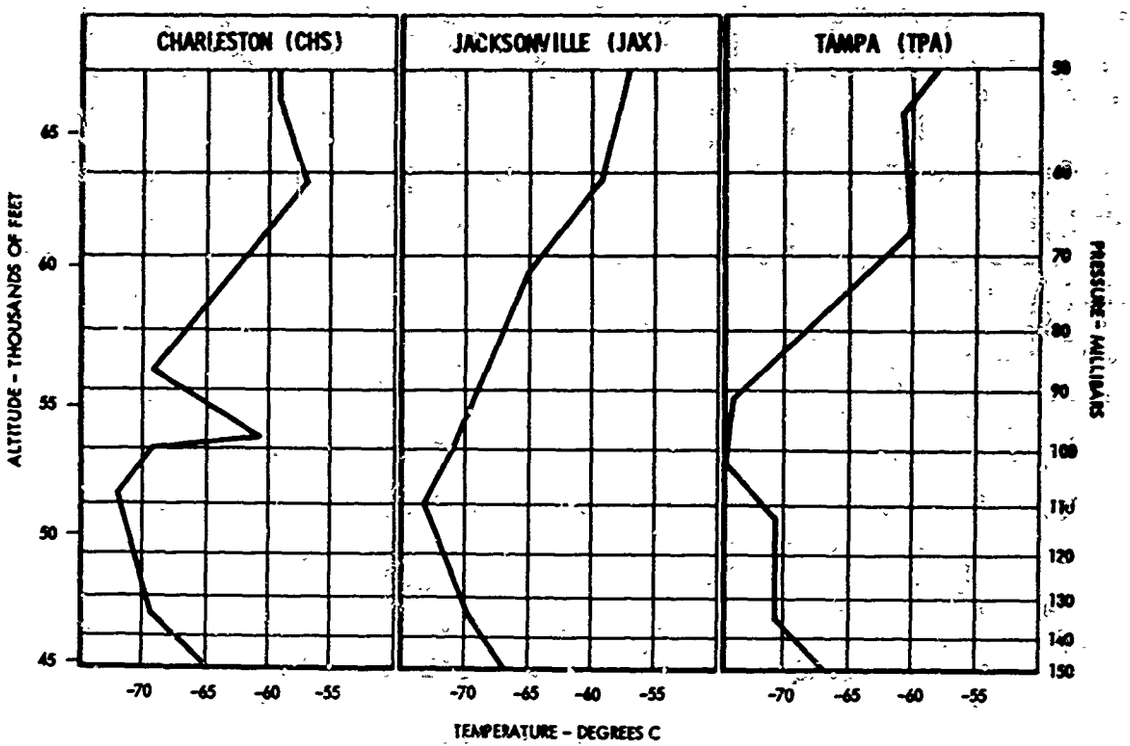


70 MB TEMPERATURES AND WINDS CHART (1200Z, 27 Sep 1967)

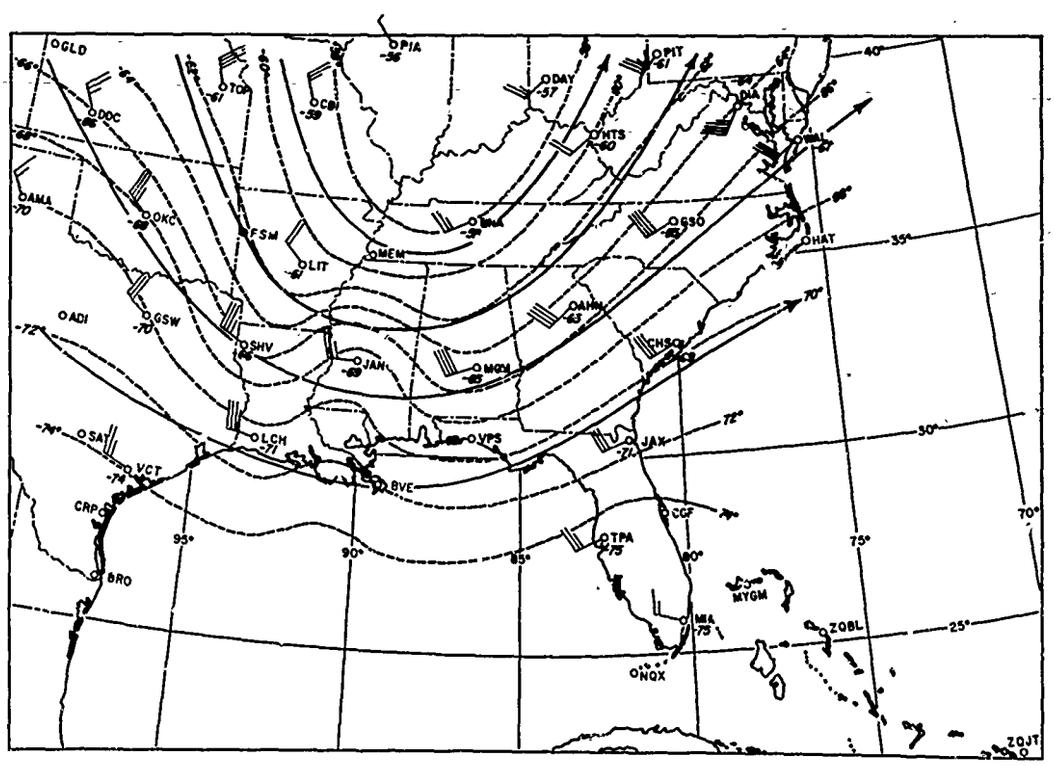


APPENDIX VI

RAOB CHARTS (1200Z, 28 Sep 1967)



100 MB TEMPERATURES AND WINDS CHART (1200Z, 28 Sep 1967)



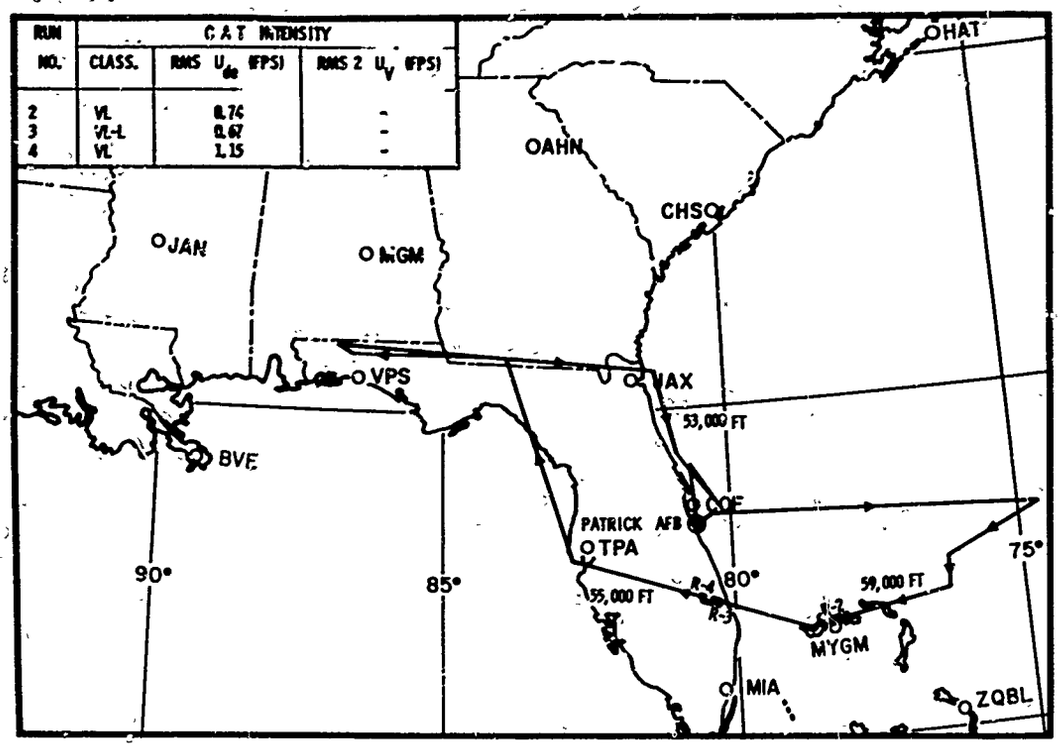
APPENDIX VI

TEST 253

29 September 1967, 1400-1854Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The active, surface cold front that was over western Florida on 28 September 1967 (Test 252) had by 1200Z, this date, moved eastward over the Atlantic. The southern end of the front trailed across lower Florida. Considerable convective activity occurred along the front over Florida.

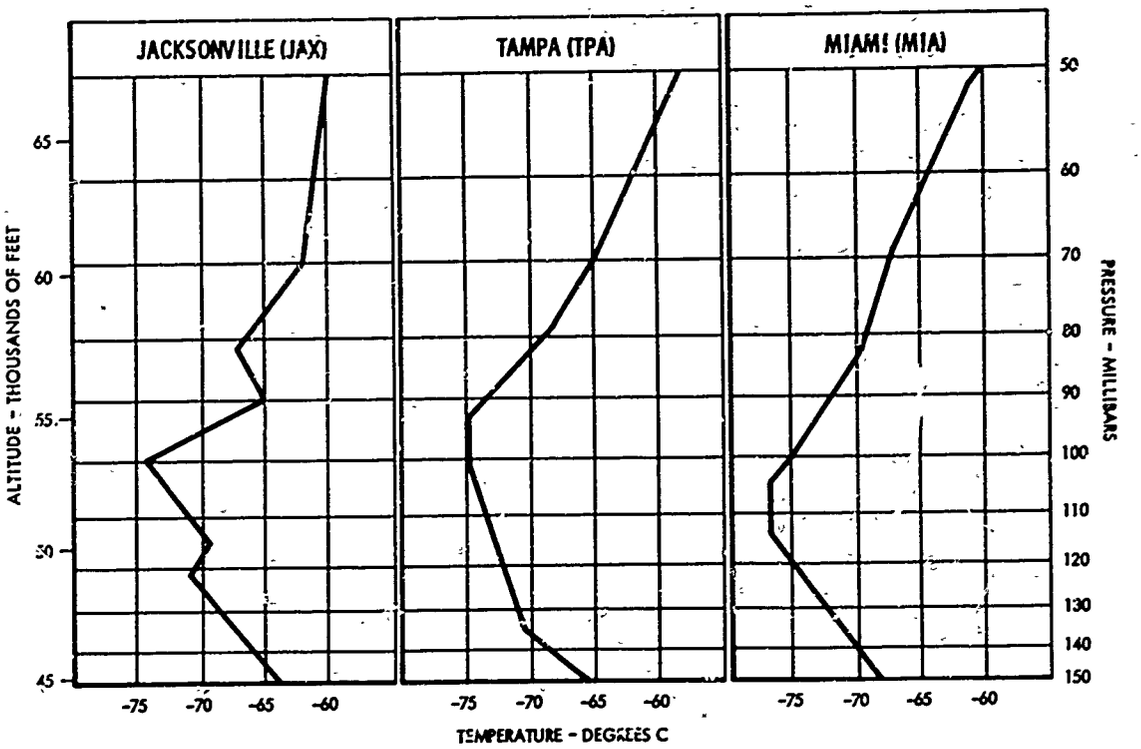
At the upper levels the 1200Z tropopause analysis showed a deep trough with the north-south axis over Alabama. A 100-knot jetstream at 39,000 feet curved around the trough passing over southern Mississippi, Alabama, central Georgia and northeastwards along the eastern seaboard.

The pilot encountered abundant very light CAT. Runs 2, 3, and 4 were processed.

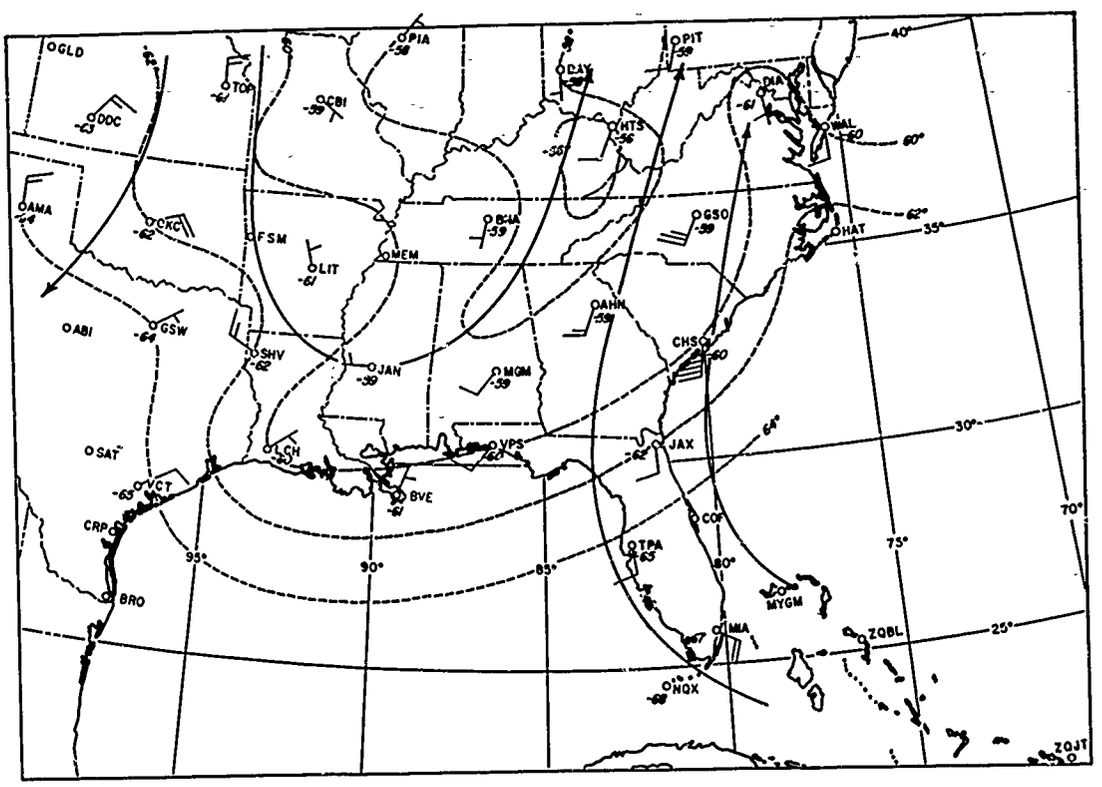
The 1200Z RAOB analysis indicates the best turbulence should have been between 49,000 - 58,000 feet.

The vertical temperature gradient through the layer was about 2°C/1000 feet. It is probable that the 6-hour difference in time between observation and sampling accounts for the CAT being less intense than expected.

RAOB CHARTS (1200Z, 29 Sep 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 29 Sep 1967)



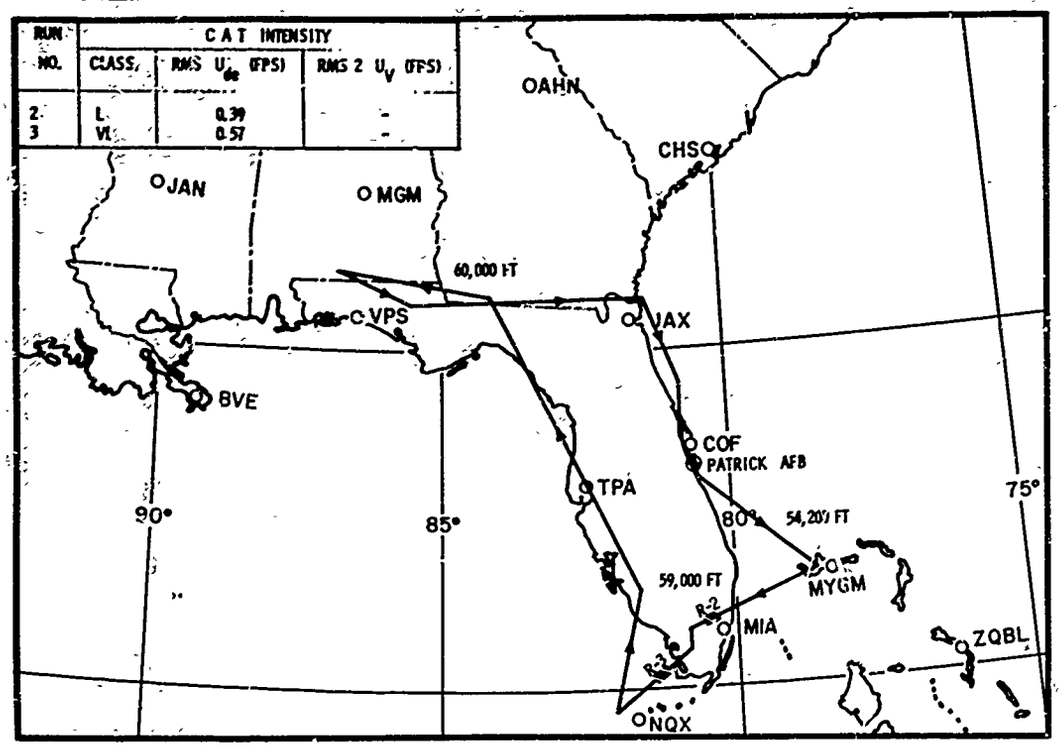
APPENDIX VI

TEST 254

2 October 1967, 1351-1753Z

Patrick AFB, Cocoa, Florida, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

On the 1200Z surface synoptic chart for this date a large high pressure system centered over northern Carolina covered all of the states east of a line from Texas to the Great Lakes.

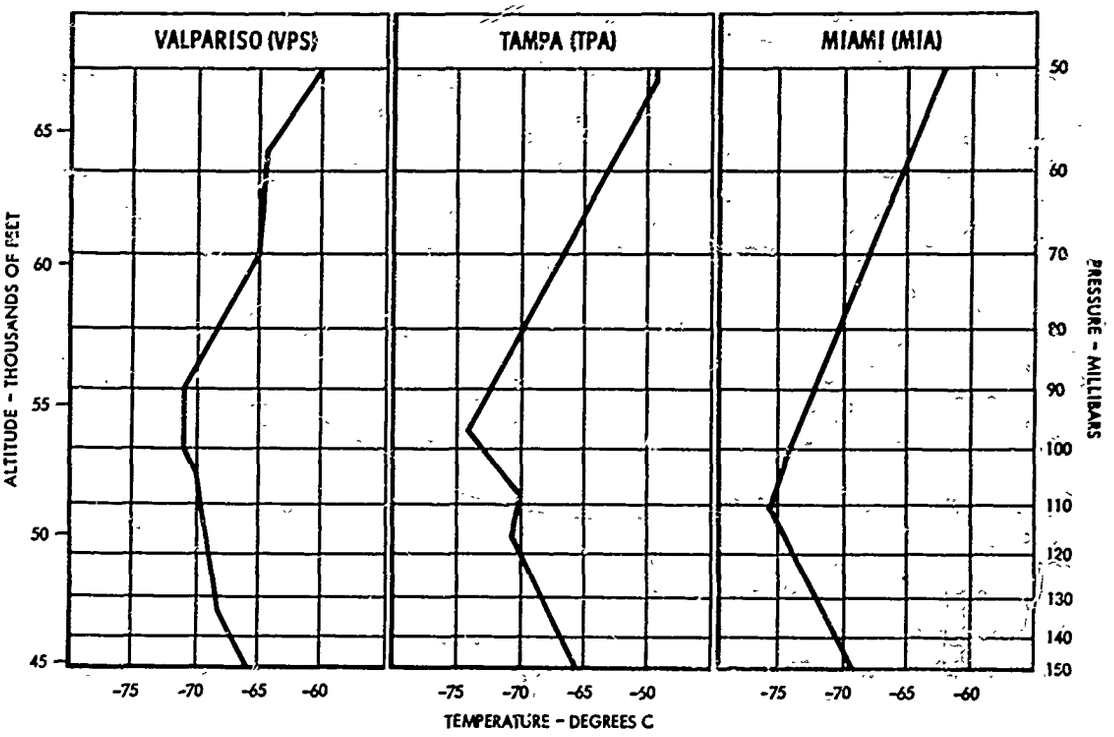
The front that had passed over Florida two days earlier was stationary across the Florida Keys. Scattered thunderstorms were observed from the Bahama Islands to the Florida Keys; aloft, a ridge at the tropopause level had its axis over Texas and Oklahoma. Winds over the flight track area were generally northwesterly.

The pilot report light CAT over the frontal zone and the scattered cumulonimbus. Runs 2 and 3 were processed. Also a few "ripples" were noted over VPS.

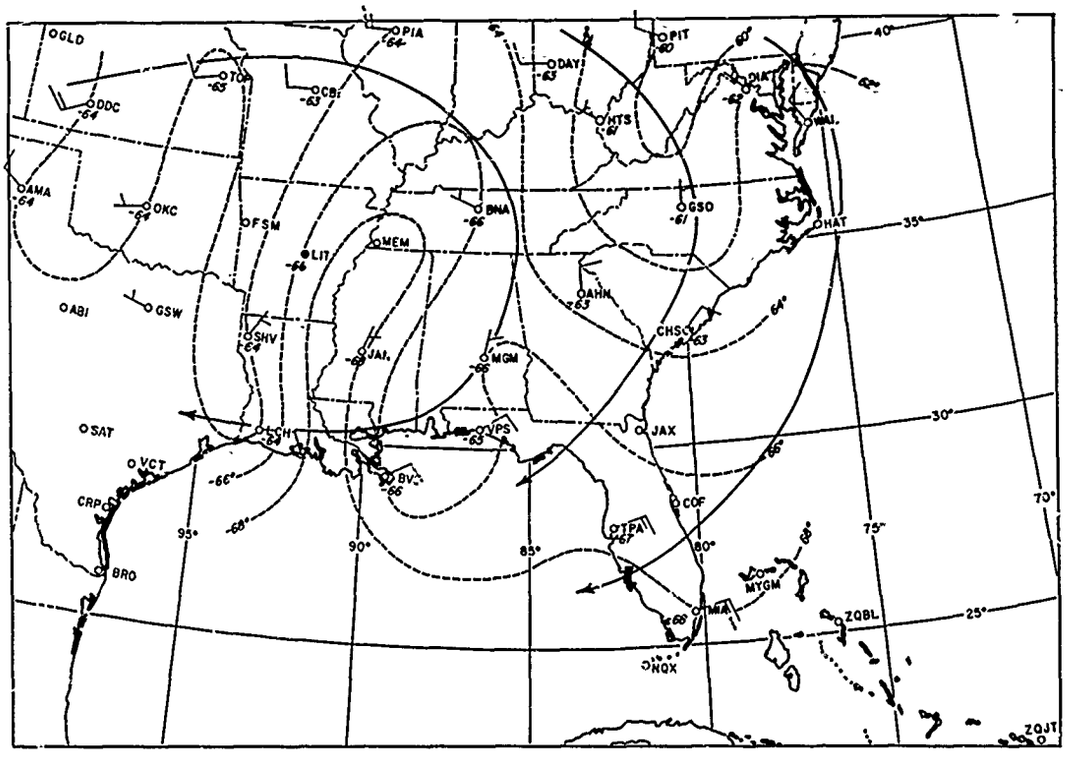
The 1200Z RAOB analysis shows small to very small vertical temperature gradients over VPS, TPA and MIA. The area was sampled about three hours after RAOB time.

The 70 mb analysis shows a very small horizontal temperature gradient over the flight track area (~1°C/150 nm) a gradient of this character is usually associated with either very light or no CAT.

RAOB CHARTS (1200Z, 2 Oct 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 2 Oct 1967)



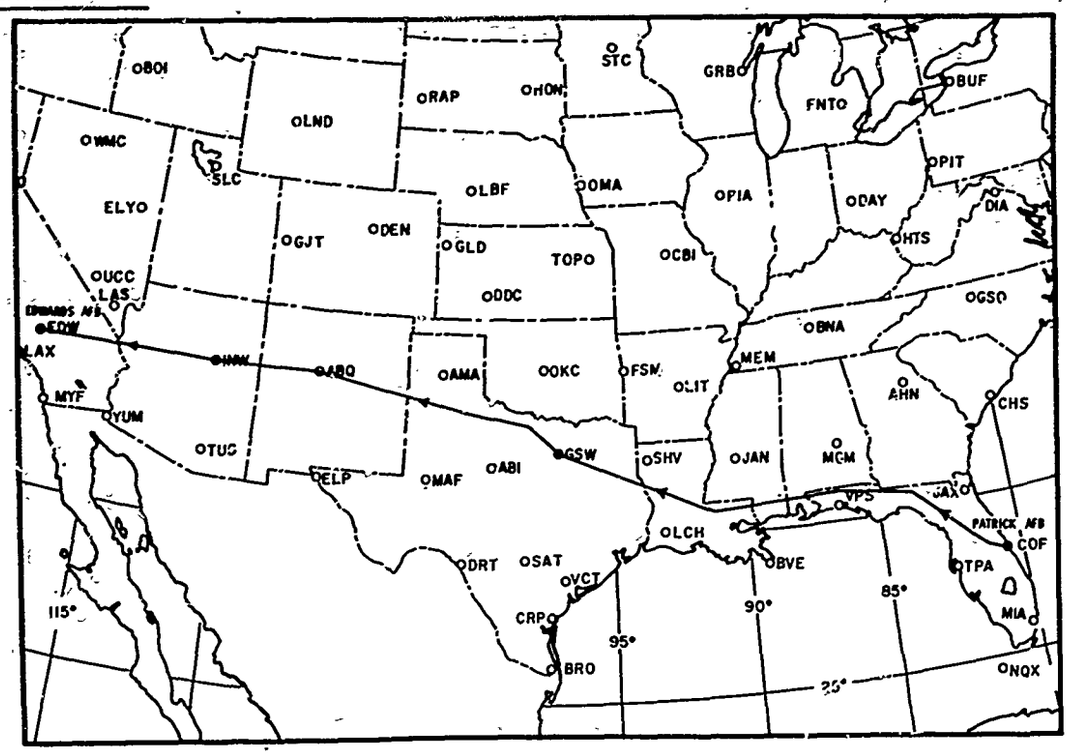
APPENDIX VI

TEST 255

3 October 1967, 1300-1810Z

Ferry flight from Patrick AFB, Florida to Edwards AFB, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Data not obtained.

APPENDIX VI

RAOB CHARTS

Data not obtained.

70 MB TEMPERATURES AND WINDS CHART

Data not obtained.

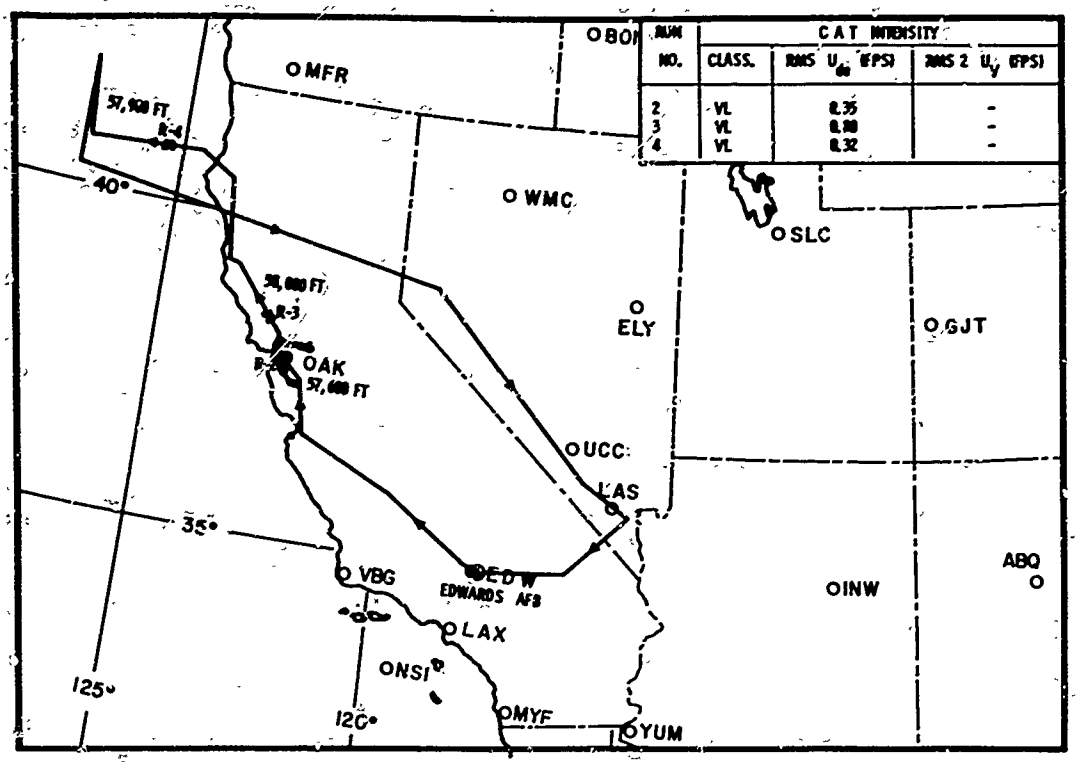
APPENDIX VI

TEST 256

16 November 1967, 1821-2254Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

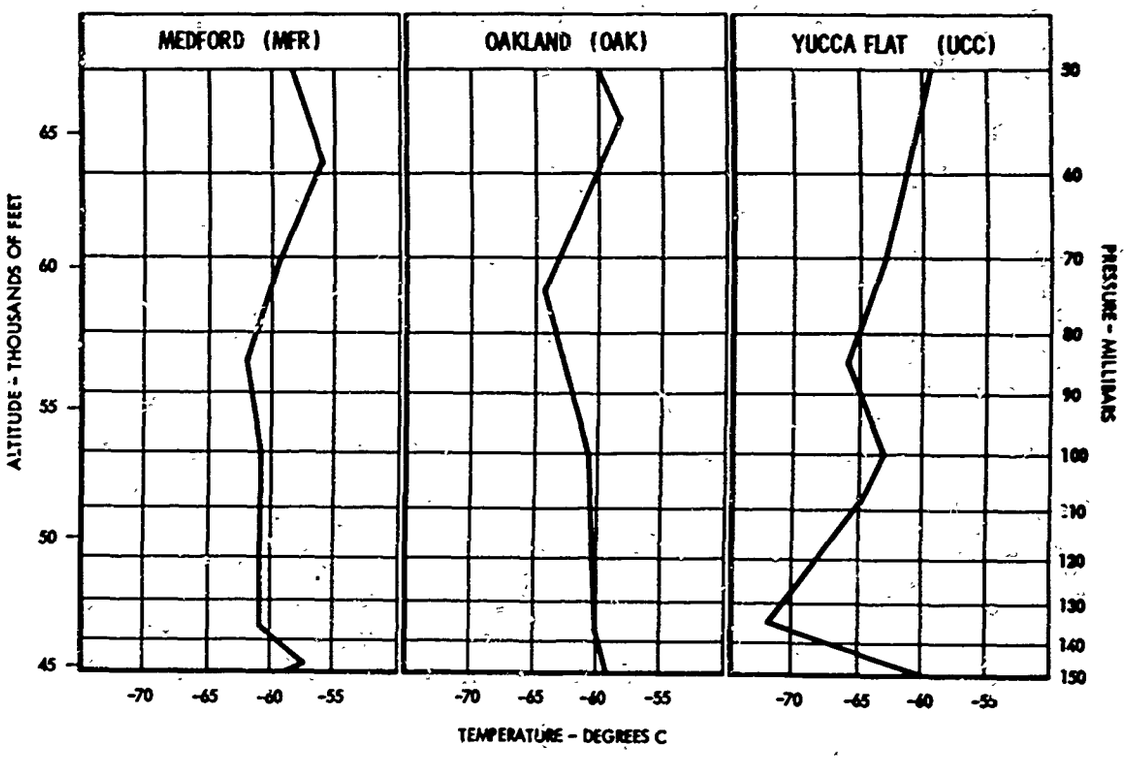
This was the first of 30 flights out of Edwards AFB between 16 November 1967 and 29 February 1968. A weak surface low was positioned about 300 miles off the central California coast with a ridging of high pressure to the north and east. A cutoff low at 500 mb was centered directly over the surface low. The jetstream was from the southwest with maximum speeds in excess of 80 knots over northern California. Clouds covered most of central and coastal California but it was generally clear over the water.

Only light, patchy turbulence was encountered. Two short runs were recorded near OAK and another patch over the water west of Eureka, California.

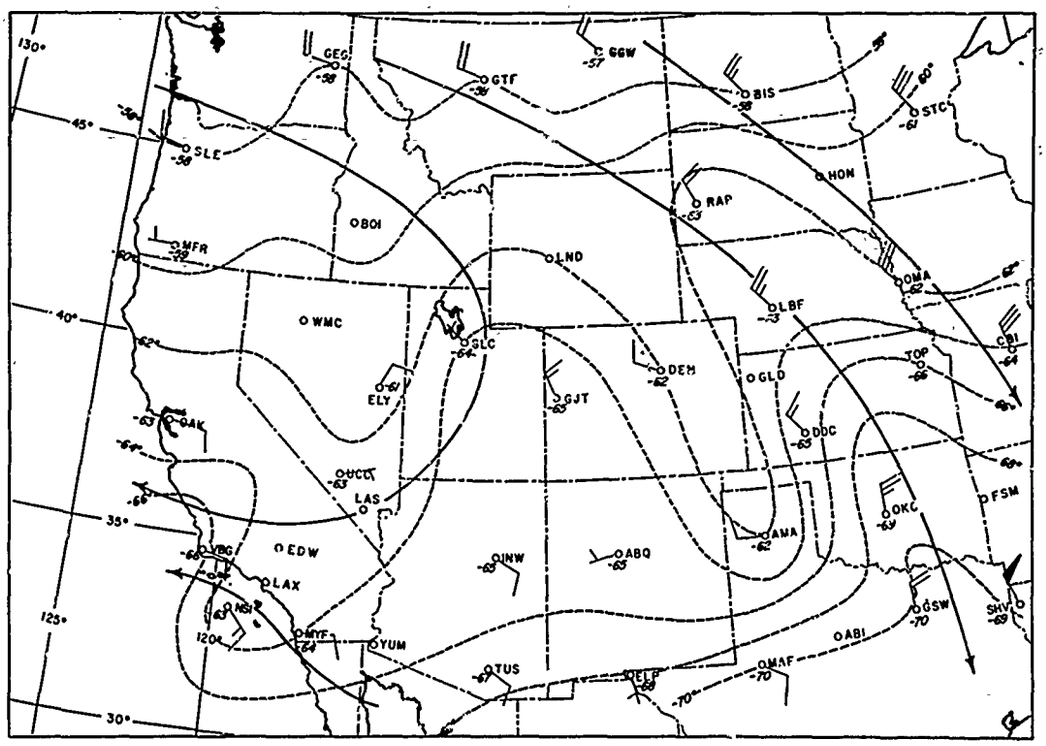
No large deviations of vertical temperature gradient were noted for any of the RAOB'S along the flight path at the altitudes flown.

The 70 mb analysis shows a shallow tongue of warm air was moving into Southern California from the north at 70 mb.

RAOB CHARTS (0000Z, 17 Nov 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 17 Nov 1967)



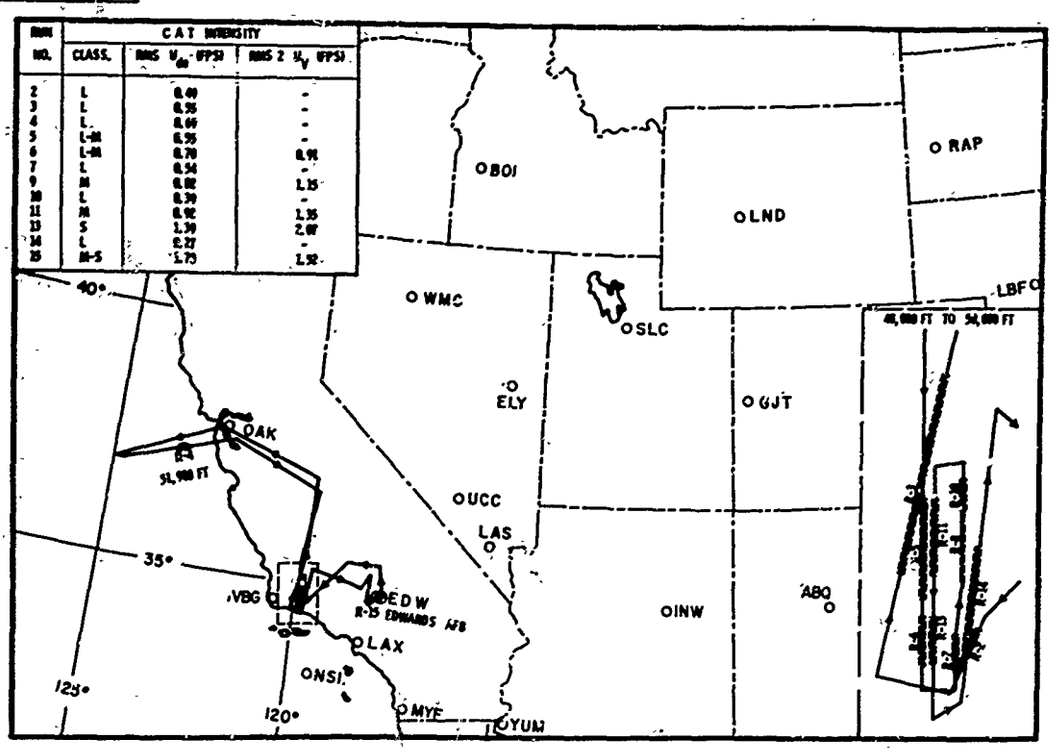
APPENDIX VI

TEST 257

17 November 1967, 1906-2256Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

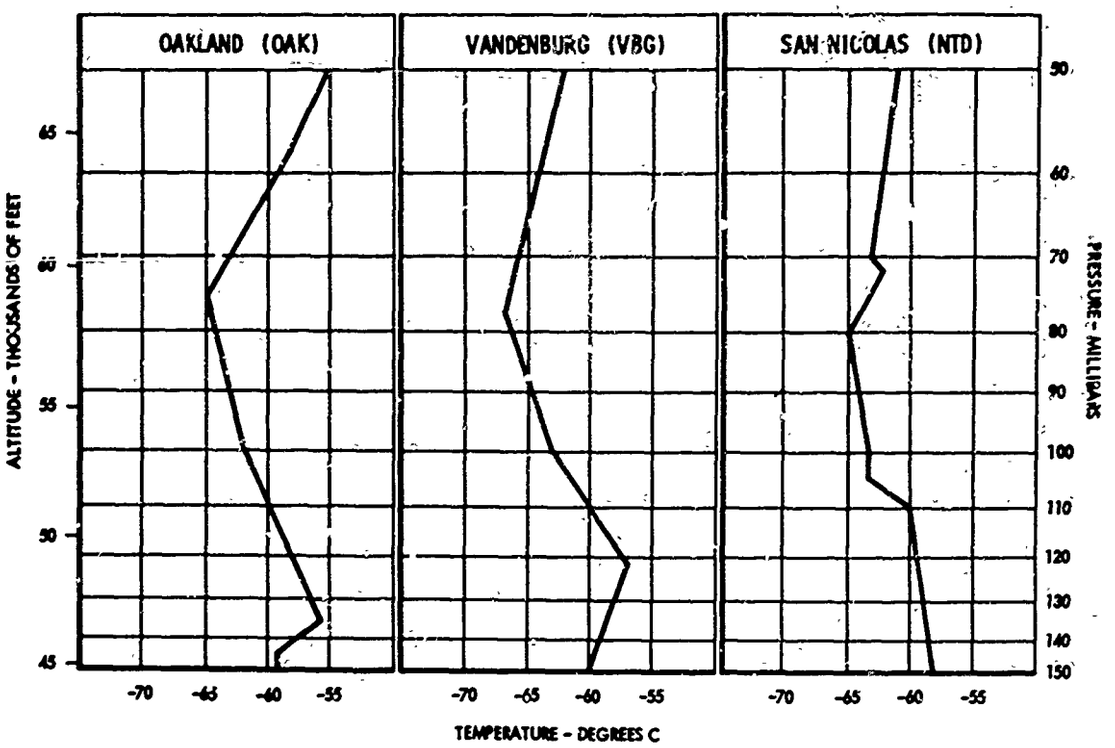
A broad but rather weak low pressure system dominated the surface flow pattern along the West Coast. The trough at 500 mb had deepened from the previous day and was now located about 250 miles off the southern California coast. Winds were weak in the vicinity of the tropopause.

A rather extensive area of turbulence was found about 50 miles east of VBG. The turbulence extended over a vertical layer of at least 3600 feet.

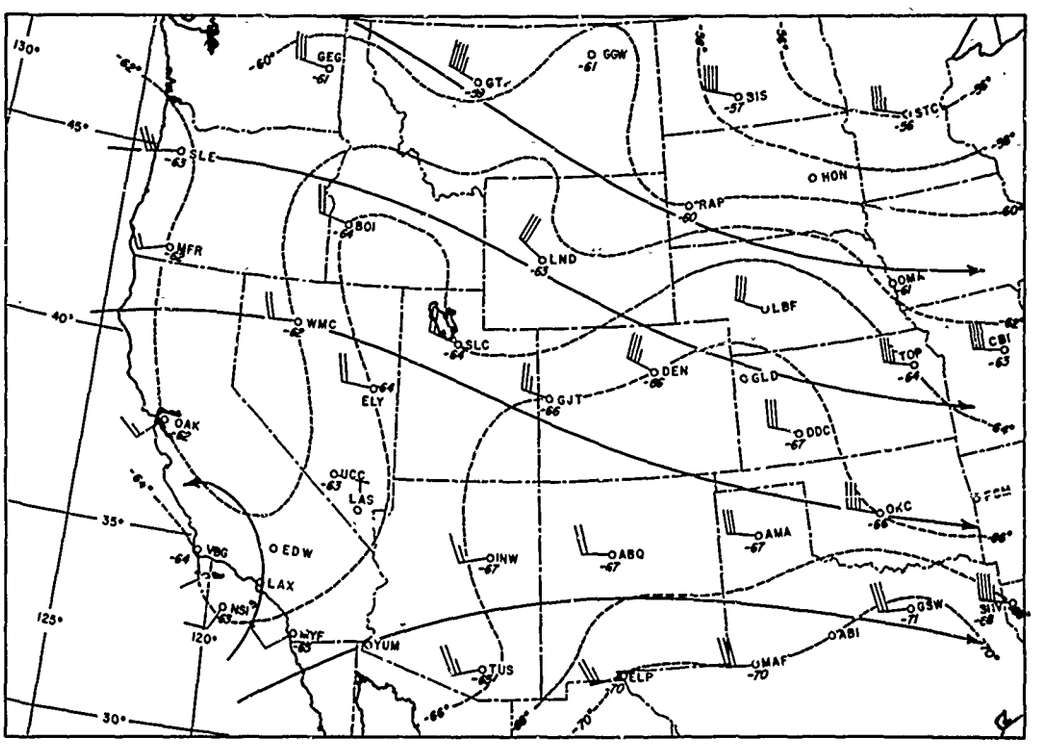
Highest readings of ±0.4 g were at 48,000 feet, corresponding to the relatively stable layer at VBG between 45,000 and 49,000 feet (RAOB charts), the lowest flight level.

At 100 mb a tongue of warm air was located over southern California. There was no evidence of convective activity and only scattered clouds at flight time.

RAOB CHARTS (0000Z, 18 Nov 1967)



100 MB TEMPERATURES AND WINDS CHART (0000Z, 18 Nov 1967)



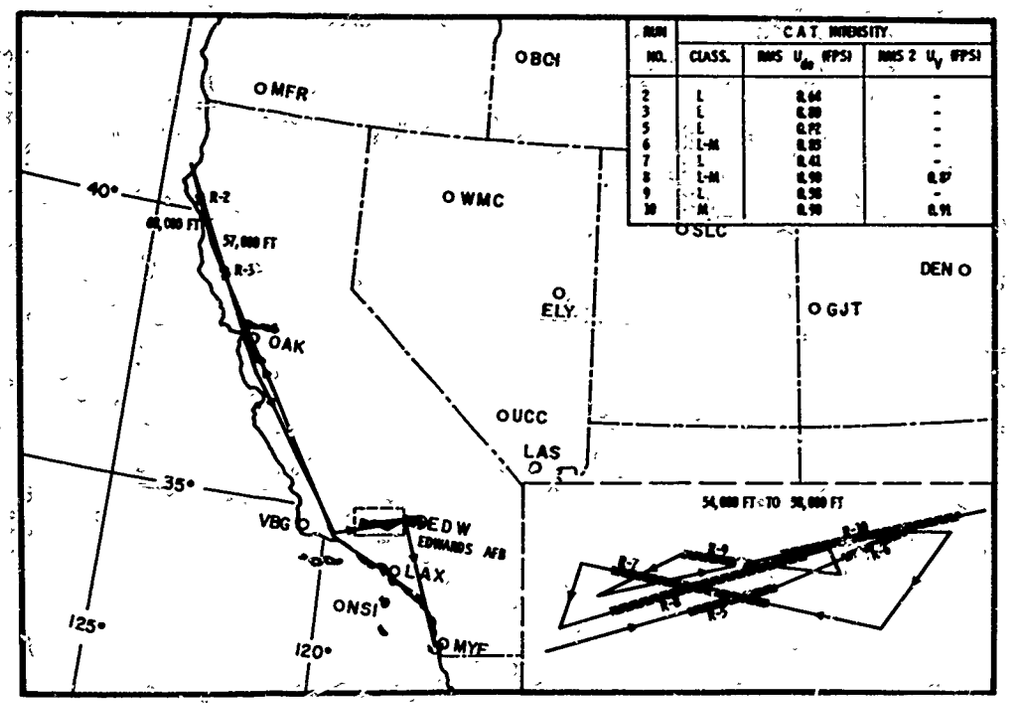
APPENDIX VI

TEST 258

20 November 1967, 1807-2309Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



RUN NO.	C.A.T. INTENSITY CLASS.	RMS U_{ds} (FPS)	RMS 2 U_V (FPS)
2	L	0.44	-
3	L	0.80	-
5	L	0.92	-
6	L-M	0.85	-
7	L	0.41	-
8	L-M	0.90	0.87
9	L	0.58	-
10	M	0.90	0.91

FLIGHT SUMMARY

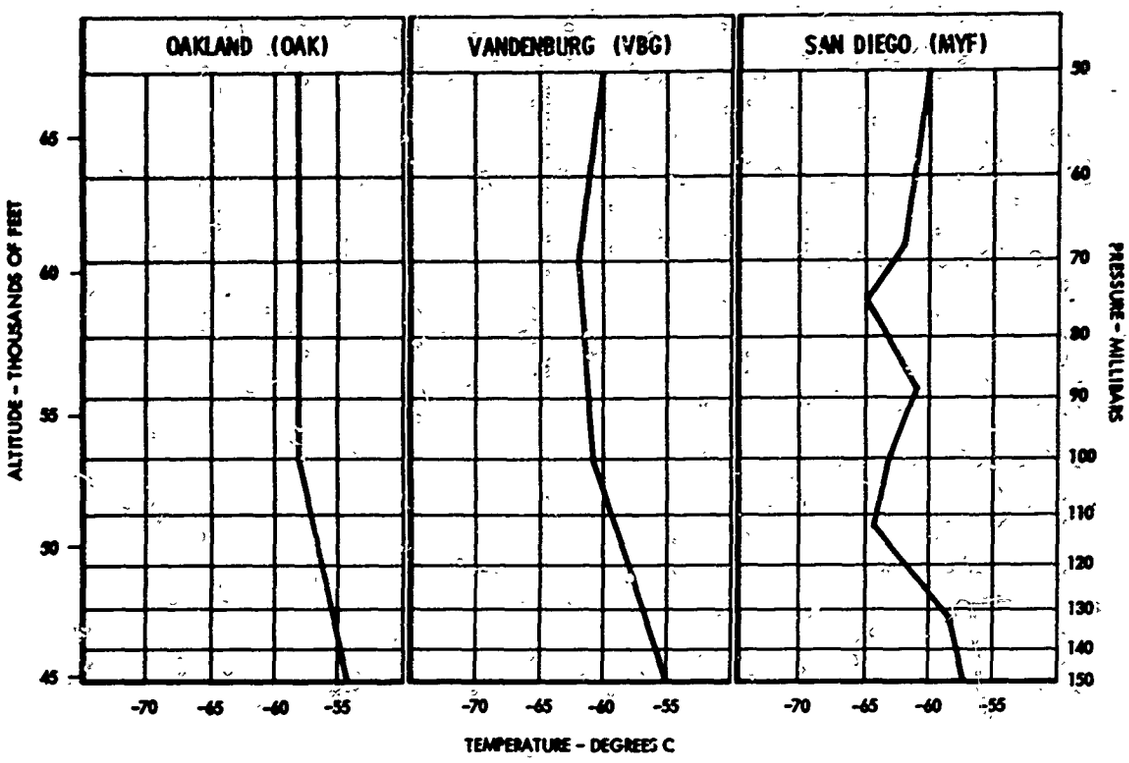
The 500 mb low that had persisted for several days off the California coast deepened considerably and, at the time of this flight, was about 200 miles off the southern California coast. The trough axis was nearly east-west. An east-west oriented jetstream flowed across the southern tip of California with maximum winds of 100 knots at 35,000 feet over MYF.

Some light patchy turbulence was recorded along the northern California coast. An extensive area of light to moderate turbulence was located between VBG and EDW. The vertical extent was from 54,400 feet to 56,400 feet.

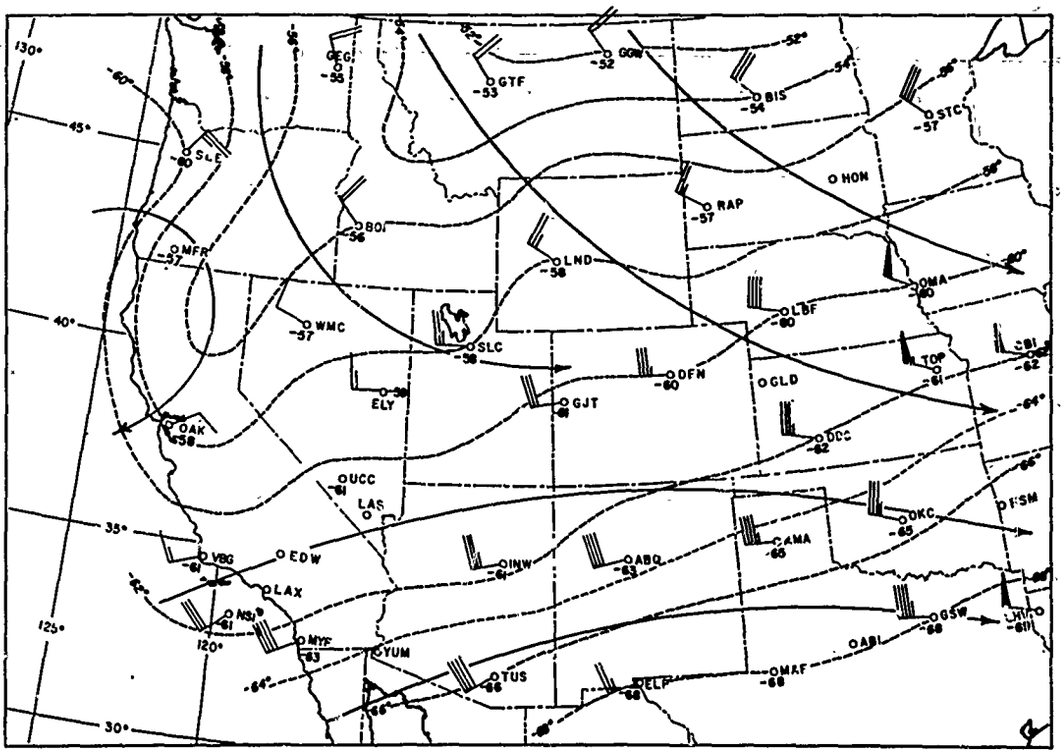
No peculiarities in the temperature sounding at VBG were observed in this layer (RAOB chart).

The 100 mb analysis showed a warm thermal trough penetrating from the north along the West Coast.

RAOB CHARTS (0000Z, 21 Nov 1967)



100-MB TEMPERATURES AND WINDS CHART (0000Z, 21 Nov 1967)



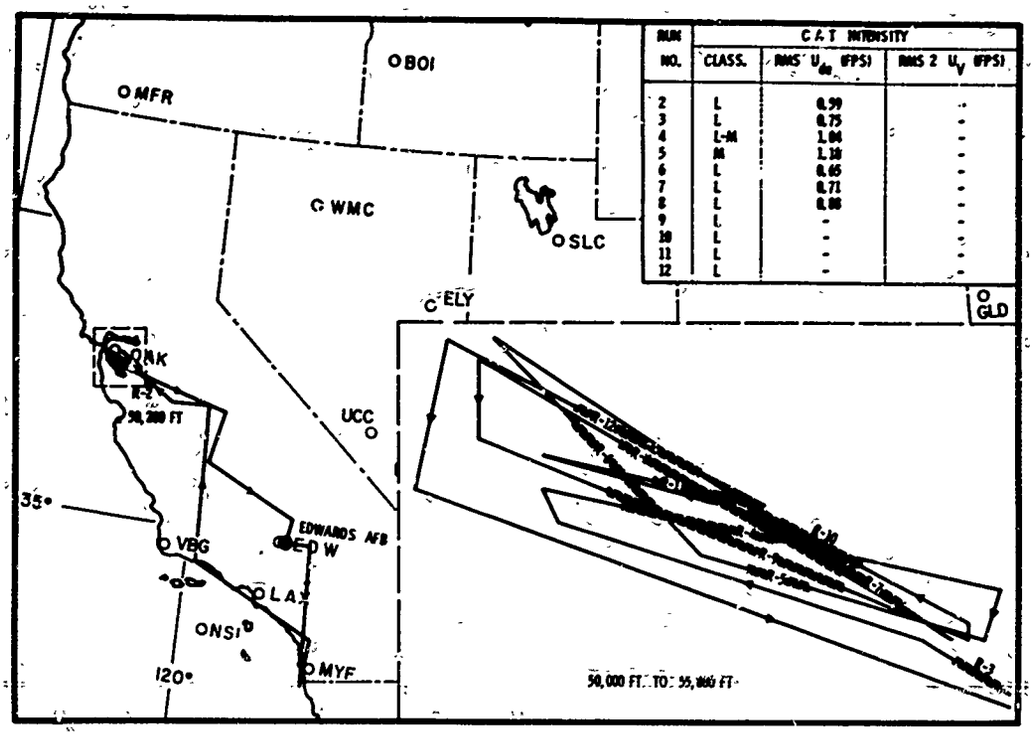
APPENDIX VI

TEST 259

21 November 1967, 1807-2143Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



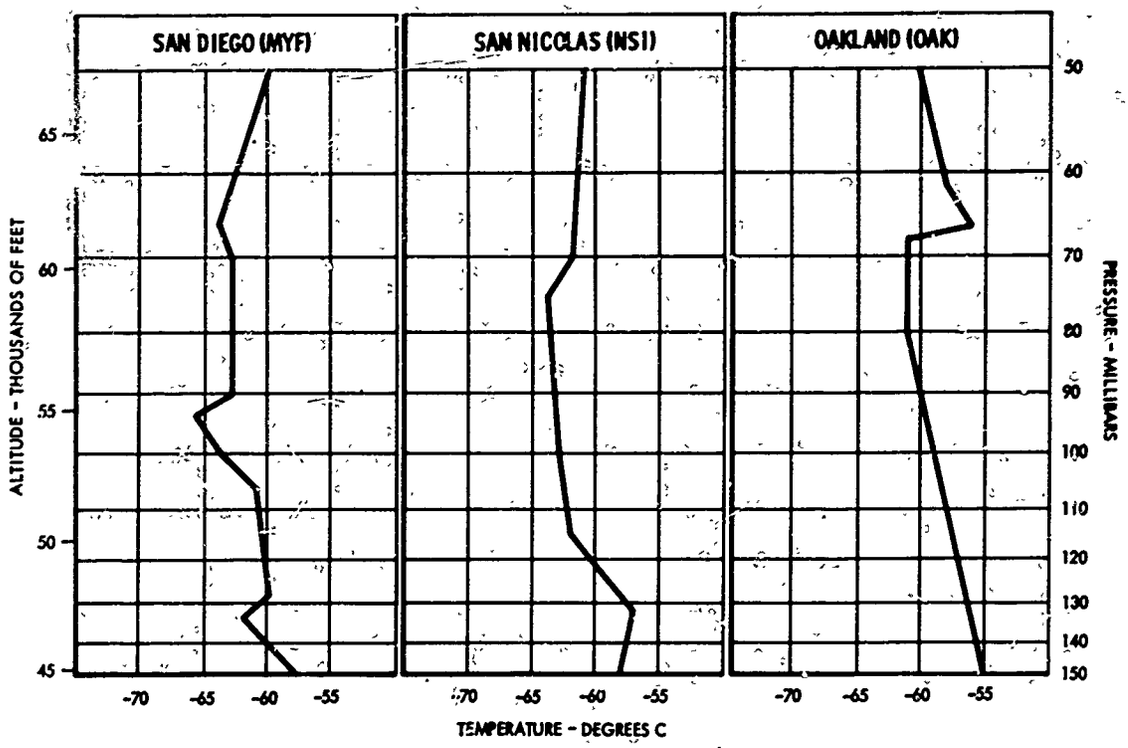
FLIGHT SUMMARY

The surface low observed the day before this test continued to persist off the southern California coast. Skies were generally overcast over California with tops about 30,000 feet.

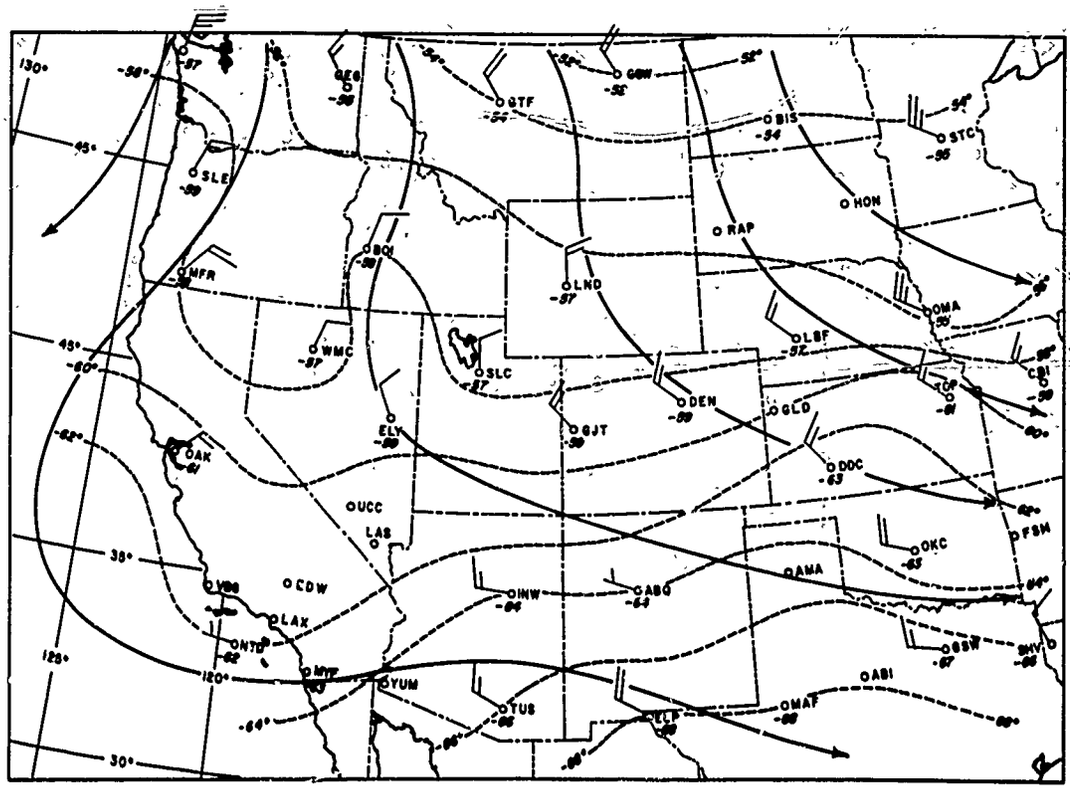
Aloft, the 1200Z, 200 mb analysis indicates a trough oriented southwest-northeast over central California and Nevada. Upper level winds were 130 knots, or more, in the extreme southern part of California but much weaker near OAK, which was on the upwind side of the trough.

The 1200Z, 70 mb analysis shows a small temperature gradient with winds crossing the isotherms in the OAK area. Evident on the 1200Z RAOB is a well defined vertical temperature gradient of 3.5°C/1000 feet between 60,000 and 63,000 feet. Note this occurred about seven hours prior to the CAT measurements.

RAOB CHARTS (1200Z, 21 Nov 1967)



70 MB TEMPERATURES AND WINDS CHART (1200Z, 21 Nov 1967)



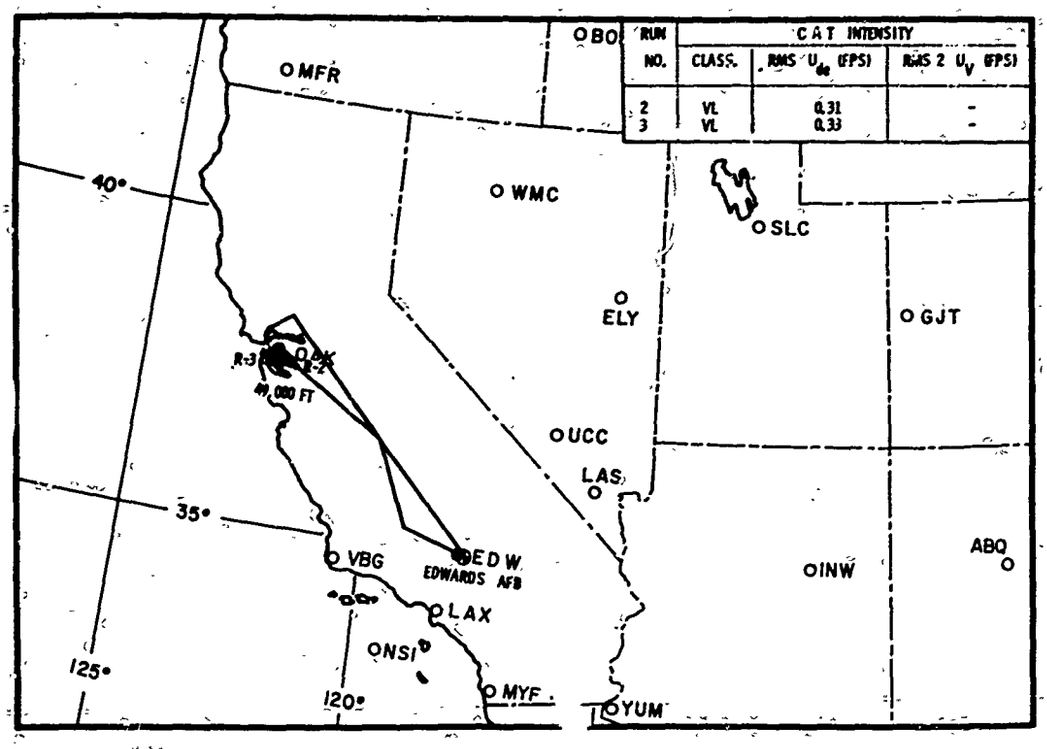
APPENDIX VI

TEST 260

22 November 1967, 0033-0303Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



RUN NO.	CAT INTENSITY CLASS.	RMS U_{de} (FPS)	RMS 2 U_V (FPS)
2	VL	0.31	-
3	VL	0.33	-

FLIGHT SUMMARY

This was a night flight, abbreviated because of engine difficulties. Sky conditions had changed considerably from the previous afternoon flight with only broken to scattered clouds over central California and mostly clear skies to the north. The 500 mb low that had persisted for several days was beginning to fill and move eastward.

An attempt was made to repeat the flight pattern around OAK where extensive light turbulence was found approximately five hours previous. Some very light turbulence was recorded at 49,000 feet and only a few ripples above.

No meteorological data were available for the flight levels.

APPENDIX VI

RAOB CHARTS

Data not available.

70 MB TEMPERATURES AND WINDS CHART

Data not available.

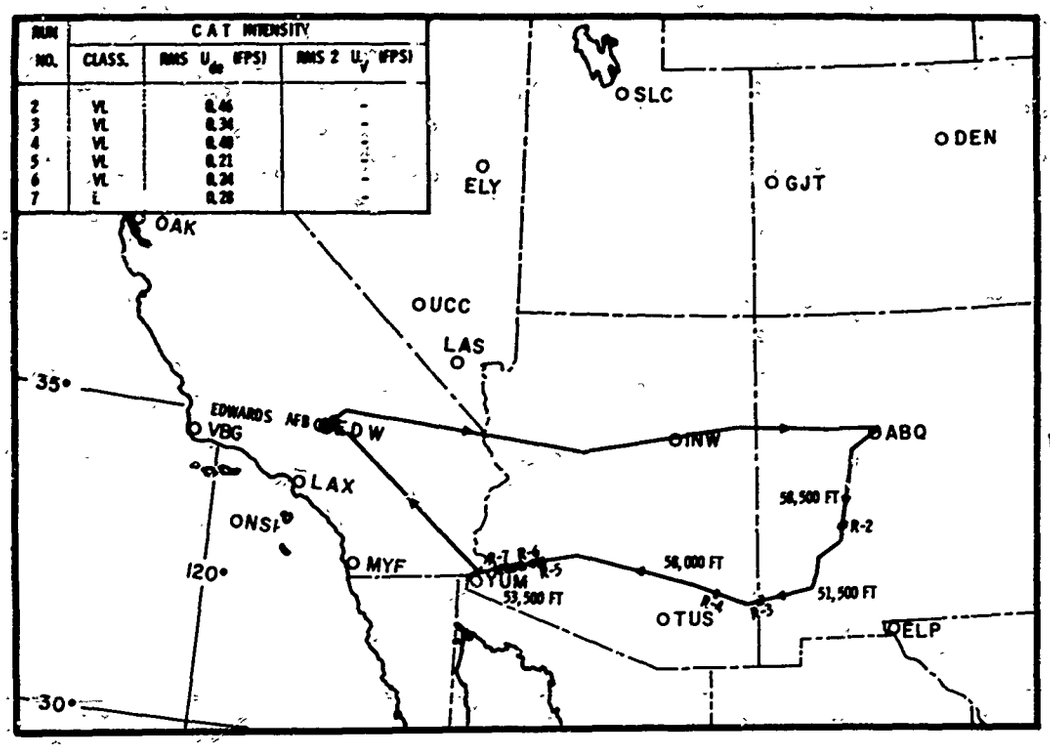
APPENDIX VI

TEST 261

28 November 1967, 0043-0436Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



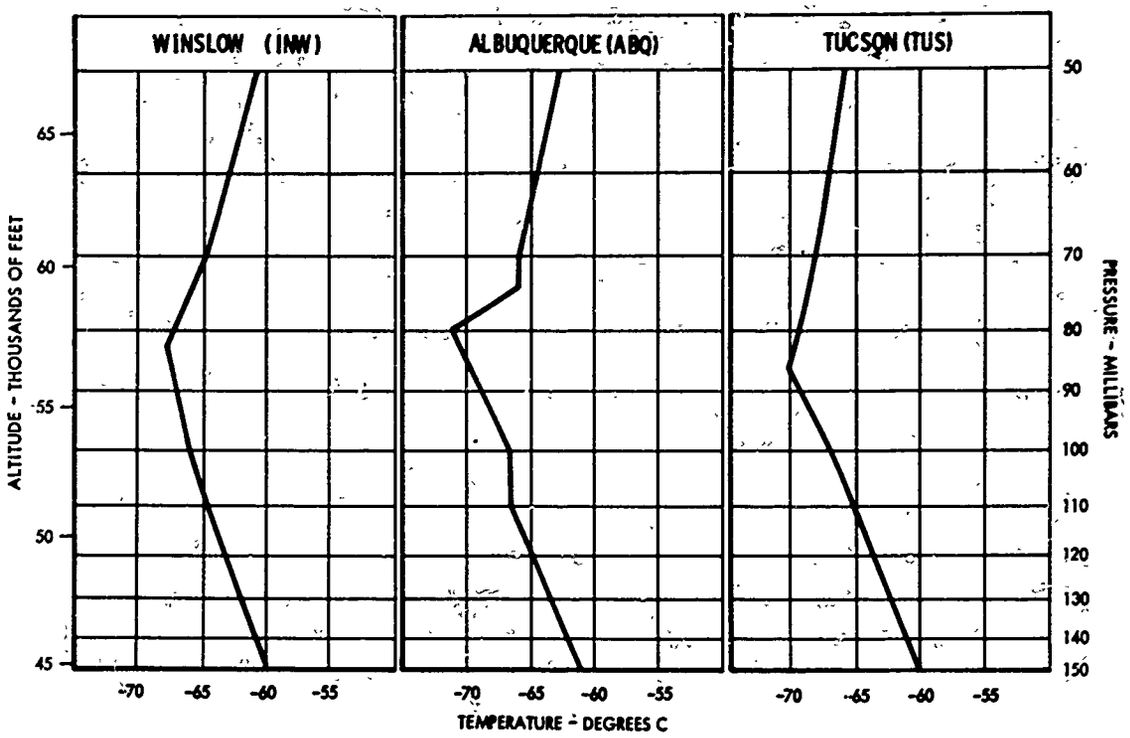
FLIGHT SUMMARY

At 0000Z, 28 November 1967, a large, surface high pressure system was centered over Kansas. A cold front that bordered the southern periphery of the cold mass of air extended over the southern sections of New Mexico and Arizona causing showers in those states.

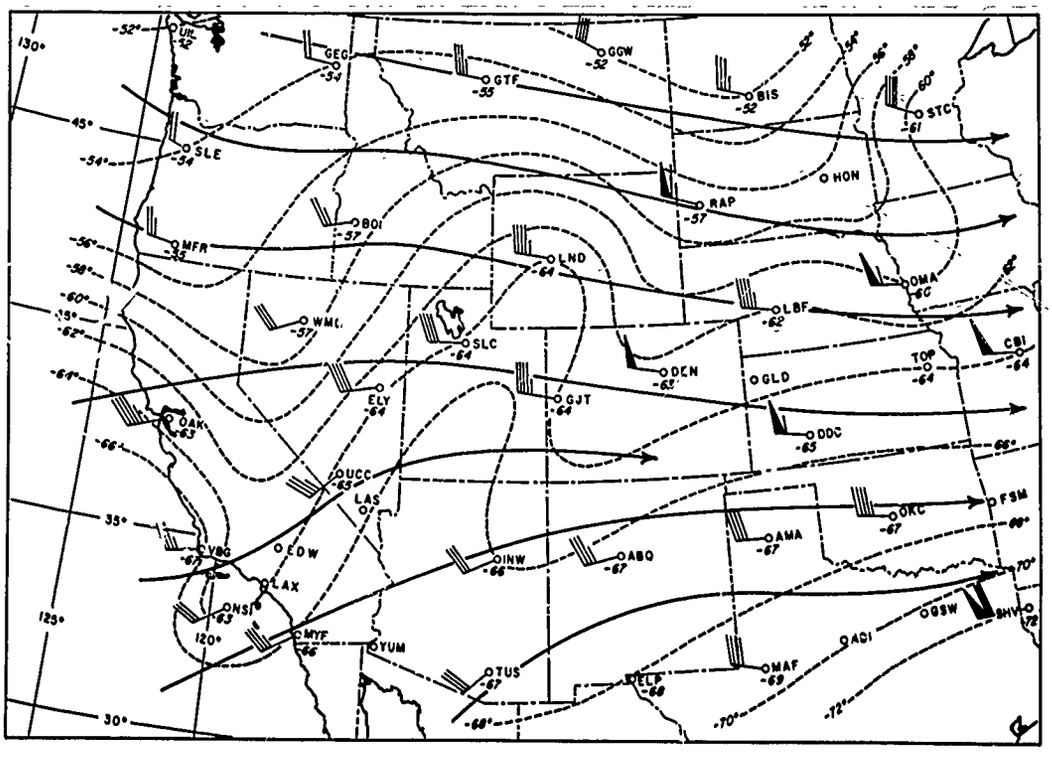
Over the flight route, winds were mostly westerly at about 50 to 60 knots. There was no jetstream in the test area. Patches of very light turbulence were encountered along the route between Albuquerque, New Mexico and Yuma, Arizona. The very light CAT that was encountered between ABQ and TUS at 58,500 and 58,000 feet was near the level of the vertical temperature gradient that can be seen on the ABQ sounding. No RAOB was received for Yuma. Notice that very light to light CAT occurred in an area of small horizontal temperature gradient apparent on the 70 mb temperatures and winds chart.

APPENDIX VI

RAOB CHARTS (0000Z, 28 Nov 1967)



100 MB TEMPERATURES AND WINDS CHART (0000Z, 28 Nov 1967)



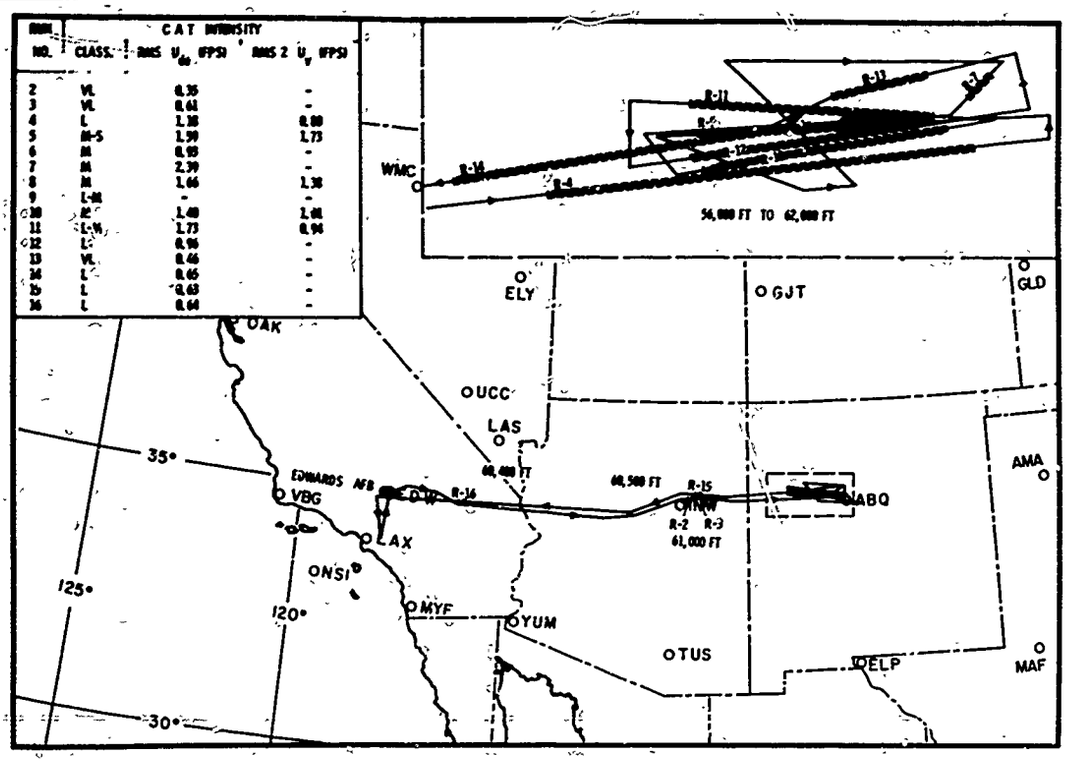
APPENDIX VI

TEST 262

29 November 1967, 1731-2228Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

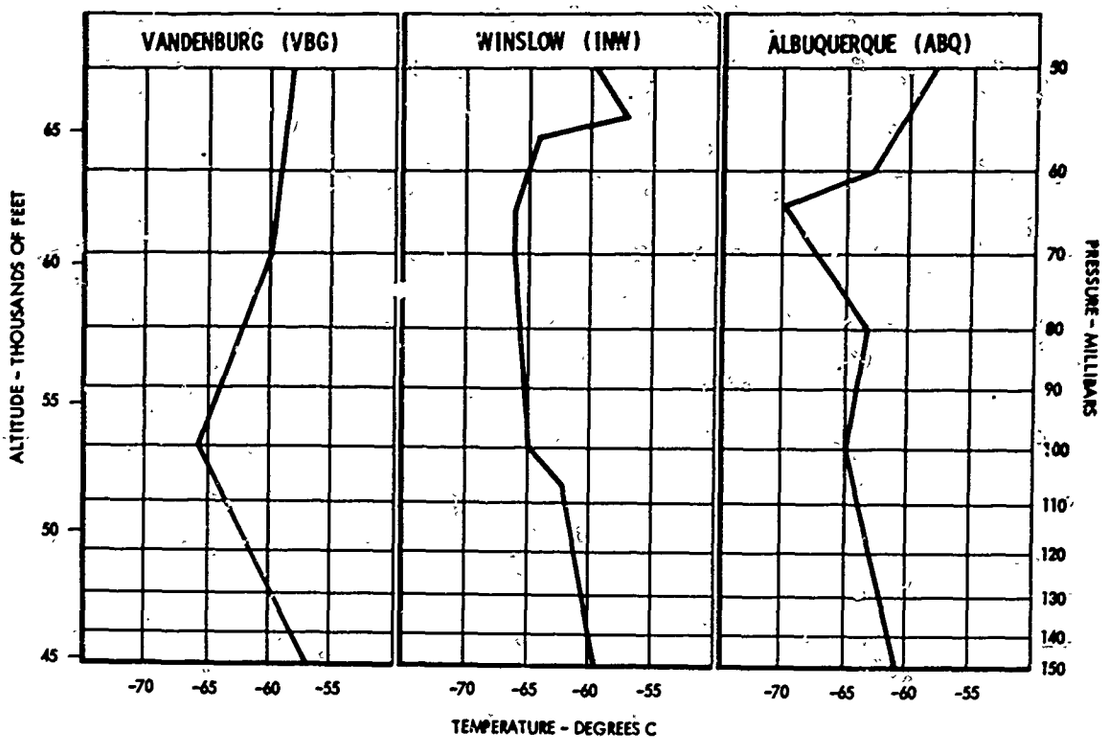
A rapidly advancing cold front, associated with a perturbation in the west-east flow moving across the Southwest, was accompanied by widespread clouds and precipitation. The trough at 500 mb was centered fairly close to ABQ. Winds were 115 knots above ABQ at 30,000 feet.

Some very light to light turbulence was encountered between 60,000 and 62,000 feet on both the outbound and inbound legs over INW. An extensive area of rather intense turbulence occurred in the layer between 56,000 and 60,000 feet.

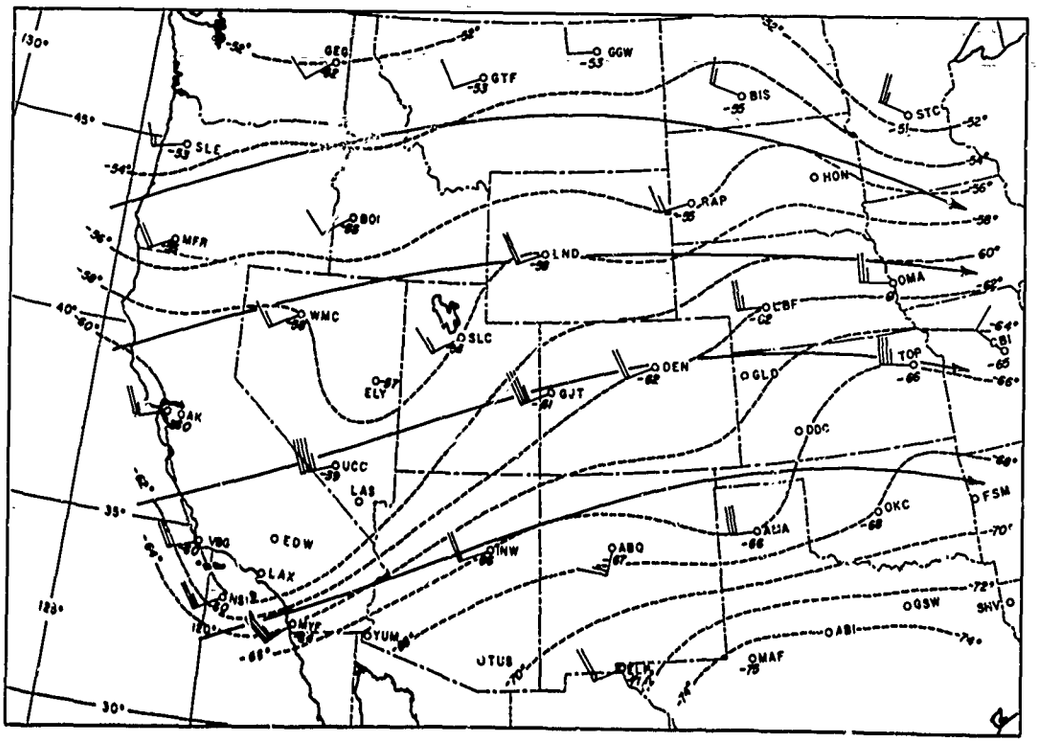
A pronounced horizontal temperature gradient is evident between GJT and INW and UCC and ABQ (RAOB chart).

The most severe turbulence (±0.5g) was between 57,000 and 58,000 feet where a vertical temperature decrease of 1.7°C/1000 feet is noted. No turbulence was found above 61,000 feet or below 56,000 feet in this area.

RAOB CHARTS (0000Z, 30 Nov 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 30 Nov 1967)



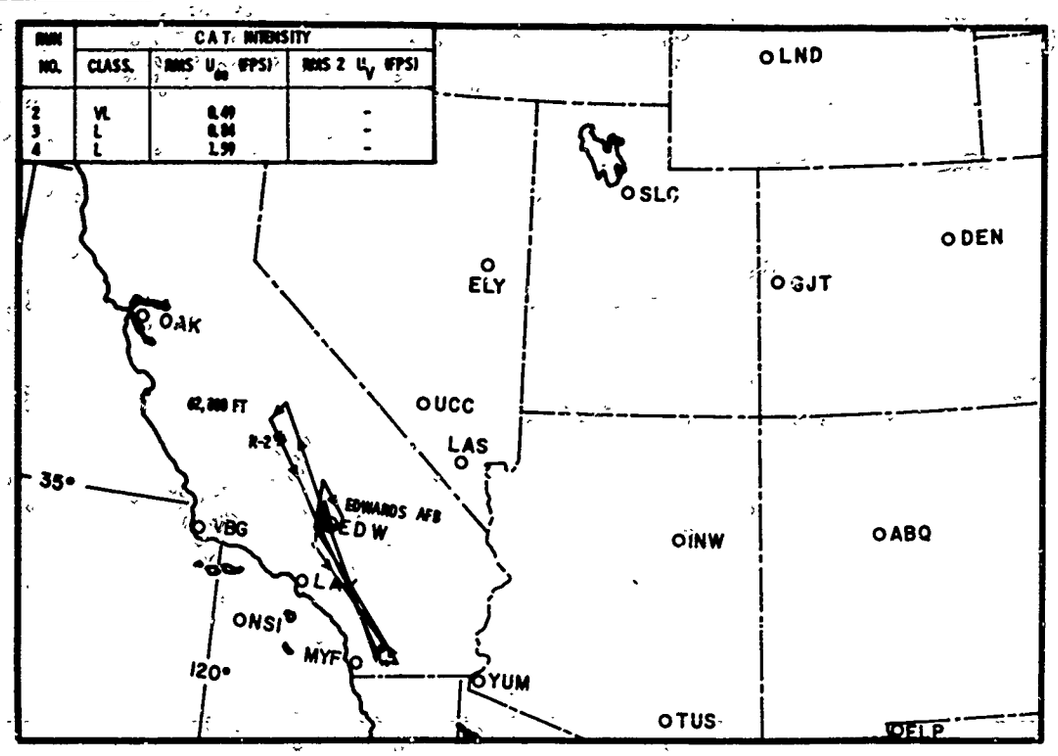
APPENDIX VI

TEST 263

30 November 1967, 0042-0403Z,

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

An occluded front was advancing towards the flight area from northern California. Southern California was on the fringe of an upper level trough but very little cyclonic circulation was present at 500 mb. Clouds were generally north of EDW and mostly low.

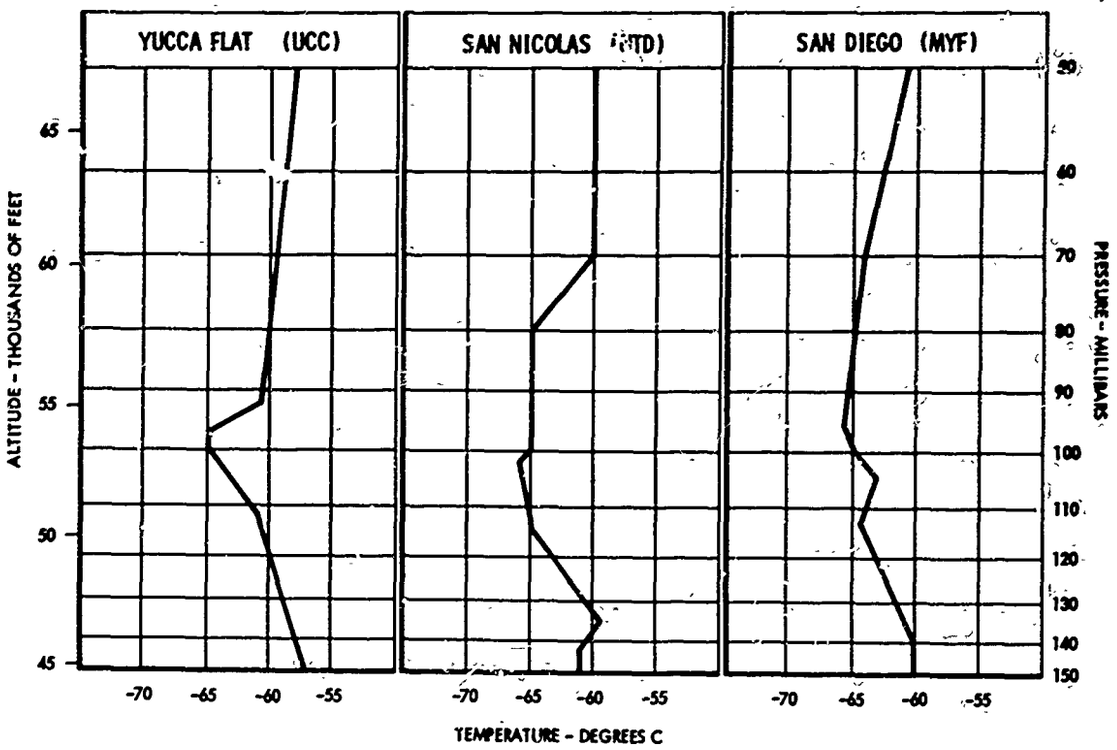
This was a night flight, keeping within southern California for the entire flight track. Very little turbulence was noted anywhere along the flight.

The 70 mb chart shows small horizontal temperature gradient in California except in the extreme southern portion of the state.

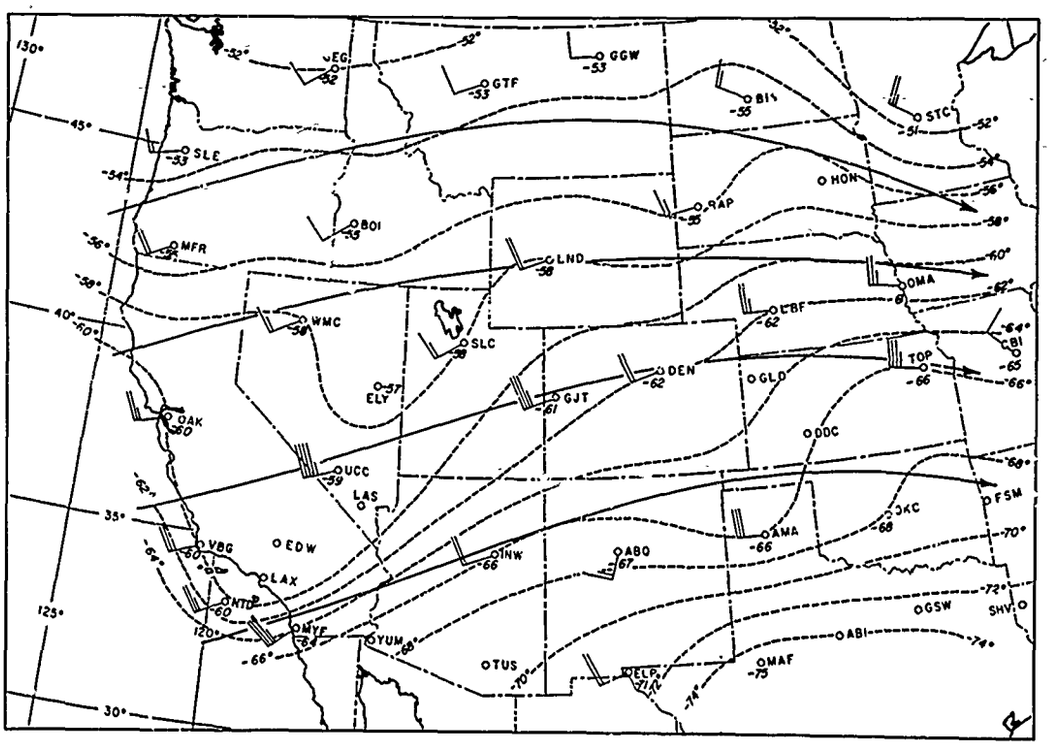
The only radiosonde data close to the flight track, MYF, shows a slight inversion around 52,000 feet but otherwise no evidence of wave motion.

APPENDIX VI

RAOB CHARTS (0000Z, 30 Nov 1967)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 30 Nov 1967)



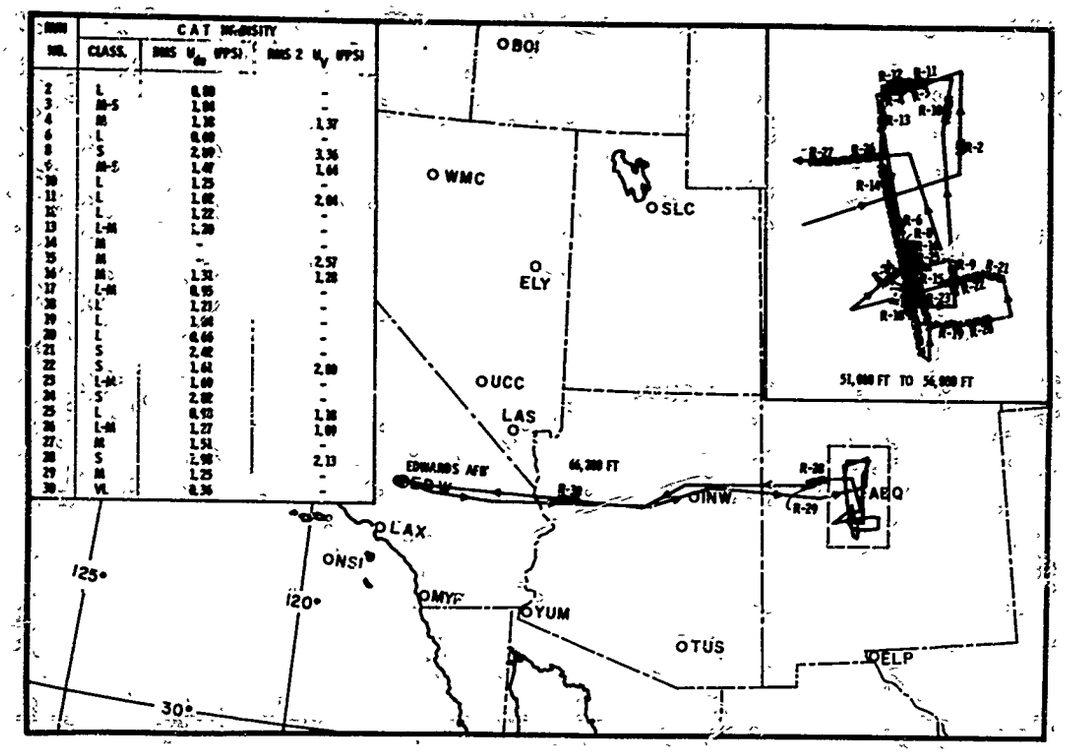
APPENDIX VI

TEST 267

2 December 1967, 0145-0620Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

This was a night flight which followed Test 266 by about 5 hours. The pilot was instructed to fly a pattern in the same general areas as on Test 266, where severe turbulence was recorded near ABQ.

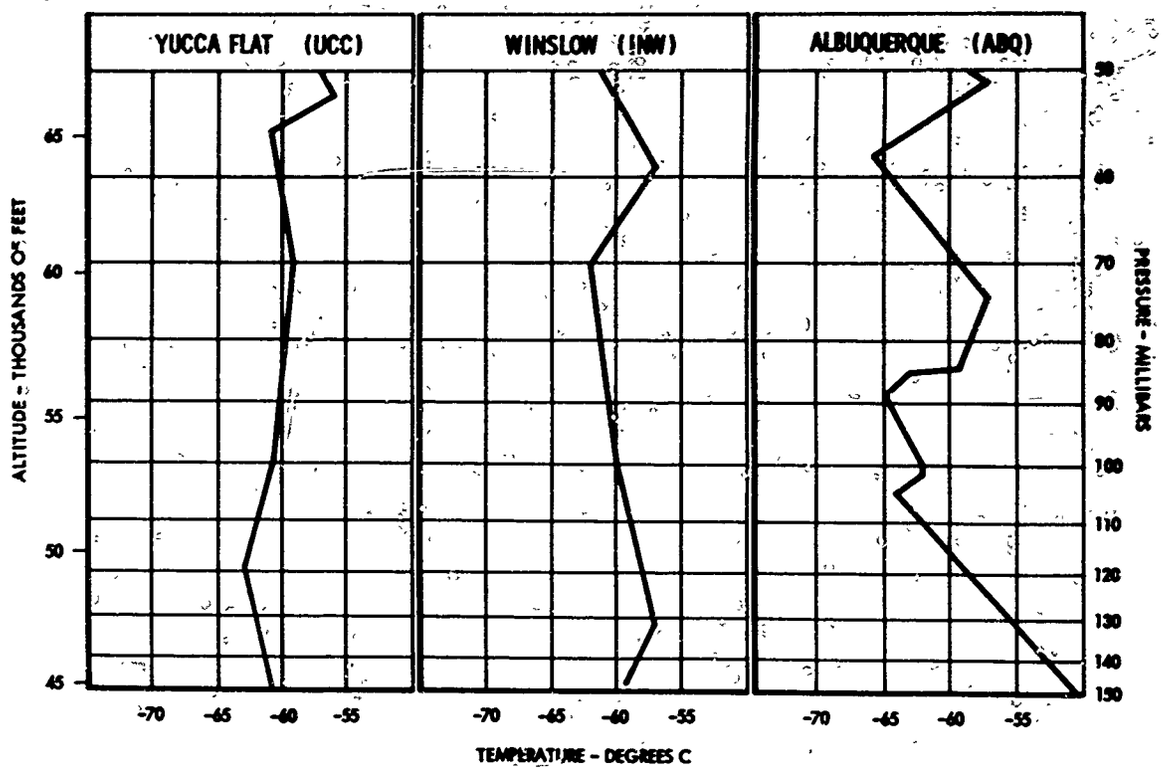
Surface conditions consisted of a cold front very close to ABQ with high pressure building west of the front. A moderate trough at 500 mb had its axis over central New Mexico. Winds were rather strong aloft at all levels up to 200 mb. Skies were clear throughout most of the flight.

Severe turbulence was reported in almost the same location as on the previous flight; the most abundant turbulence was between 51,000 and 52,000 feet.

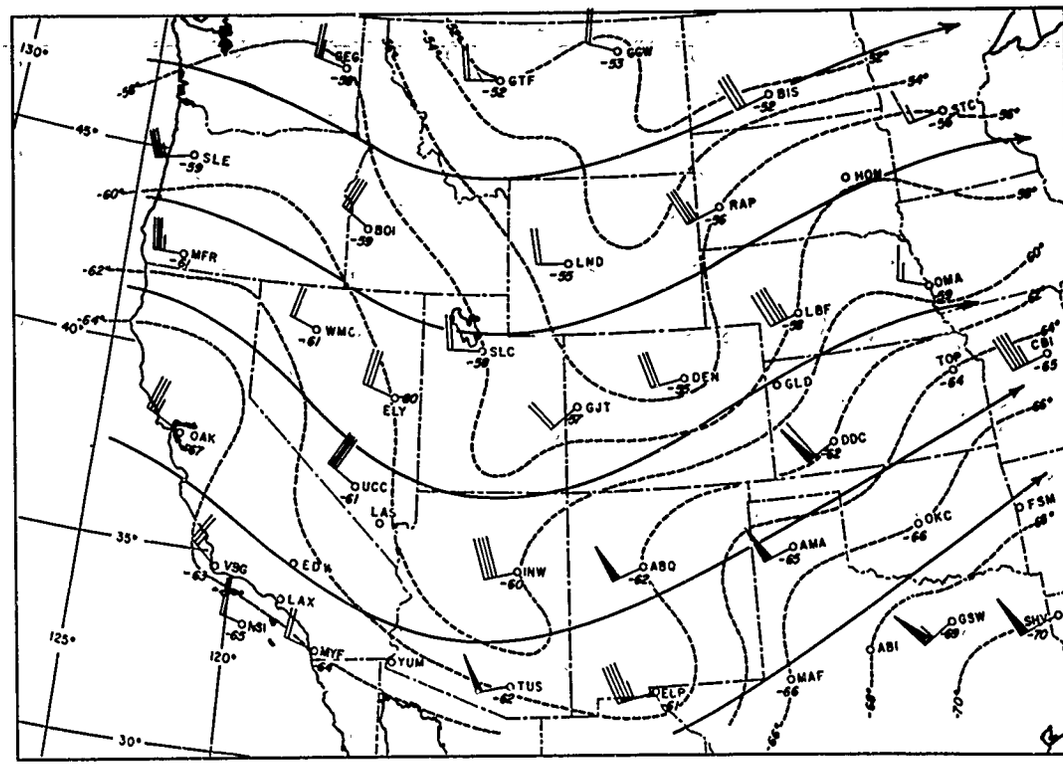
The 100 mb temperature gradient between GJT and ABQ is not especially large.

However, a 9°C difference between the two stations exists at the level of the maximum turbulence. The sounding at ABQ shows large fluctuations at several levels while INW is relatively smooth (temperatures and winds chart).

RAOB CHARTS (0000Z, 2 Dec 1967)



100 MB TEMPERATURES AND WINDS CHART (0000Z, 2 Dec 1967)



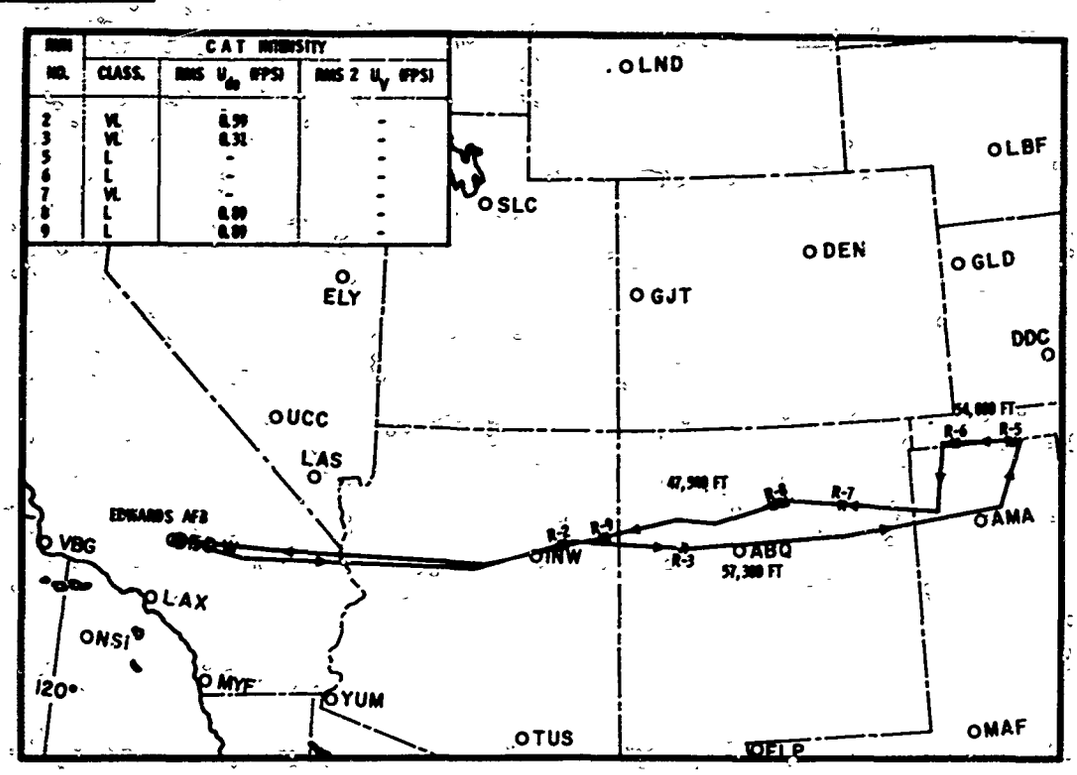
APPENDIX VI

TEST 268

2 December 1967, 1721-2158Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

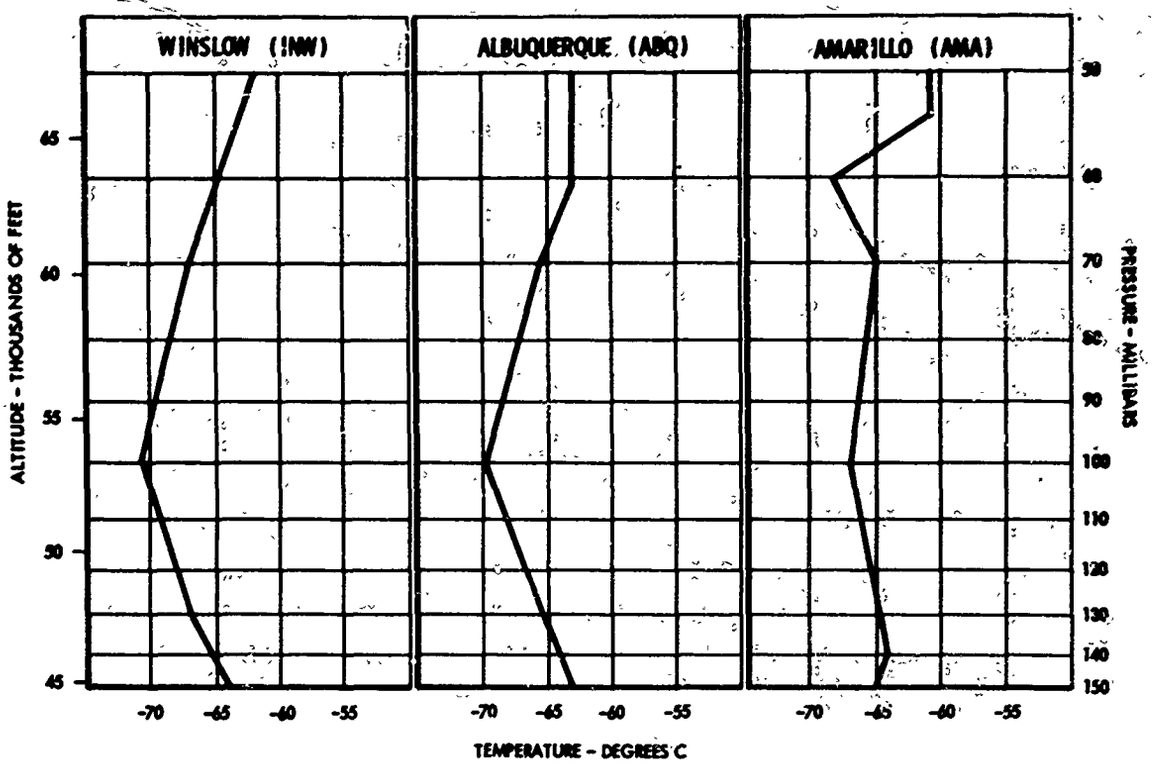
Surface pressures were rising over the Southwest as the cold front and upper level trough which accompanied the severe turbulence over ABQ moved east. Skies were generally clear and winds aloft had decreased somewhat except in northern Texas, which was still on the upwind side of the trough.

Over INW very little turbulence was recorded on the outbound leg at 56,500 feet; while about 1 minute of light CAT occurred at 52,000 feet on return north of AMA. Some light turbulence around 52,000 to 55,000 feet was observed. There was three minutes of moderate turbulence 50 miles northeast of ABQ at 47,500 feet on the return leg.

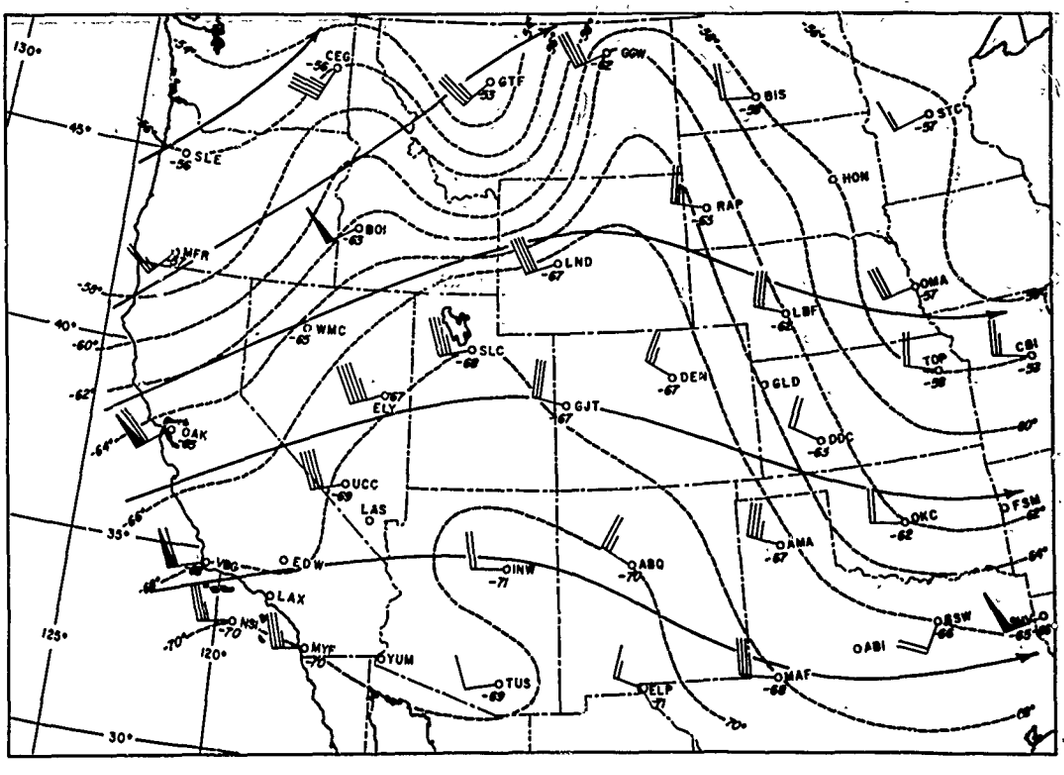
The RAOB chart shows temperature gradients at 100 mb were quite small along the flight path but increased somewhat to the east.

None of the radiosonde soundings for the stations along the flight track showed any substantial deviations below 60,000 feet.

RAOB CHARTS (0000Z, 3 Dec 1967)



100 MB TEMPERATURES AND WINDS CHART (0000Z, 3 Dec 1967)



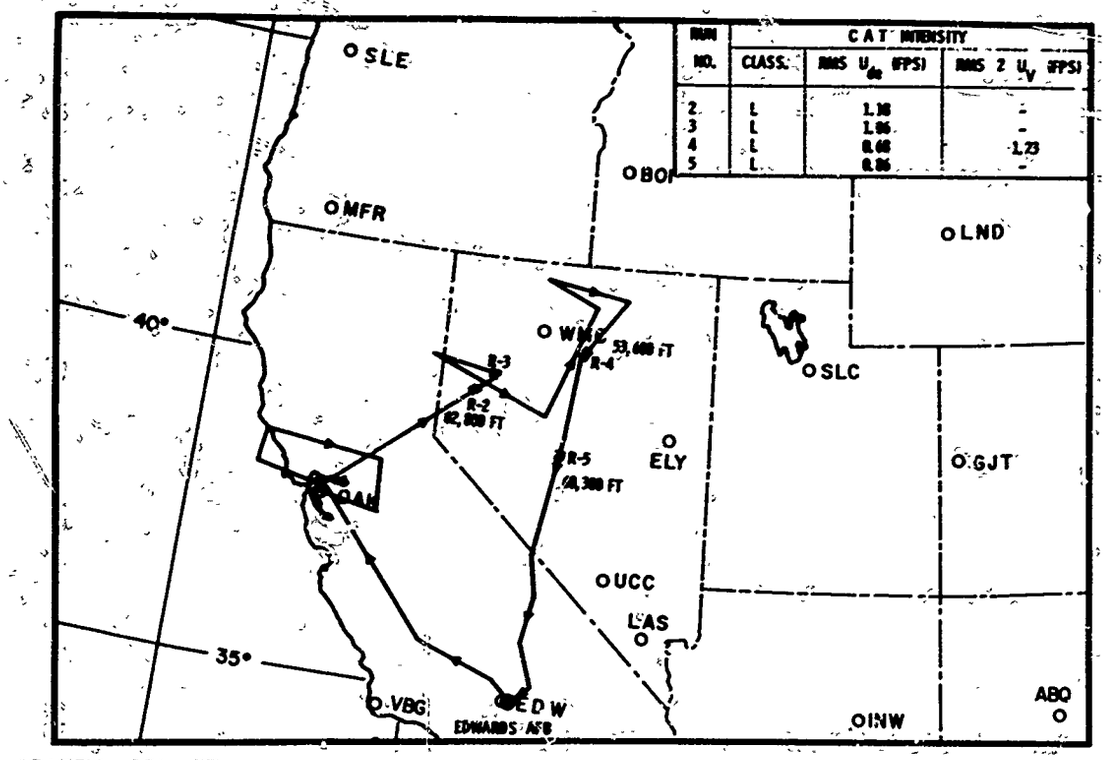
APPENDIX VI

TEST 269

30 January 1968, 1816-2315Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



RUN NO.	CAT INTENSITY CLASS.	RMS U_{ds} (FPS)	RMS 2 U_V (FPS)
2	L	1.38	-
3	L	1.86	-
4	L	0.68	1.23
5	L	0.86	-

FLIGHT SUMMARY

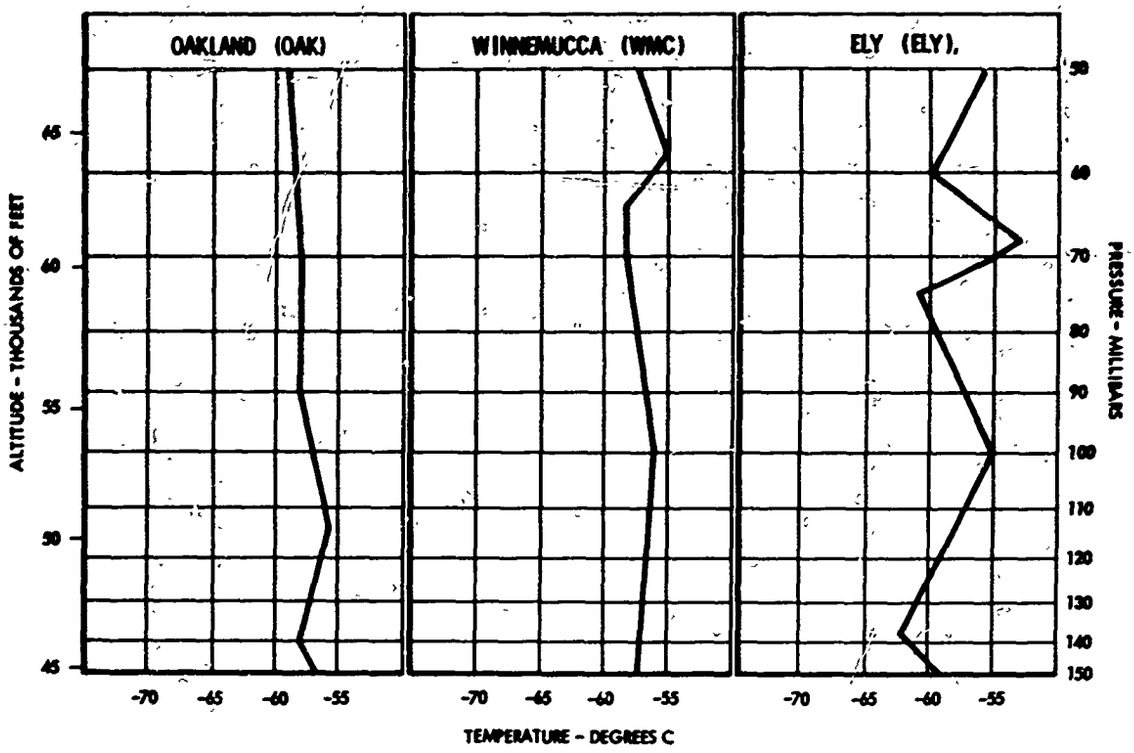
A high pressure system covered most of the Southwest at the surface but a cold front was advancing into northern California and Nevada, accompanied by moderate rain. An upper level trough remained stationary off the coast of Oregon and Washington with west-southwest winds at 500 mb persisting across the entire country.

Light turbulence was reported southwest and south of WMC above 60,000 feet and again at 53,600 feet but very little elsewhere.

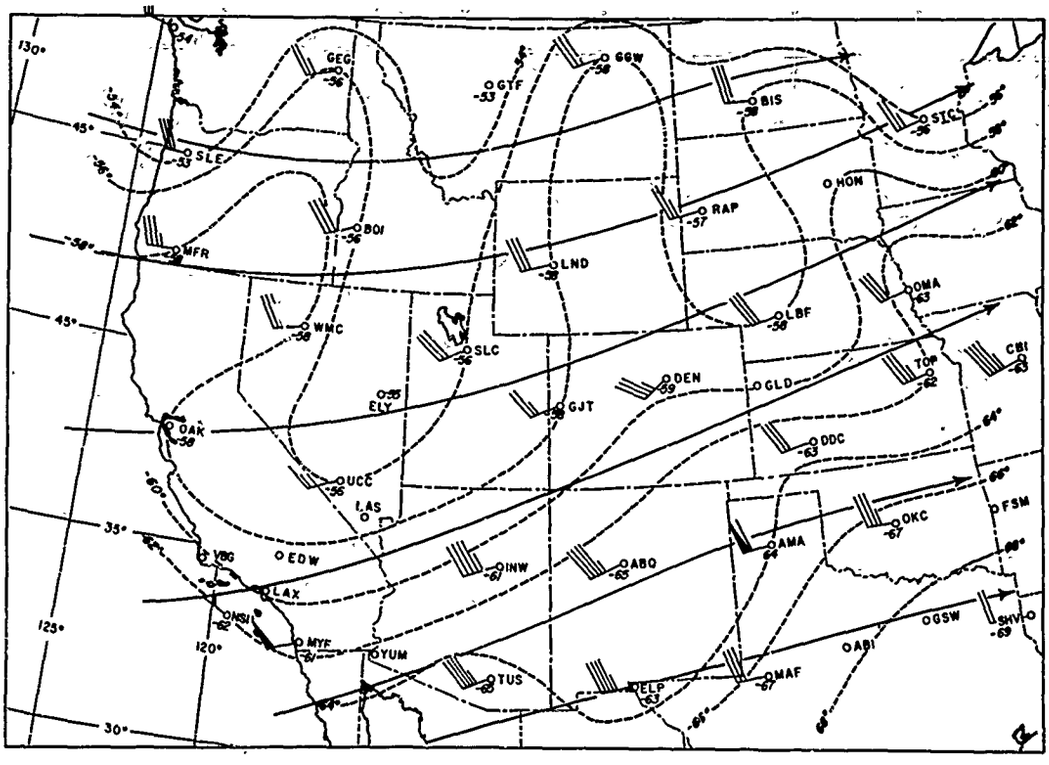
A thermal trough is present on the 70 mb chart between WMC and SLC but horizontal temperature gradients are weak.

WMC sounding shows a slight inversion between 62,000 and 64,000 feet. Very little temperature change with elevation exists at OAK, whereas ELY has a 15°C total change between 58,500 and 63,500 feet.

RAOB CHARTS (0000Z, 31 Jan 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 31 Jan 1968)



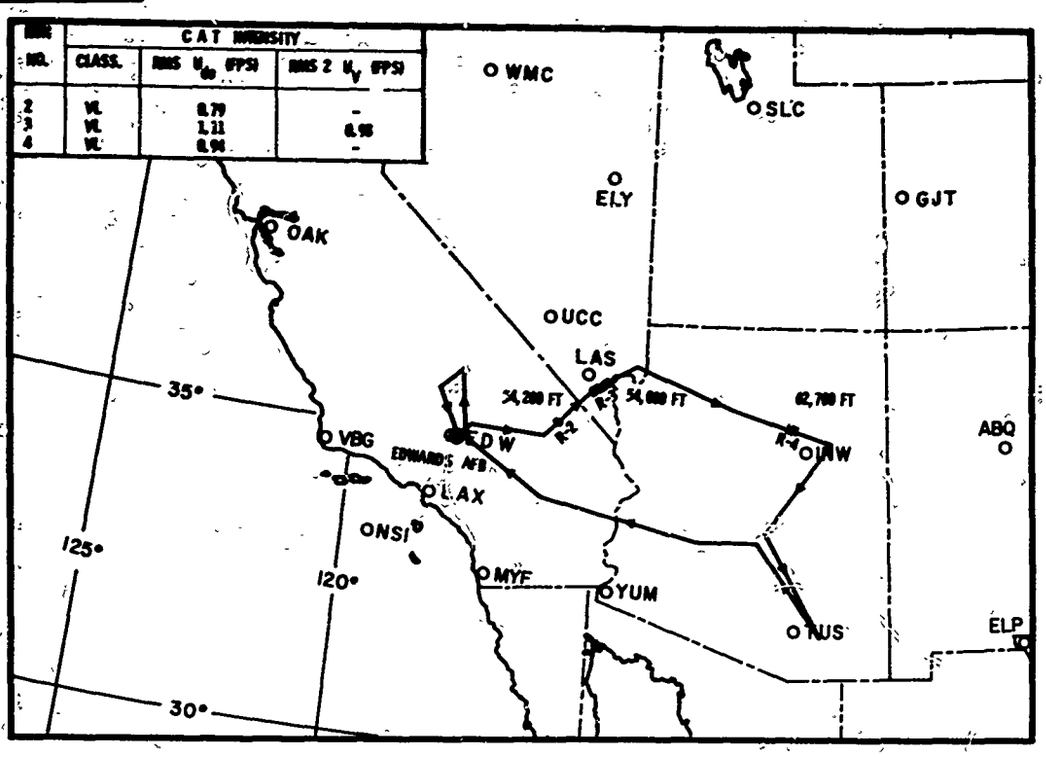
APPENDIX VI

TEST 270

31 January-1 February 1968, 2053-0031Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

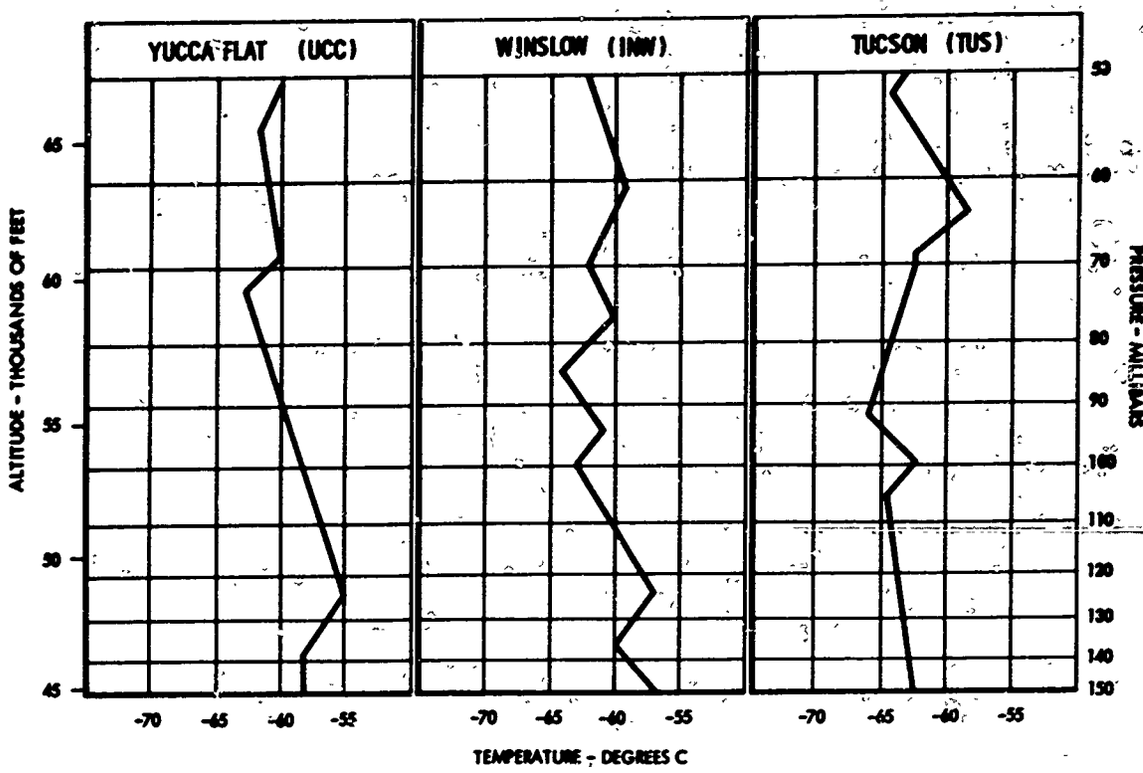
A long wave trough at 500 and 300 mb was centered over Arizona and New Mexico. Winds were quite strong at 35,000 feet, 115 knots at TUC and 90 knots at INW. Ridging was evident behind a cold front extending from New Mexico into the Dakotas. There were no significant clouds above 10,000 feet.

The only persistent turbulence throughout the flight was over LAS at 54,000 feet, but only of the very light category. One short run was recorded northwest of INW at 62,700 feet, again only very light turbulence.

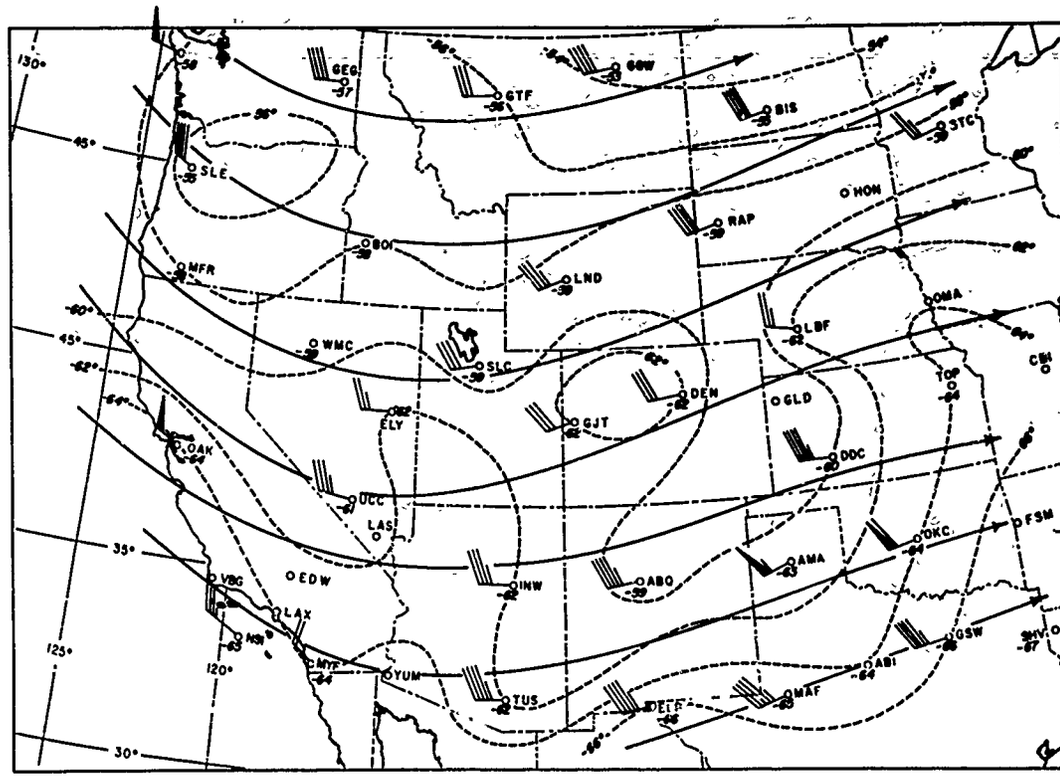
No sharp gradients are evident in the temperature pattern at 70 mb along the flight track.

The soundings for INW and TUC are rather irregular in their vertical structure between 52,000 and 63,000 feet. However, no significant turbulence was found at these altitudes.

RAOB CHARTS (0000Z, 1 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 1 Feb 1968)



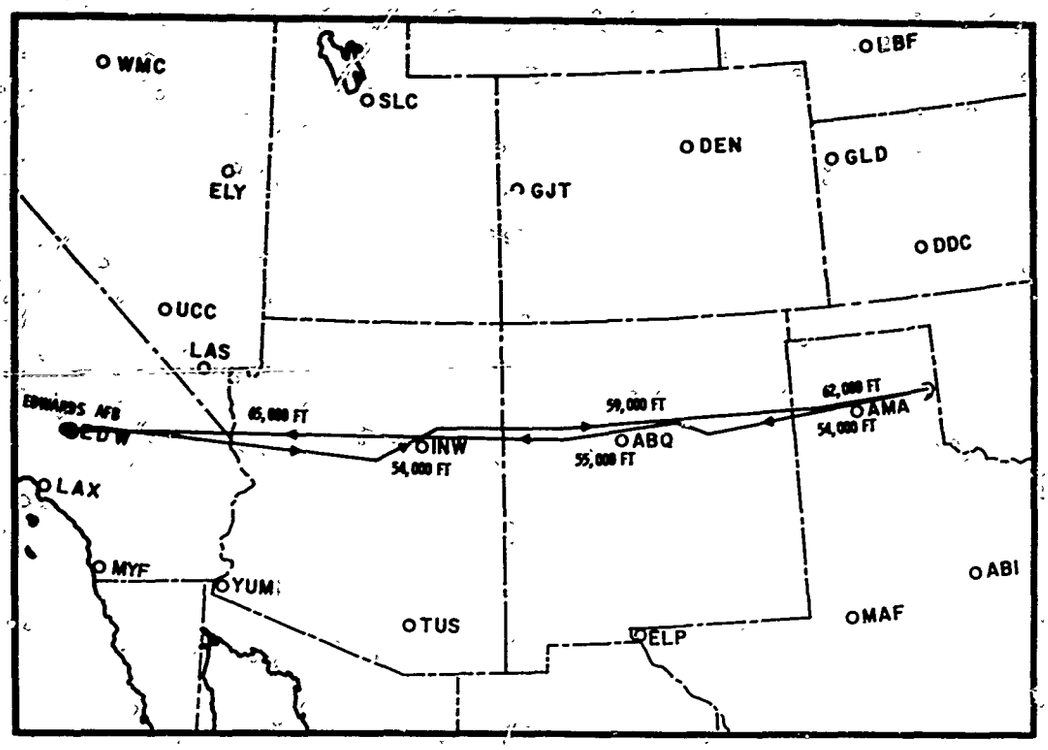
APPENDIX VI

TEST 271

1 and 2 February 1968, 2054-0154Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The entire Southwest was under the influence of high pressure at the surface and a ridge aloft.

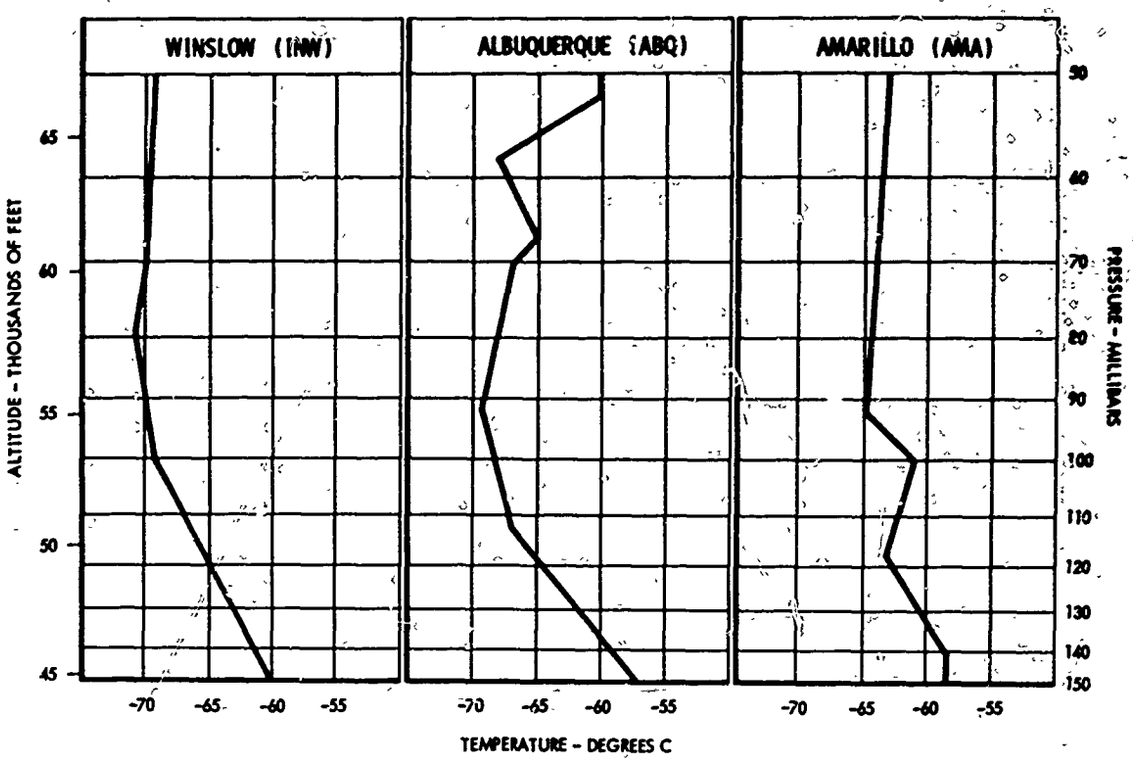
The pilot reported some light turbulence at 60,000 feet in eastern New Mexico both on the outbound and inbound legs; all other turbulence was of little consequence. Skies were clear east of INW with some cirrus to the west. Maximum winds along the flight path were 85 knots at 40,000 feet over INW.

There is a rather strong temperature gradient between GJT and INW (RAOB chart) but no pronounced gradients along the flight path.

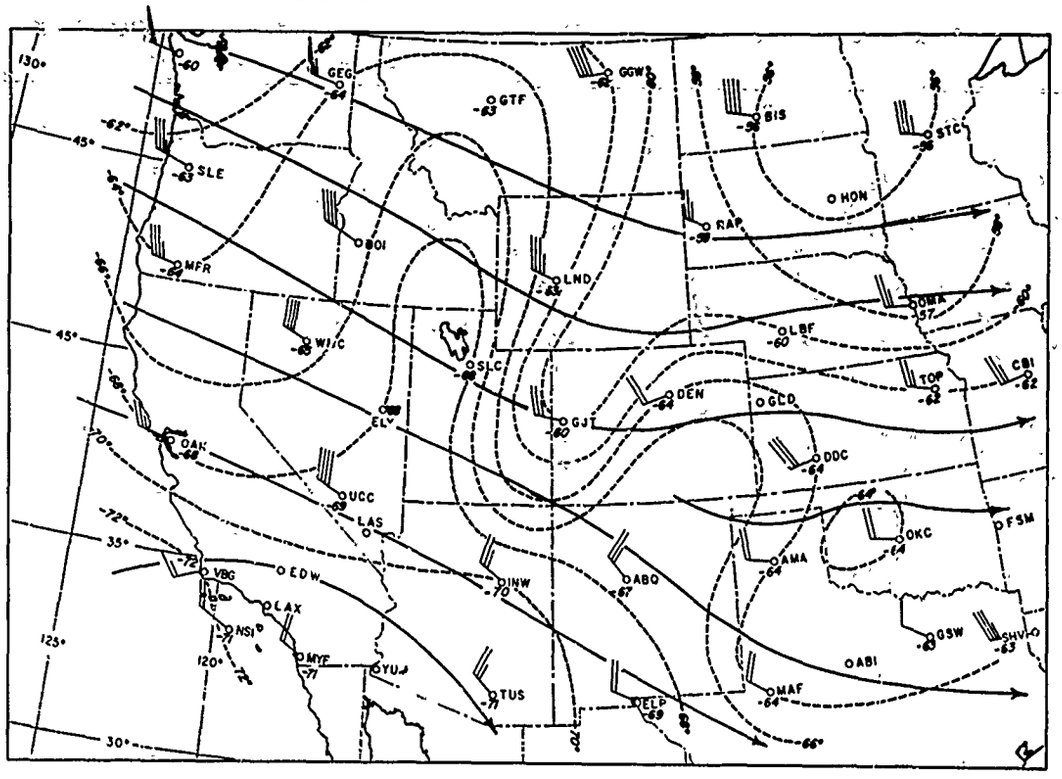
ABQ sounding shows a moderately sharp inversion near the height where the pilot reported turbulence east of this station.

APPENDIX VI

RAOB CHARTS (0000Z, 2 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 2 Feb 1968)



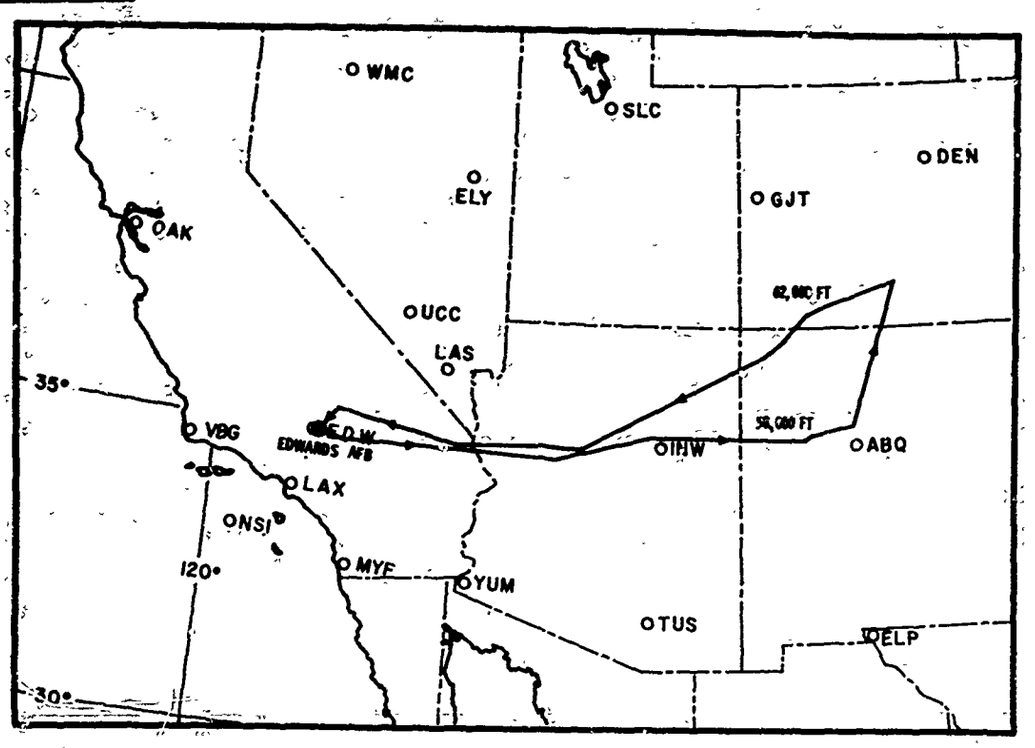
APPENDIX VI

TEST 272

2 February 1968, 0308-0649Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



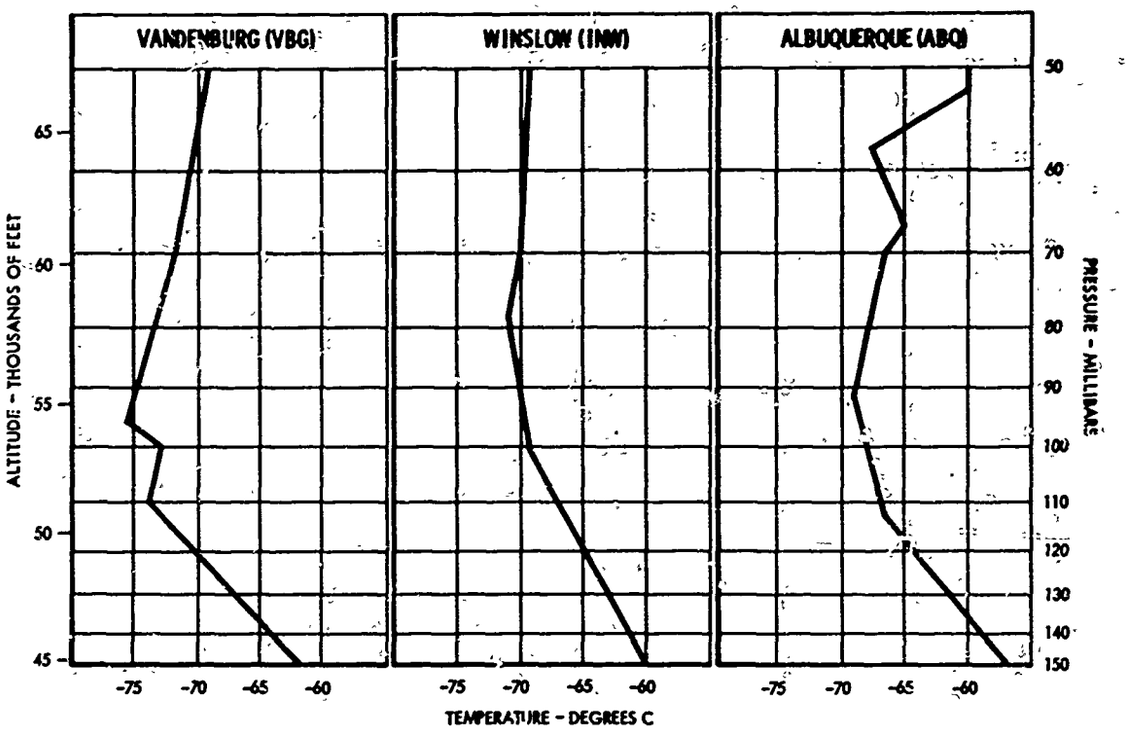
FLIGHT SUMMARY

This was a night flight covering the same area as Test 271 earlier in the day, with the exception of turning north at ABQ, instead of flying east to AMA.

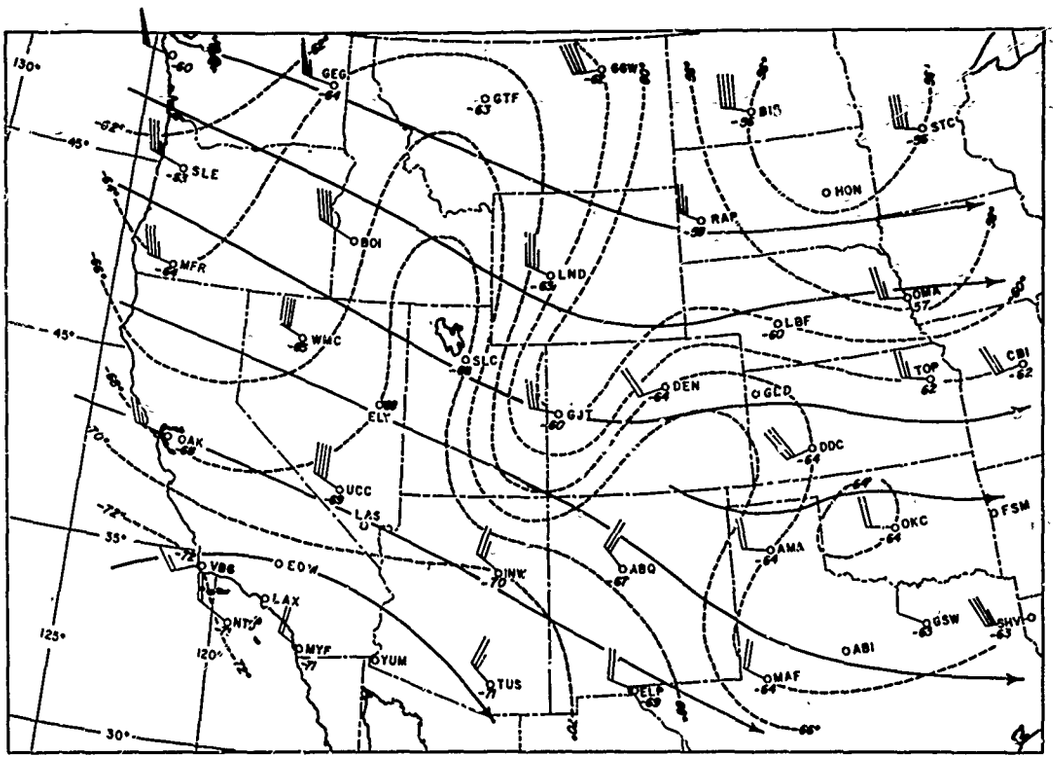
High clouds still persisted west of Phoenix, Arizona but had dissipated by the return flight. The synoptic pattern remained about the same as during the previous flight.

Only very light turbulence was recorded northeast of ABQ between 62,000 and 64,000 feet which is in the same general area as the medium horizontal temperature gradient (~1°C/22 nm) at 70 mb and the rapidly fluctuating temperature change with height at ABQ.

RAOB CHARTS (0000Z, 2 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 2 Feb 1967)



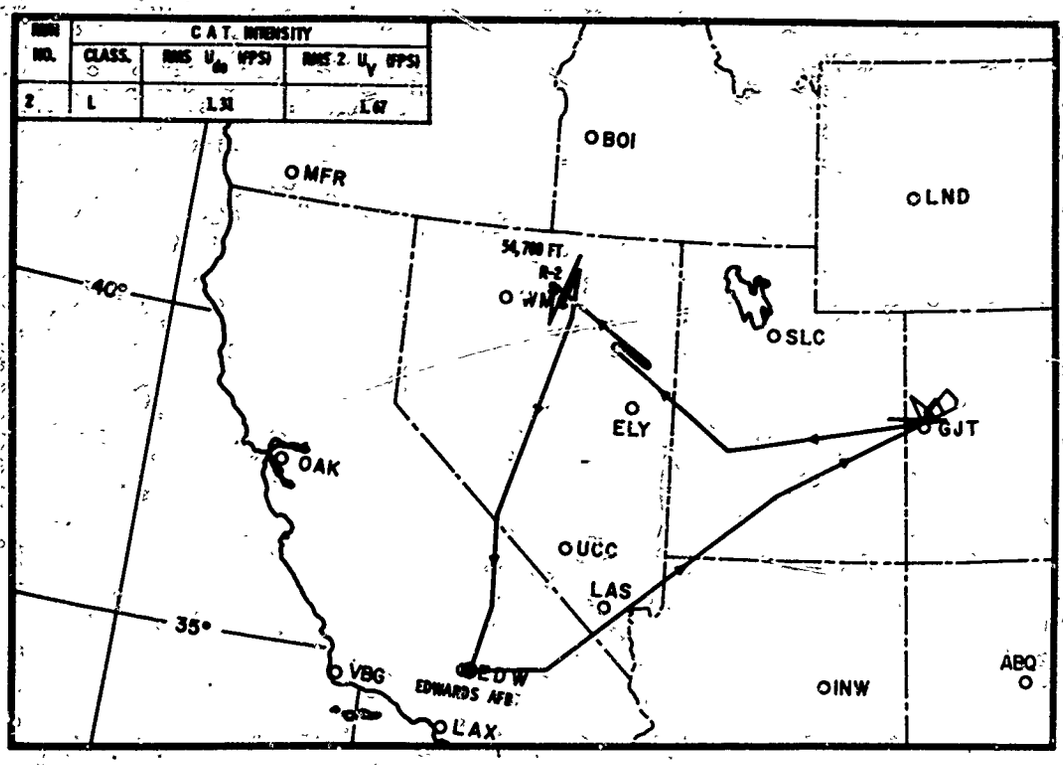
APPENDIX VI

TEST 273

2 February 1968, 1818-2336Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

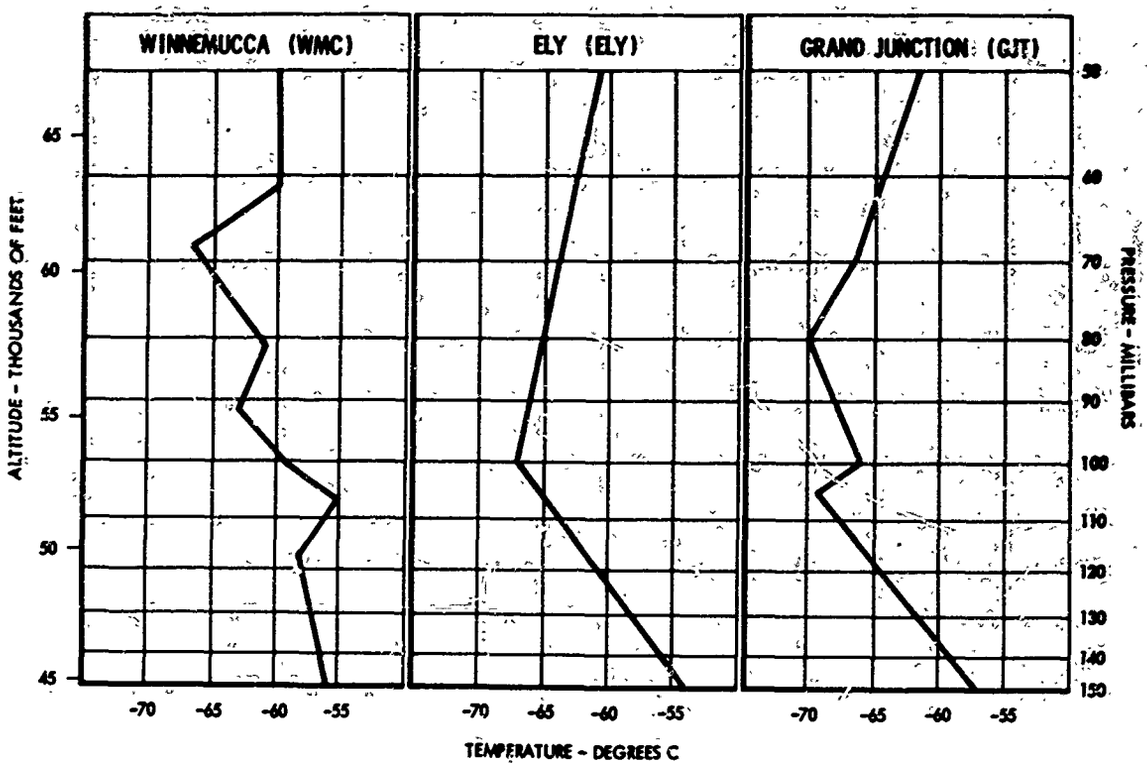
High pressure at the surface covered most of the West. The flow at 500 mb was nearly west-east. Scattered clouds were present in the south with mostly cloudy skies around GJT and ELY.

The pilot reported some light turbulence over GJT at 51,500 feet and near ELY at 55,000 feet. A limited area of light to moderate turbulence was reported east of ELY between 55,000 and 56,000 feet.

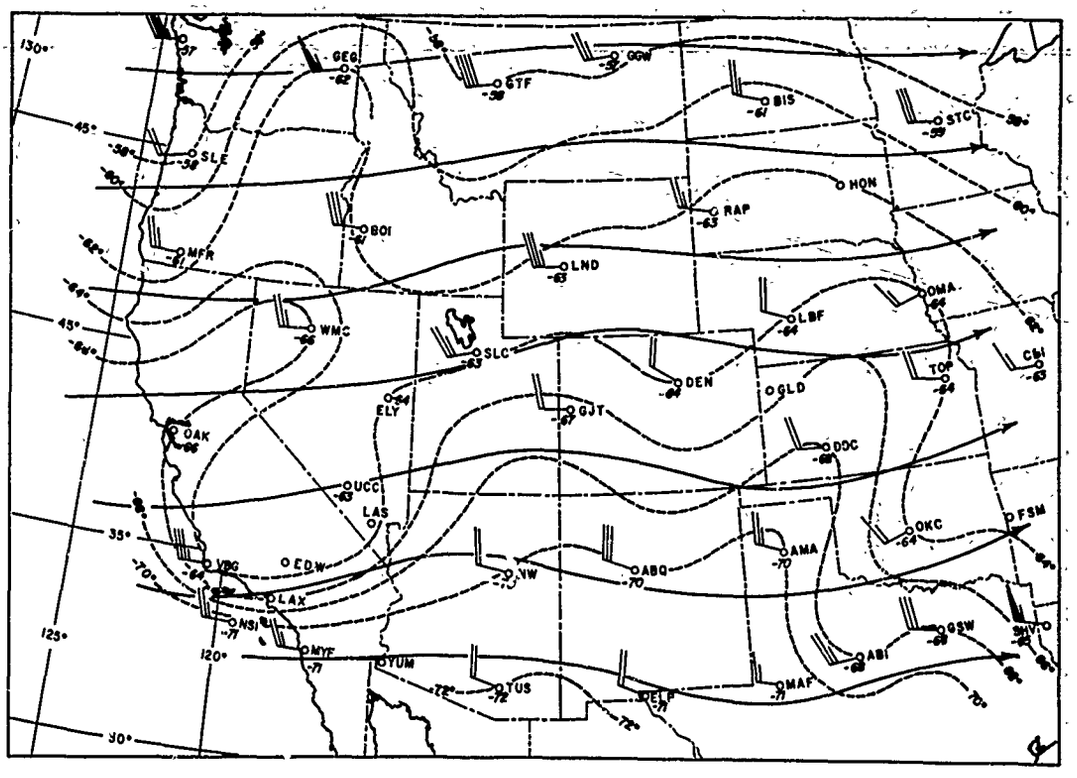
The 70 mb horizontal temperature pattern shows a well defined thermal trough extending southwest from Nevada to the southern California coast.

A 7°C temperature gradient is seen between VBG and NSI, a distance of about 100 miles. Both WMC and GJT soundings exhibit inversions near the levels where the turbulence was reported. However, ELY'S sounding had no significant levels between 150 and 50 mb.

RAOB CHARTS (0000Z, 3 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 3 Feb 1968)



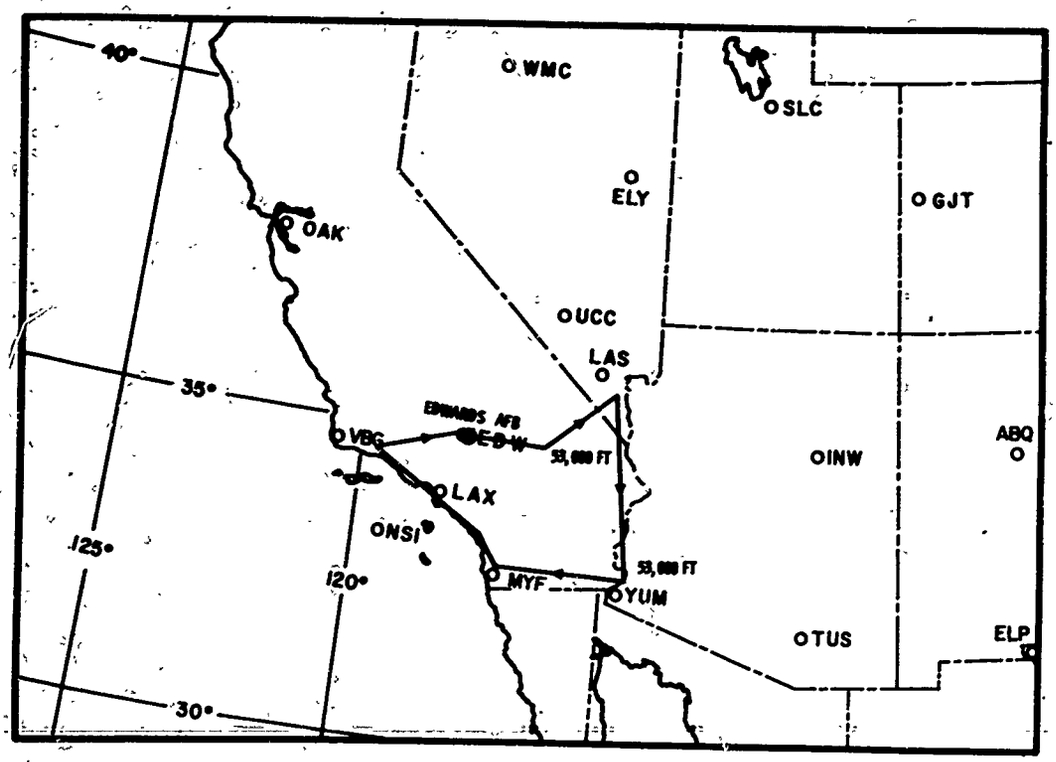
APPENDIX VI

TEST 274

5 February 1968, 2030-2349Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

A weak surface front extending from Idaho into northern California was dissipating upon coming into contact with high pressure over the Great Basin. At 500 mb a cutoff low was located 200 miles off the central California coast but the flow was generally weak otherwise. A cirrostratus deck covered most of the flight area.

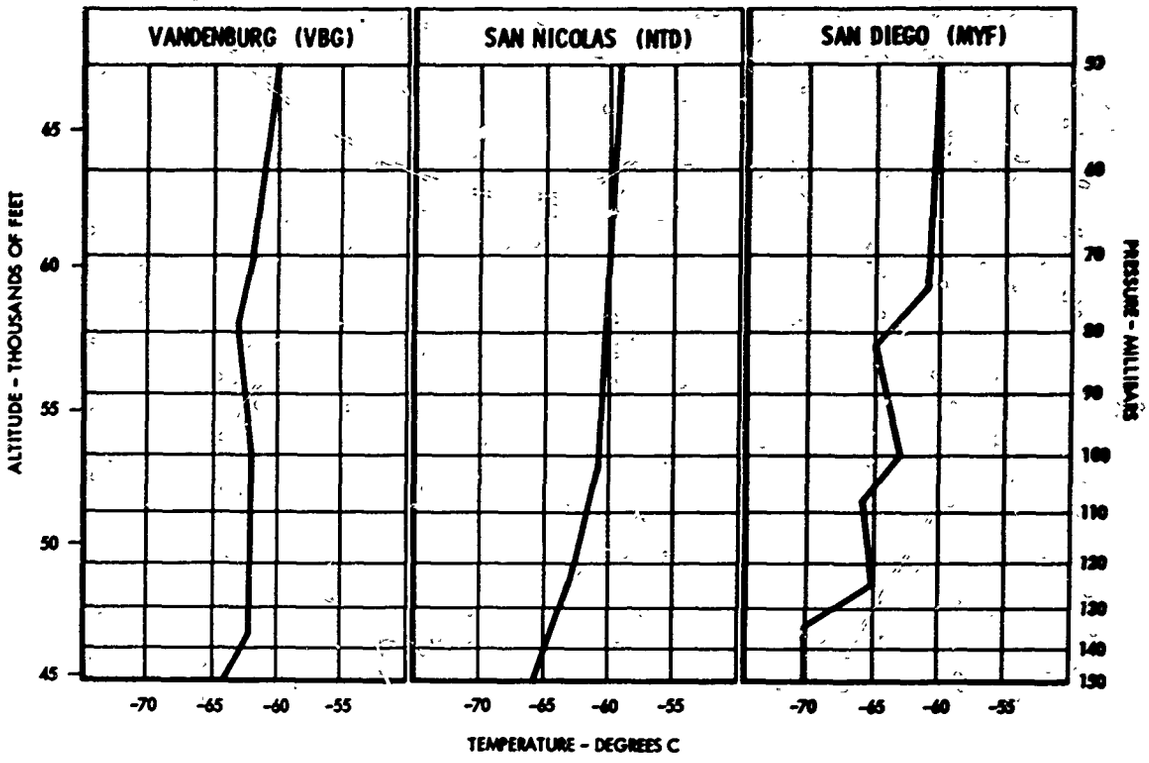
There were only a few patches of very light turbulence south of LAS at 53,000 feet.

Although VBG and NSI show only slight variations of temperature with height between 150 and 50 mb three distinct inversions are noted on MYF's sounding.

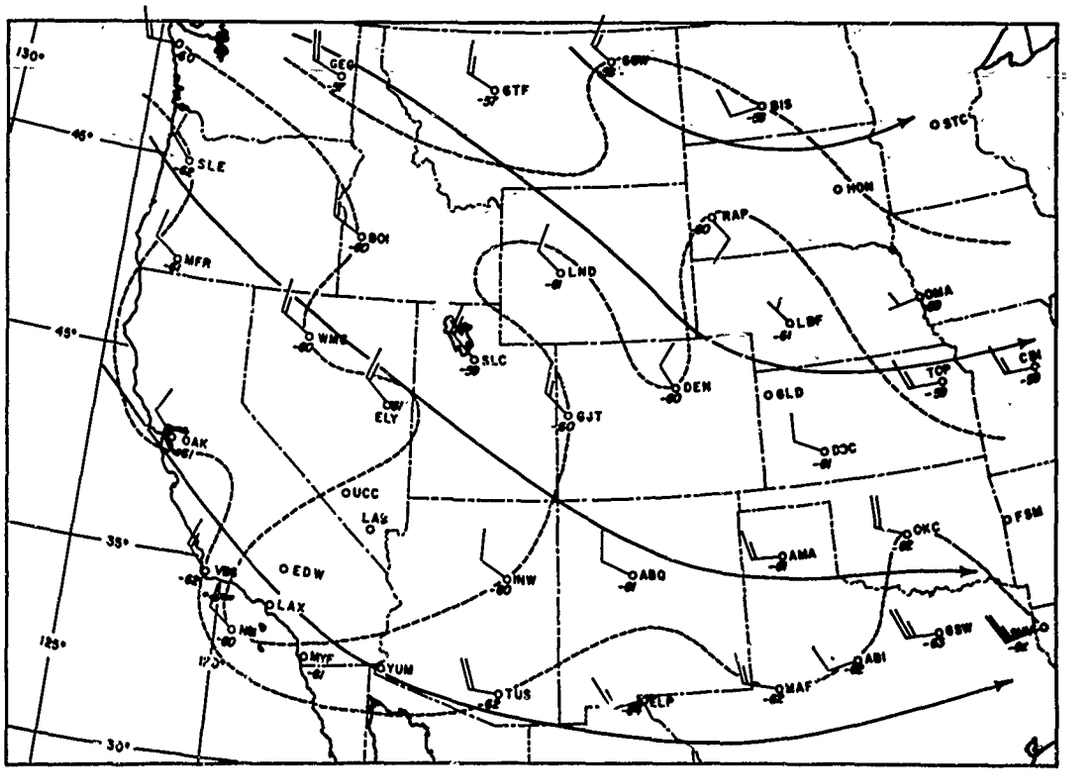
A very weak temperature gradient is seen at 70 mb.

APPENDIX VI

RAOB CHARTS (0000Z, 6 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 6 Feb 1968)



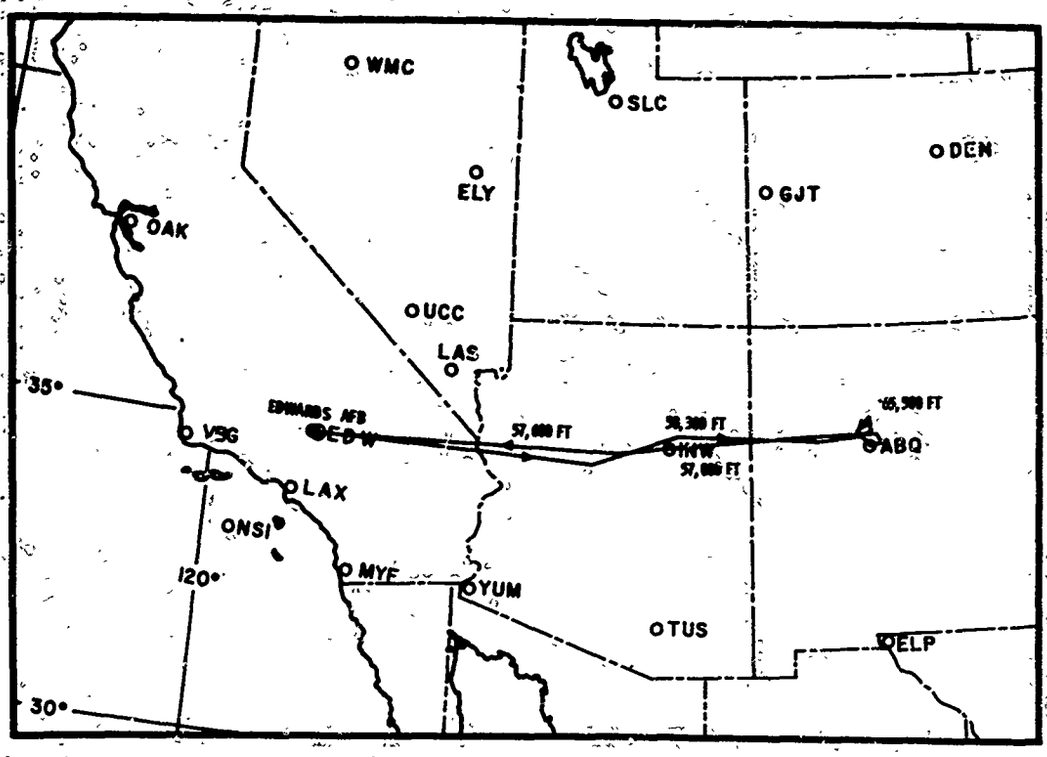
APPENDIX VI

TEST 275

6 and 7 February 1968, 2040-0020Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

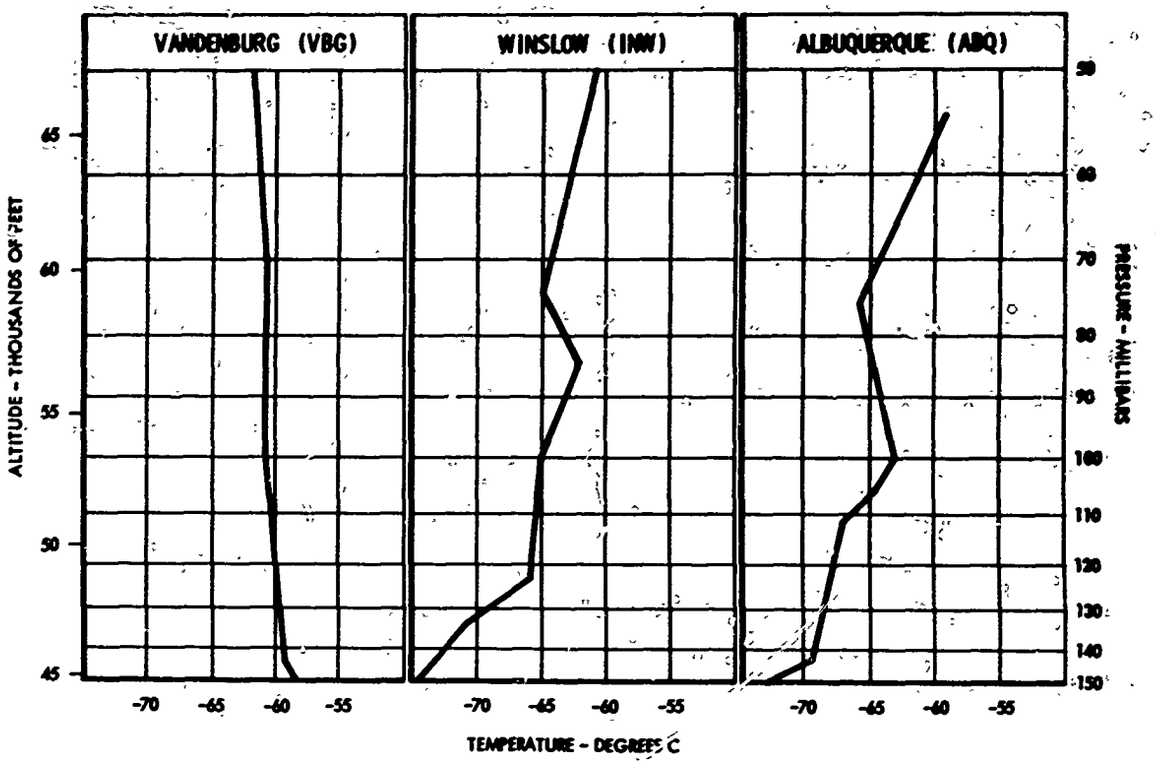
High pressure covered most of the Rocky Mountain States with a weak trough along the Pacific Coast. A cold core low just off the central California coast extended from below 700 mb on up into the high troposphere. Cirrostratus clouds were reported over most of Arizona.

Only occasional "ripples" occurred during the entire flight, generally around 56,000 to 57,000 feet.

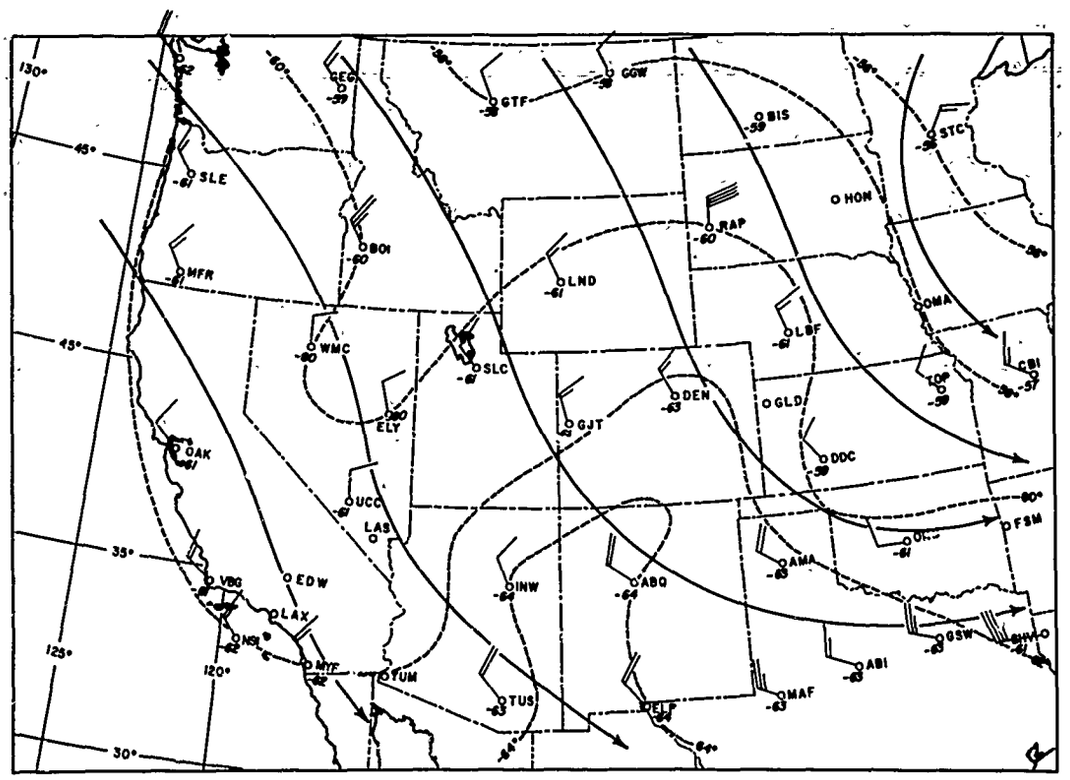
The soundings at both INW and ABQ (RAOB chart) indicate fairly stable conditions in the lower stratosphere, this was enhanced by the rather cold temperatures at 150 mb.

The temperatures and winds chart shows that the temperature gradient is weak and the winds light over the entire western United States.

RAOB CHARTS (0000Z, 7 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 7 Feb 1968)



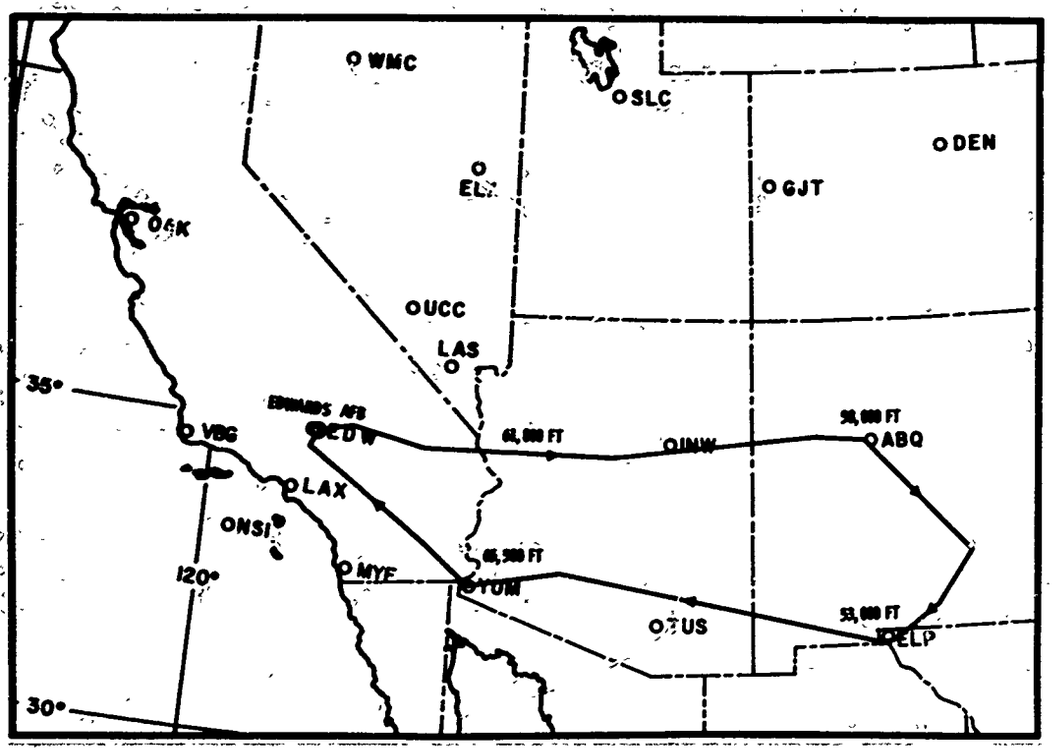
APPENDIX VI

TEST 276

8 and 9 February 1968, 2050-0106Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Weather patterns remained relatively unchanged from the previous two days. The low pressure aloft, off the California coast, was weakening, since most of the West was under the dominance of a large ridge. At the surface a weak trough persisted along the West Coast and high pressure covered the interior. Winds aloft were 120 knots at 40,000 feet over ELP.

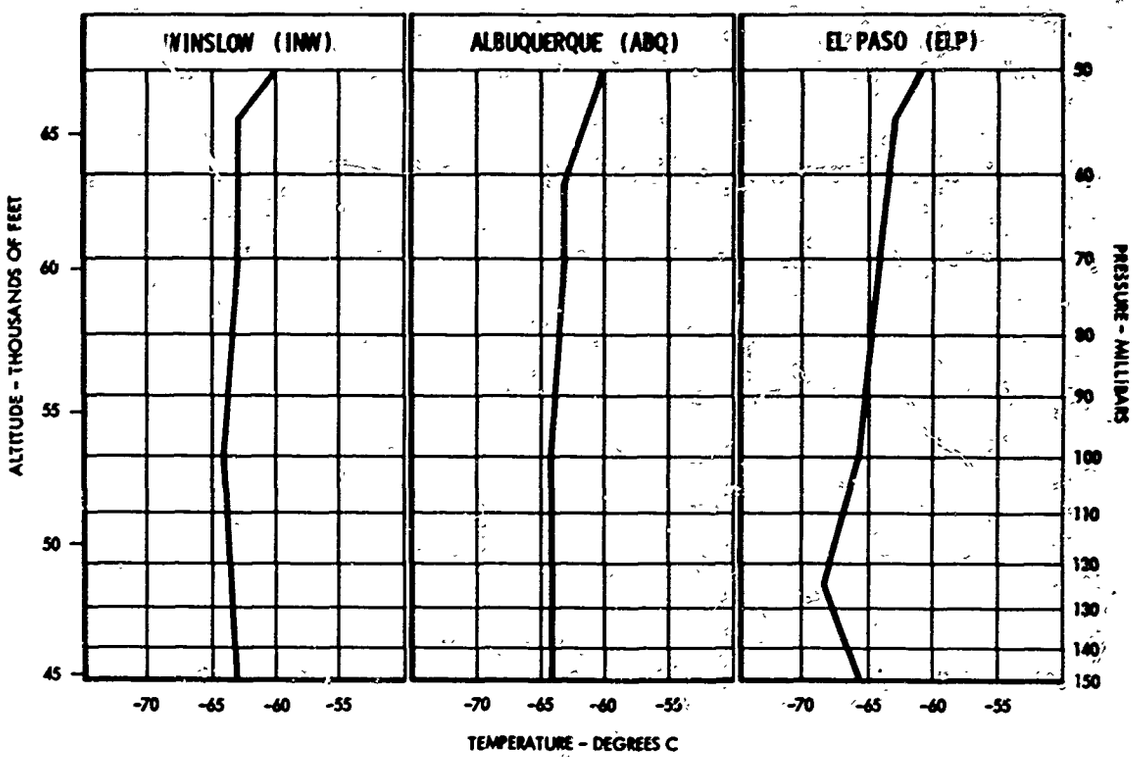
The entire flight was calm except for a few "ripples" at 62,000 feet northeast of El Paso. Cirrostratus overcast covered all of Arizona and California.

The winds at 70 mb have increased in intensity and remained from the northwest. The temperature gradient was weak.

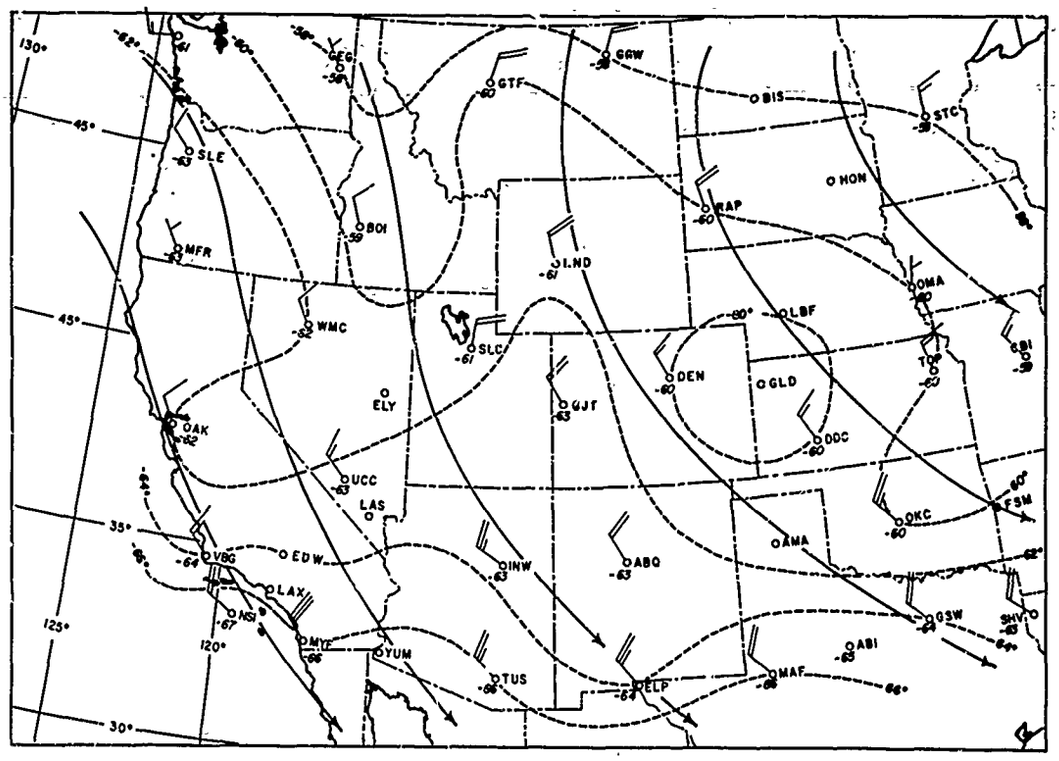
No significant vertical temperature gradients are visible on any of the radiosonde soundings.

APPENDIX VI

RAOB CHARTS (0000Z, 9 Feb 1968)



70-MB TEMPERATURES AND WINDS CHART (0000Z, 9 Feb 1968)



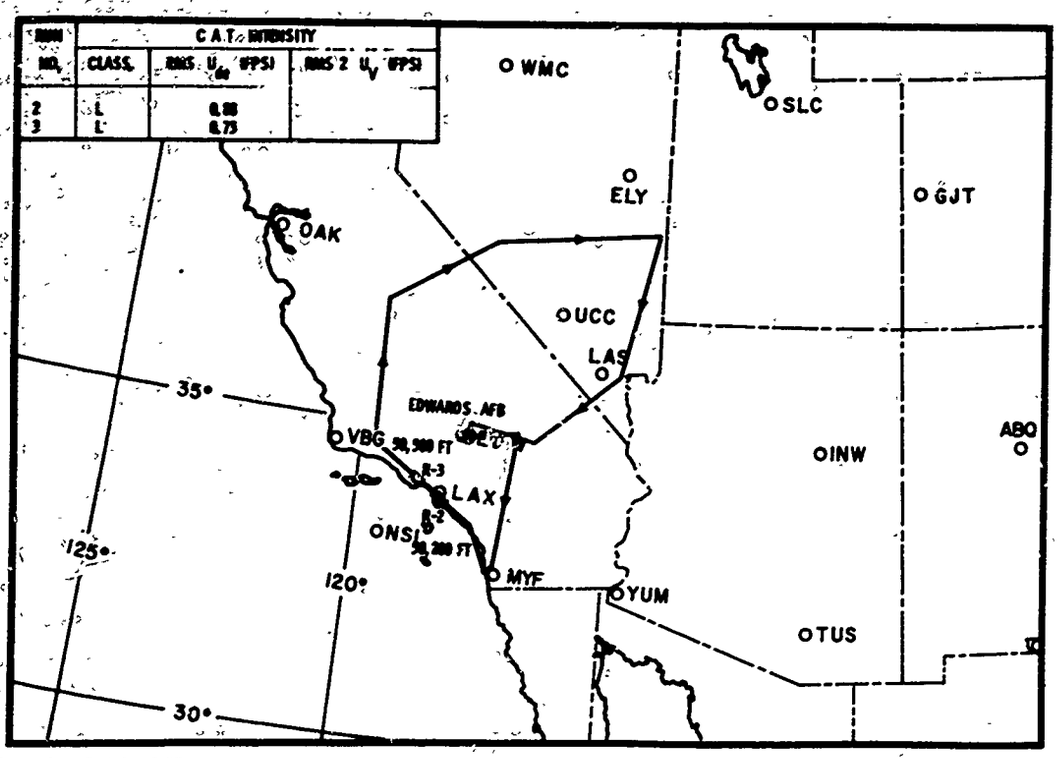
APPENDIX VI

TEST 277

9 February 1968, 1927-2336Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The pressure patterns at the surface and aloft changed very little from the previous day. The ridge at 500 mb over the West became somewhat weakened. The result was a greater influx of cold air associated with the 500 mb low off the California coast and light rain throughout most of the Southwest.

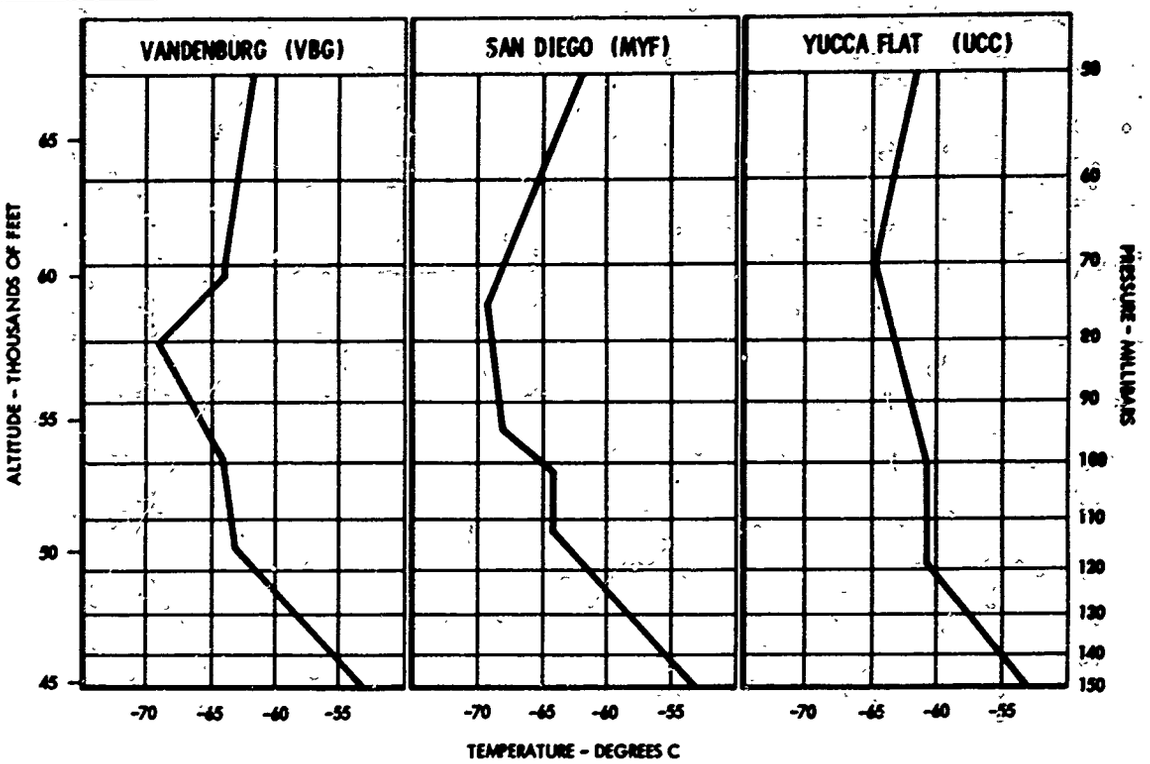
Continuous light turbulence, up to ±0.3g, was recorded just northwest of LAX. No other significant turbulence was recorded at 51,000 feet.

A 3°C gradient can be seen between VBG and MYF at 70 mb, but only 1°C at flight level.

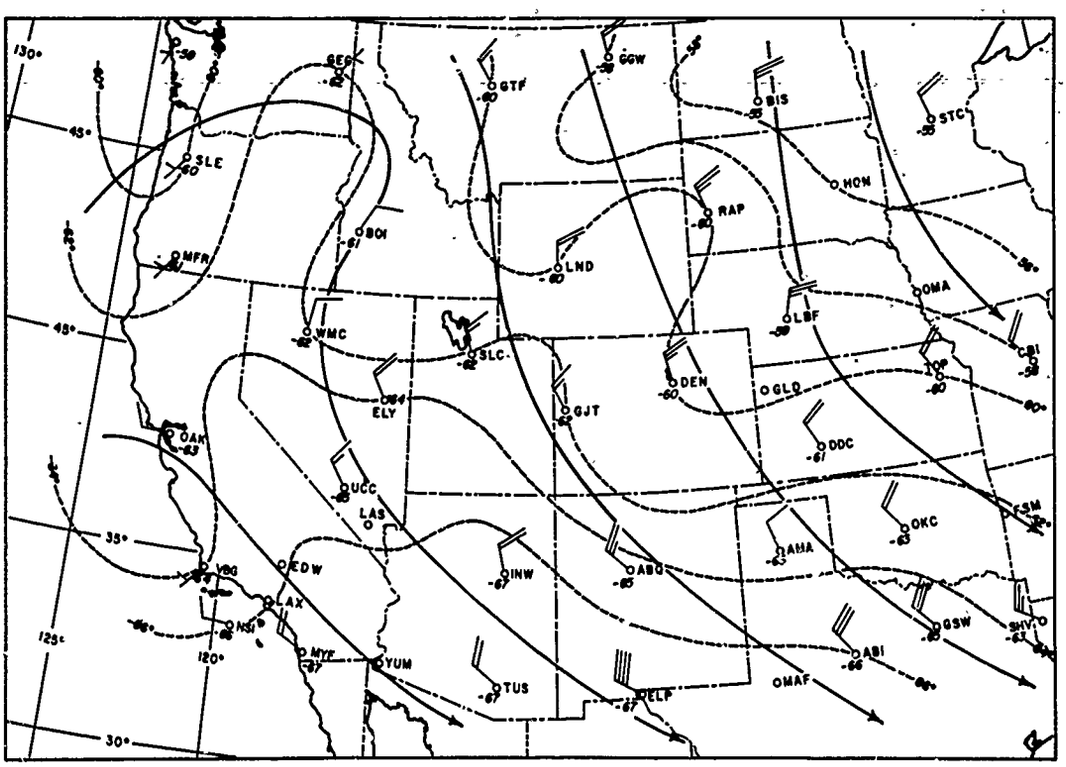
Vertical temperature gradients are quite pronounced in the turbulence zone between 45,000 feet and 50,000 feet. Changes on the order of -2°C/1000 feet are present at both VBG and MYF.

APPENDIX VI

RAOB CHARTS (0000Z, 10 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 10 Feb 1968)



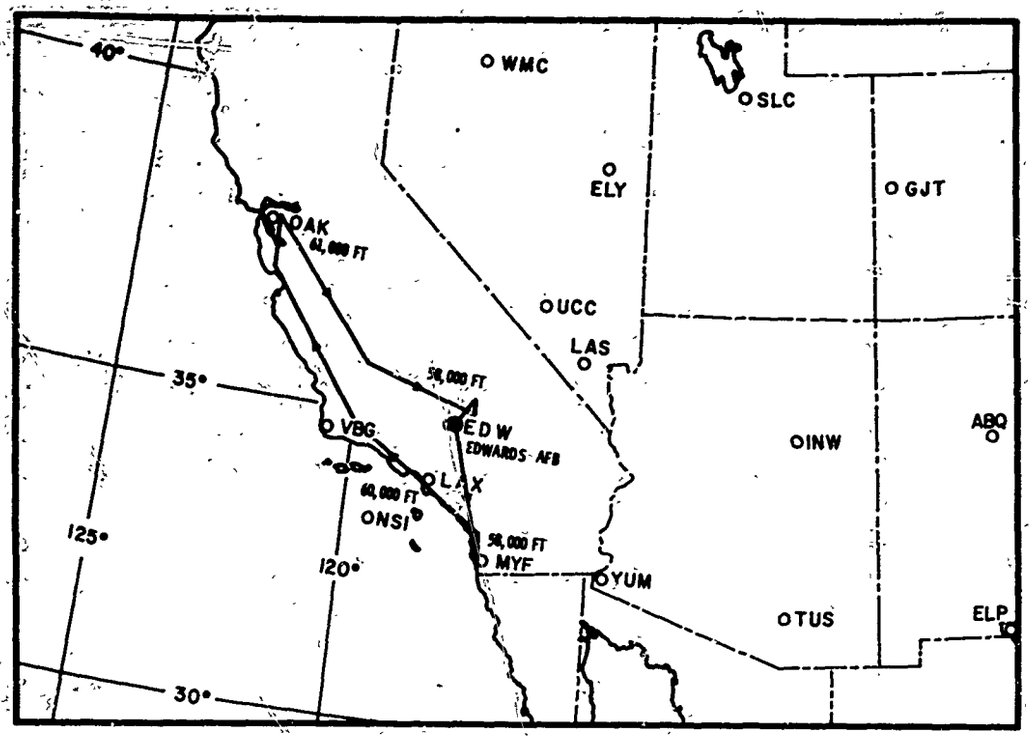
APPENDIX VI

TEST 278

12 February 1968, 2037-2329Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

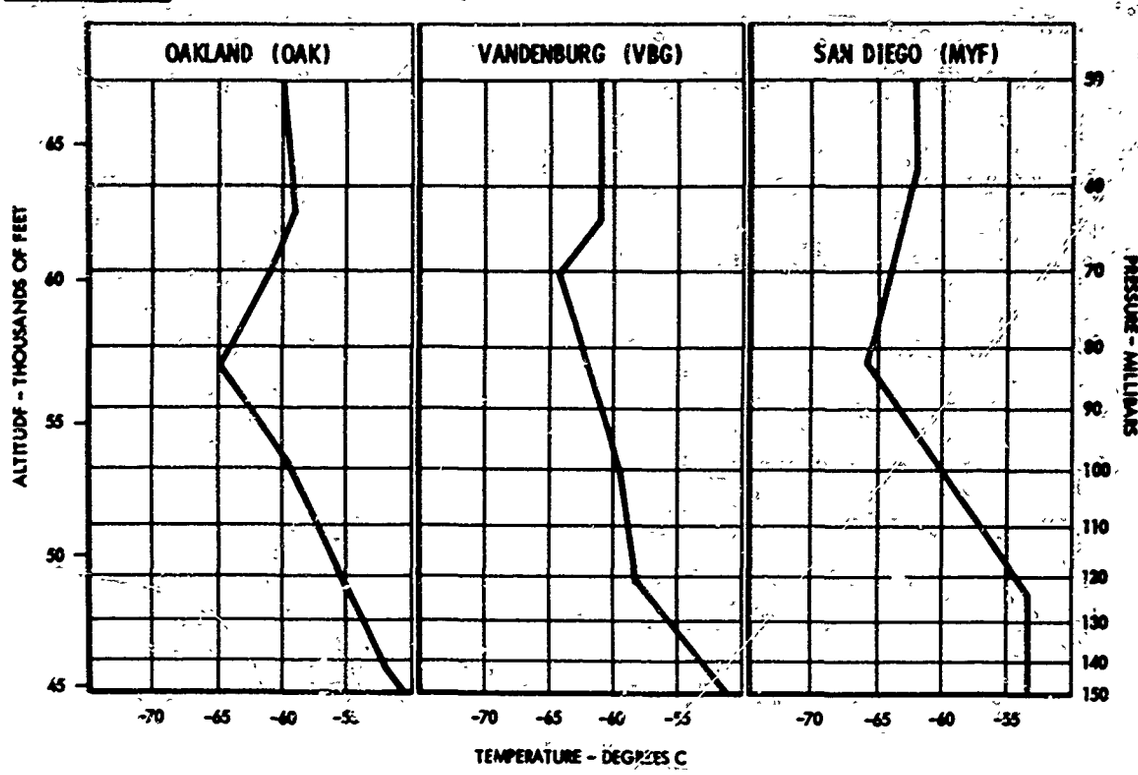
Low pressure and scattered light rain dominated the surface weather picture in the Southwest. A southwest - northeast trough at 500 mb extended from western Montana through central California. Clouds were general except over the San Francisco area and out over the water.

Only patches of very light turbulence were reported by the pilot, at 65,000 feet above MYF and 100 miles southwest of OAK from 55,000 to 57,000 feet.

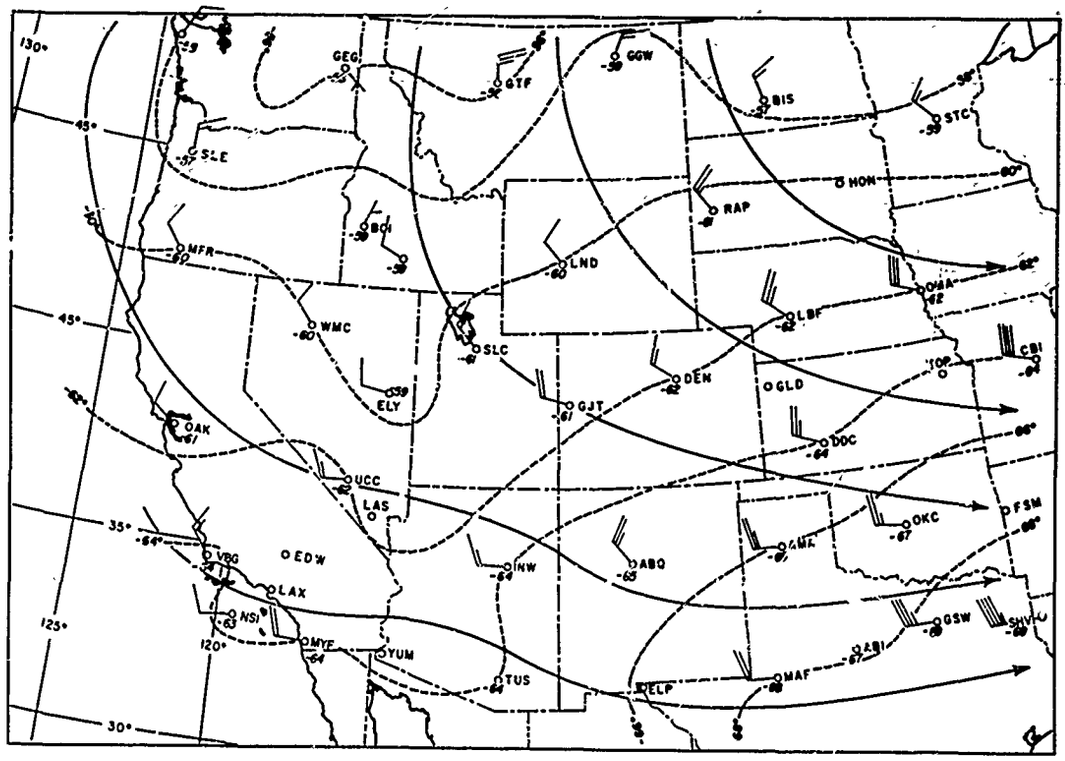
The RAOB's for these stations show no unusual temperature fluctuations.

Horizontal temperature gradients were very small throughout the entire flight area.

RAOB CHARTS (0000Z, 13 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 13 Feb 1968)



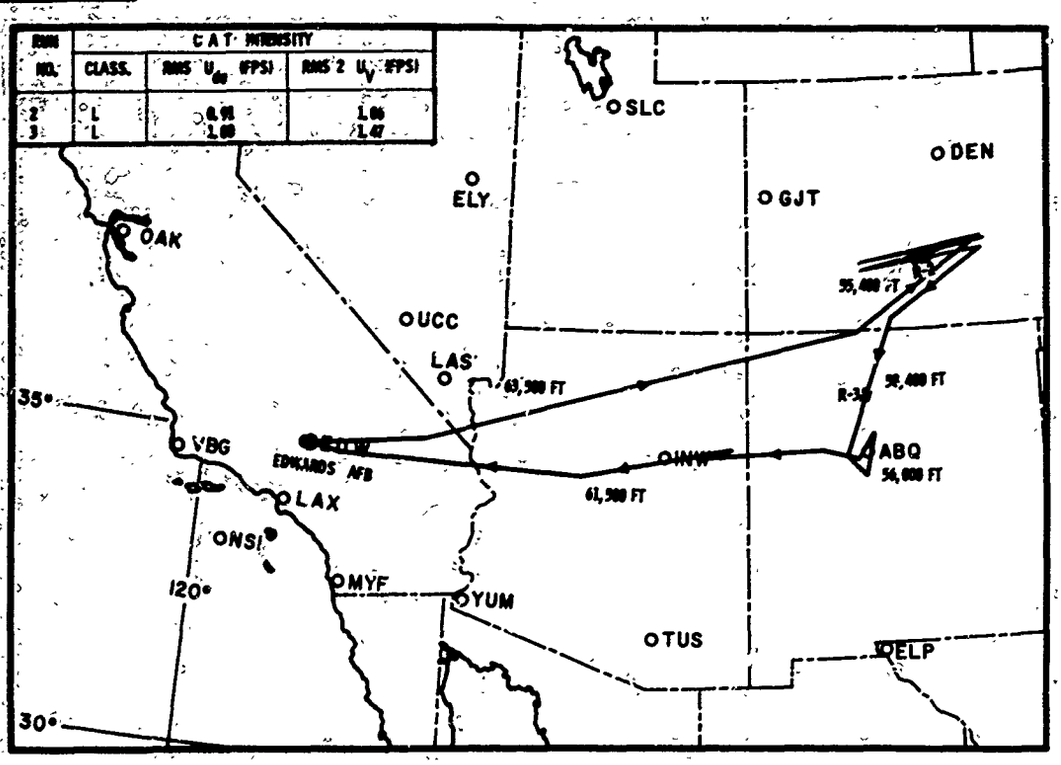
APPENDIX VI

TEST 279

14 and 15 February 1968, 1902-0057Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

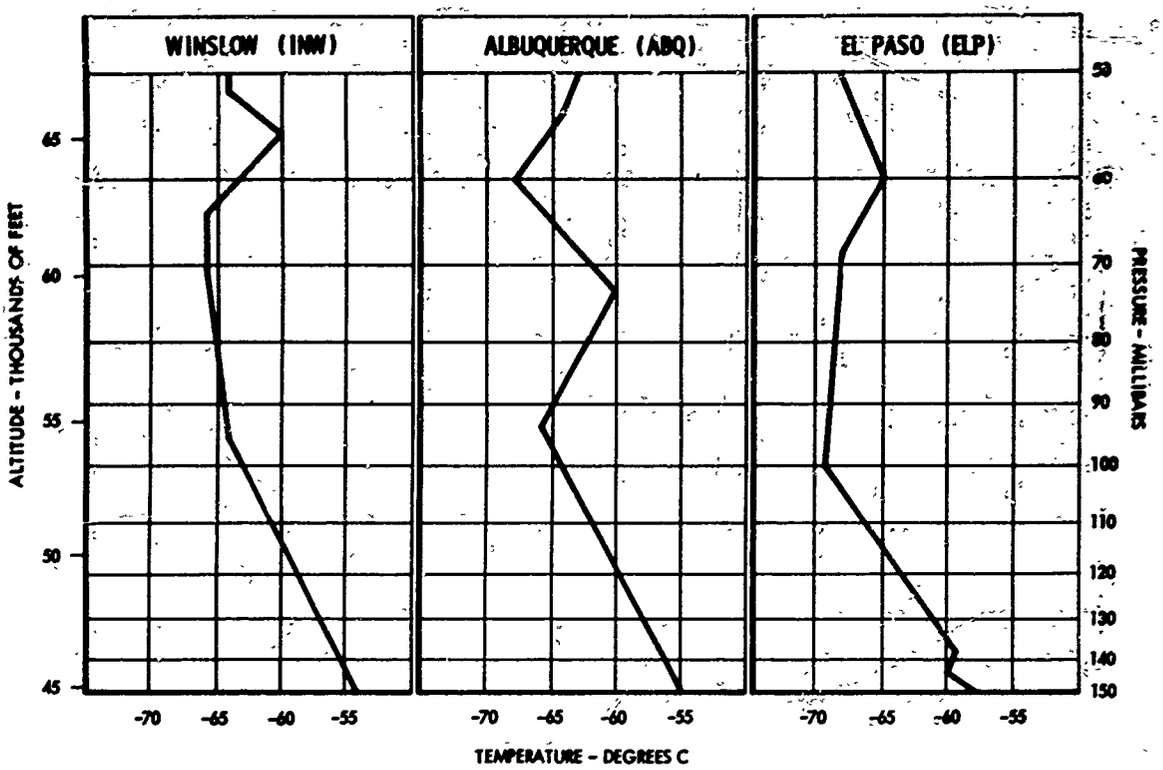
On this date, cold arctic air was moving from Canada into the western half of the U.S.A. Widespread rainfall that had fallen throughout the Southwest for the previous two days began to decrease as an occluded front moved southward into Arizona and New Mexico. Flow aloft was predominately west-east with strong winds extending over a deep layer in New Mexico and Texas. Clouds covered most of the area east of the Rockies with some rain clouds visible to the lee of the mountains.

Extensive but very light turbulence was reported by the pilot on the outbound leg of the flight track between 52,500 and 63,500 feet from western Arizona to Colorado. A pattern was flown above Pueblo, Colorado, 90 miles south of DEN. Turbulence was found between 53,000 and 61,000 feet, very light at the extreme altitudes and light or better around 59,000 feet. Light turbulence was also recorded at 62,000 feet northeast of ABQ.

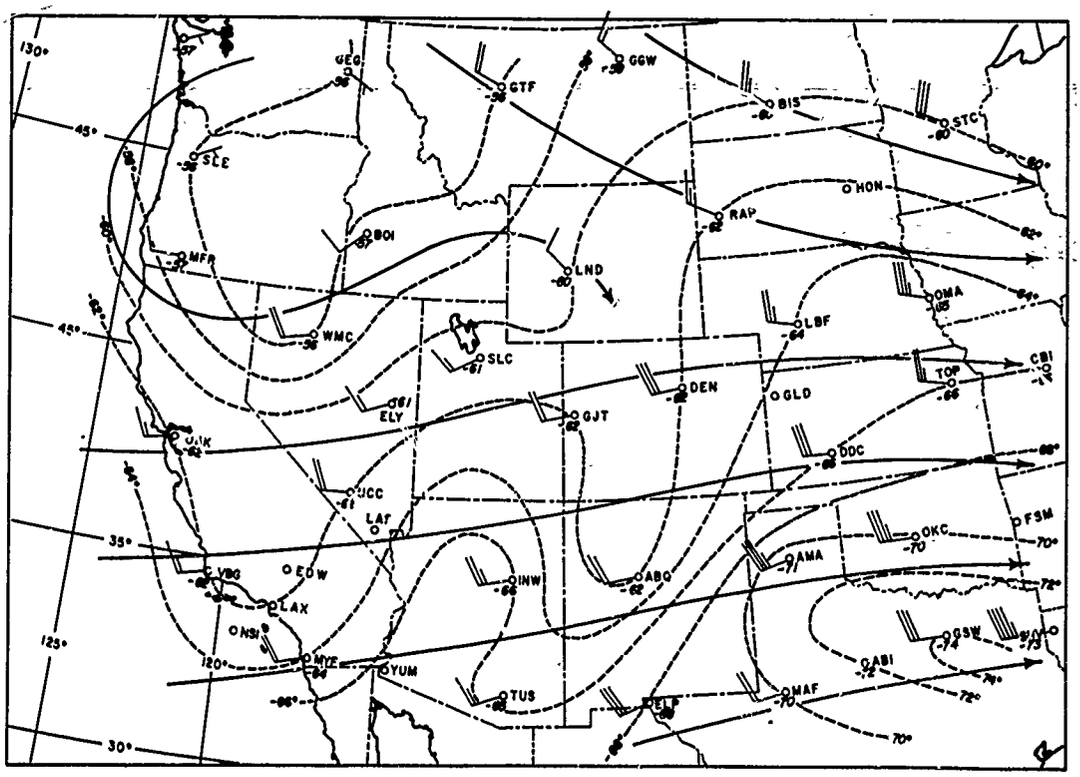
This flight was made in conjunction with the NCAR mountain wave investigation. Other aircraft taking simultaneous measurements at lower altitudes were a T-33 and a B-57.

The RAOB for ABQ shows a pronounced inversion and lapse layer between 54,500 and 64,000 feet. A familiar wave pattern is seen on the 70 mb thermal analysis with a medium horizontal gradient (1°C/25 nm) east of ABQ.

RAOB CHARTS (0000Z, 15 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 15 Feb 1968)



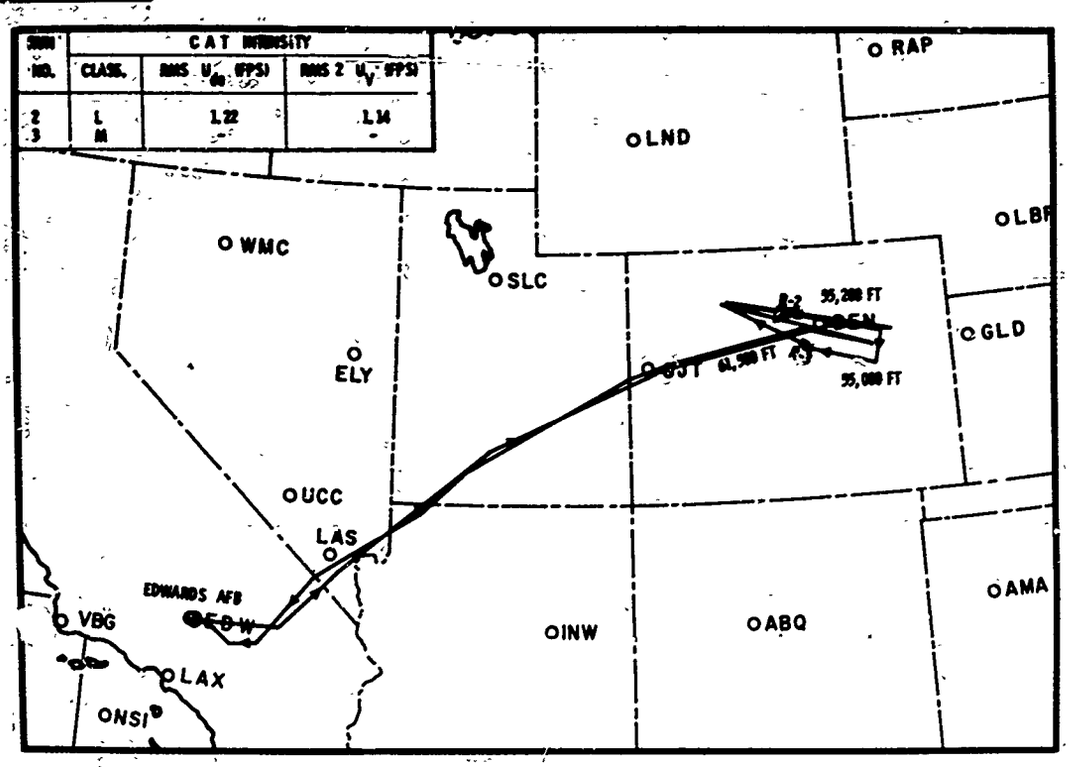
APPENDIX VI

TEST 281

16 and 17 February 1968, 1858-0113Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



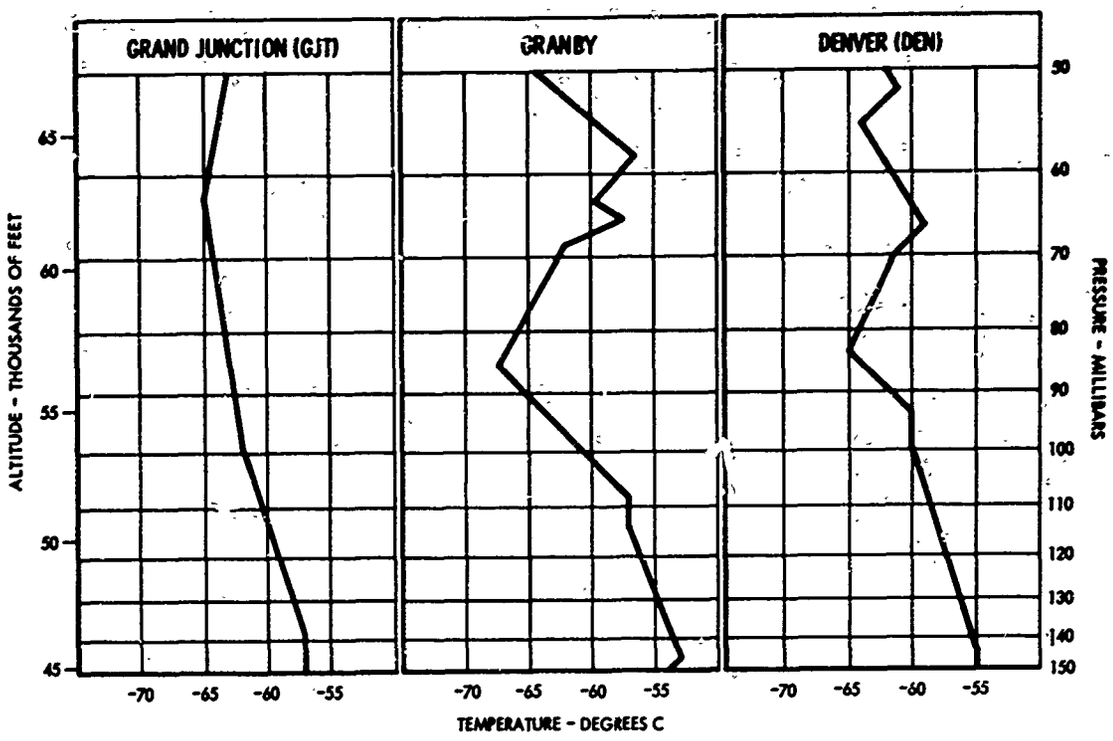
FLIGHT SUMMARY

At 0000Z, 17 February 1968, a mass of cold arctic air was positioned over northern Colorado and southern Nebraska. Overcast skies and snow showers prevailed along the cold front. Skies were partly cloudy over Denver. The upper level winds were from the northwest over the western states and from the west over the central states. Conditions seemed favorable for the occurrence of mountain waves over the Denver area, and a test was flown to investigate this possibility.

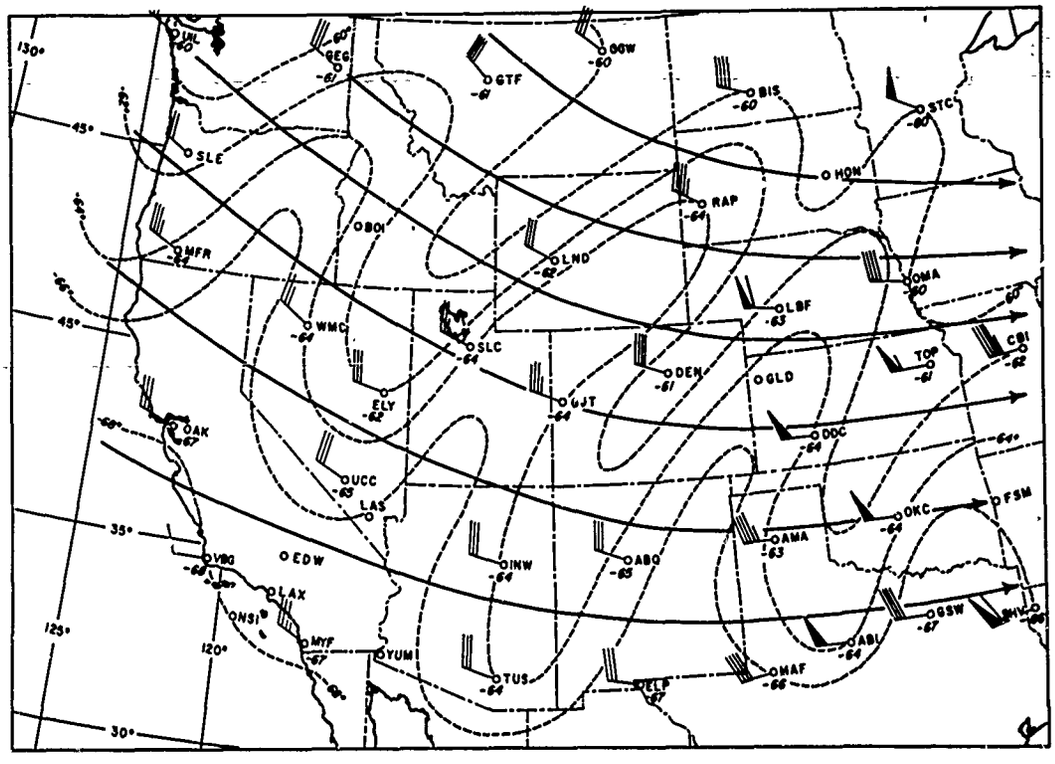
This test was made in conjunction with the NCAR mountain wave investigation. Other aircraft participating at lower altitudes included a Queen Air, a T-33, and a B-57. During a vertical search pattern over Denver, light to moderate CAT was encountered near 55,000 feet, and the pilot reported about 8 minutes of severe CAT approximately 80 miles southwest of Denver on the return flight.

Notice that medium vertical temperature gradients (1.5 to 2.5°C/1000 feet) were evident from 52,000 to 67,500 feet over Granby, and 55,000 to 67,500 feet over Denver. The 70 mb temperatures and winds chart shows the relatively strong flow that existed at that level. Winds were particularly strong just east of the Rockies. Also note the large waves evident in the horizontal temperature analysis. This type of wave is normally associated with moderate or greater CAT.

RAOB CHARTS (GJT and DEN - 0000Z, 17 Feb 1968; Granby - 1640Z, 16 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 17 Feb 1968)



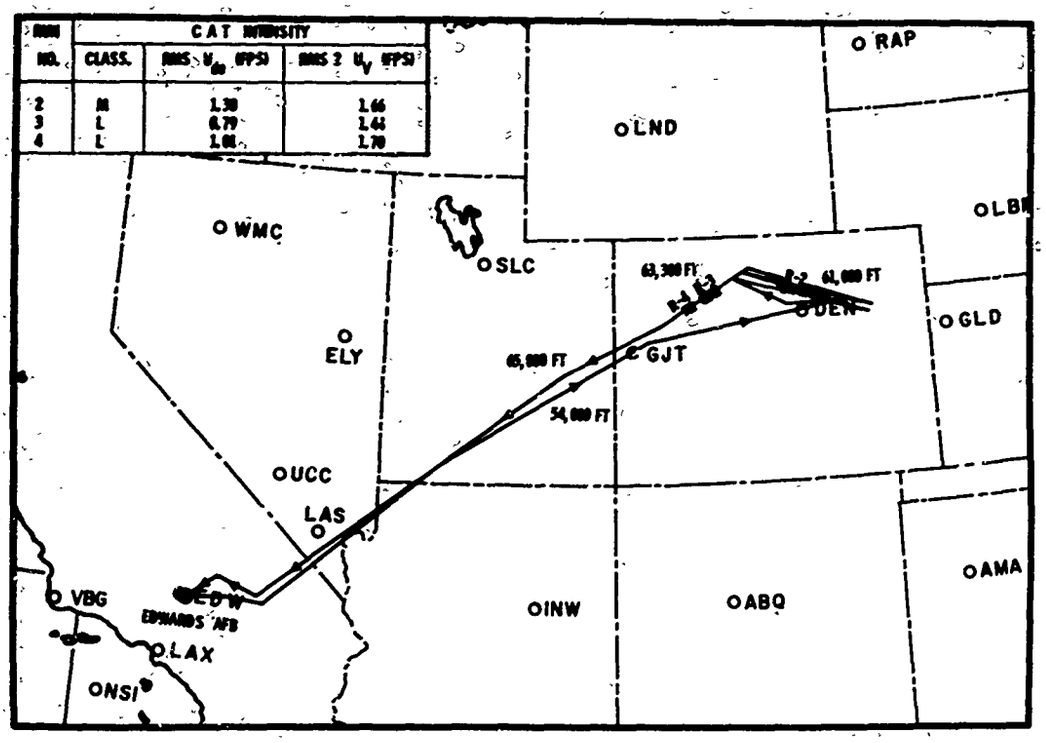
APPENDIX VI

TEST 282

19 and 20 February 1968; 1837-0021Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

Ridging over the Western States extended all the way from the ground to above 200 mb. The surface high, centered over Utah, was gradually weakening. Broken-to-overcast high, thin cirrus covered most of the flight track area. The polar and subtropical jetstreams were far to the north and south of DEN. However, winds were especially strong in the higher altitudes, exceeding 85 knots over GJT and 70 knots over DEN at 45,000 feet.

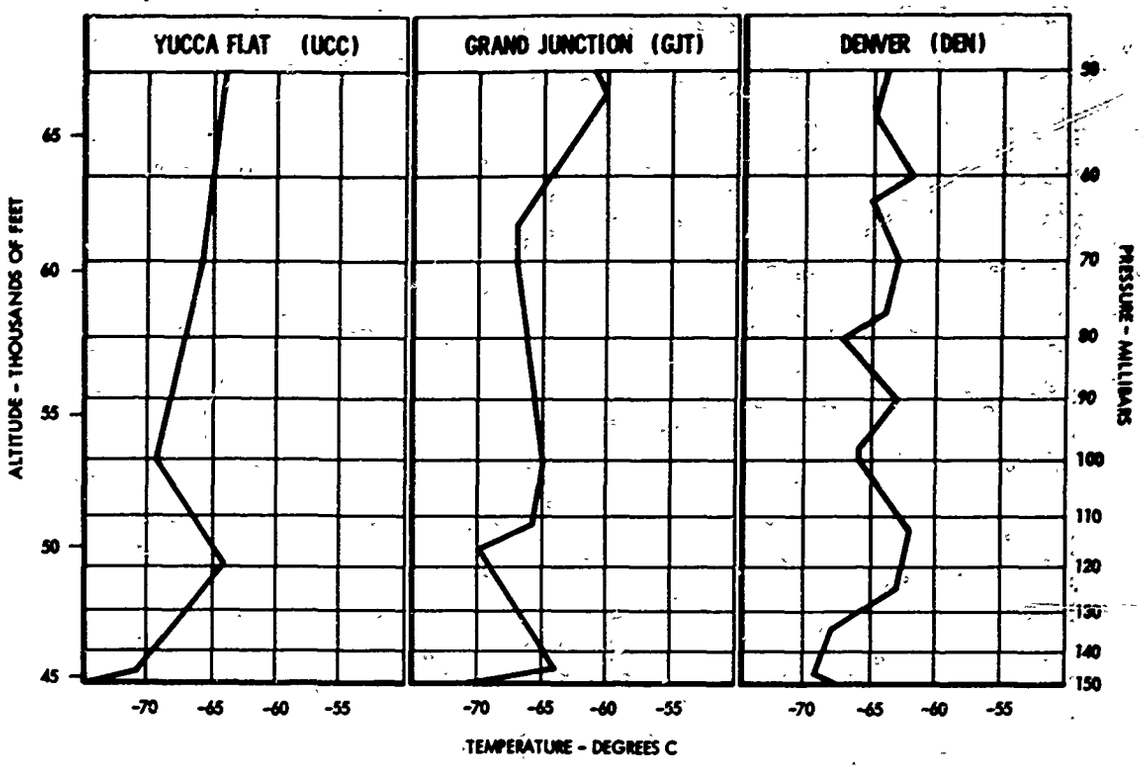
Three altitudes were flown over DEN. Very little turbulence was reported at the lowest altitude, 52,000 feet. The pilot reported light to moderate turbulence east of DEN at 57,000 feet and moderate to severe turbulence west of DEN at 62,000 feet and on the return leg to GJT at 64,000 feet. The heaviest turbulence processed on this latter leg was only light. No significant turbulence was observed west of GJT.

This flight was made in conjunction with the mountain wave investigation conducted by NCAR. A Queen Air and a T-33 made simultaneous low altitude penetrations in the test area.

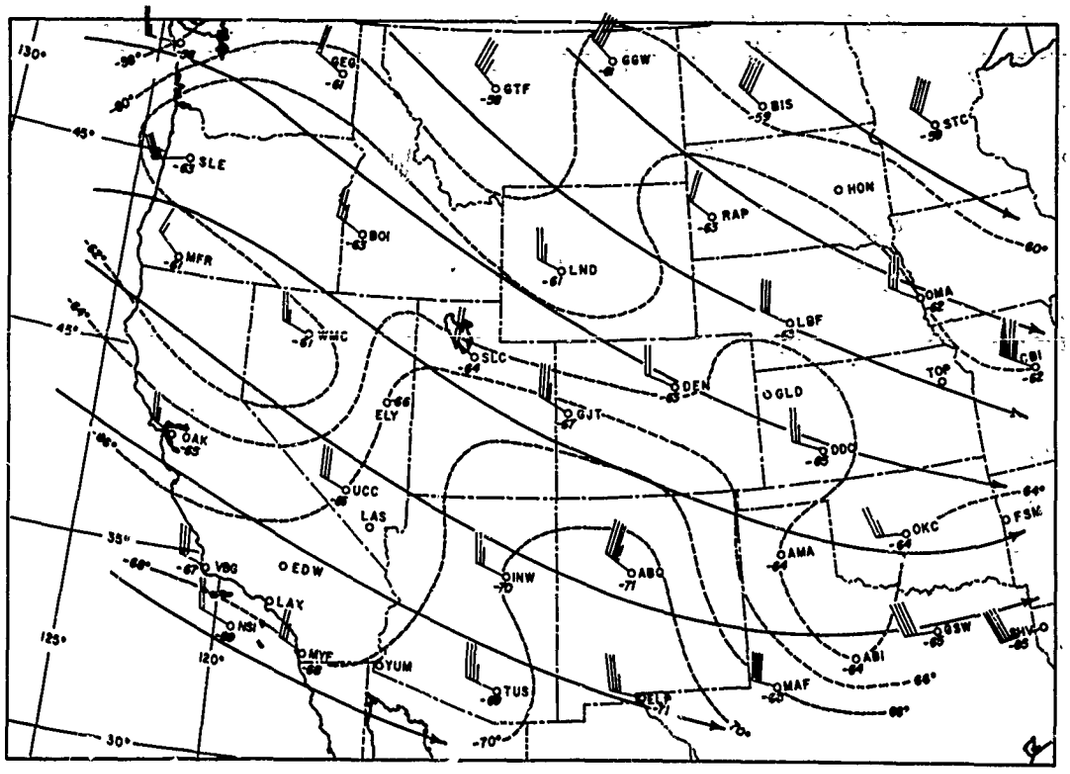
The DEN sounding shows several layers above 45,000 feet and below 64,000 feet with inversions. Note that the two sharpest inversions began at 58,000 feet and 63,000 feet, i.e., close to the altitudes where the turbulence was found.

A moderately strong north-south horizontal temperature gradient can be seen at 70 mb in the vicinity of the turbulence.

RAOB CHARTS (0000Z, 20 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 20 Feb 1968)



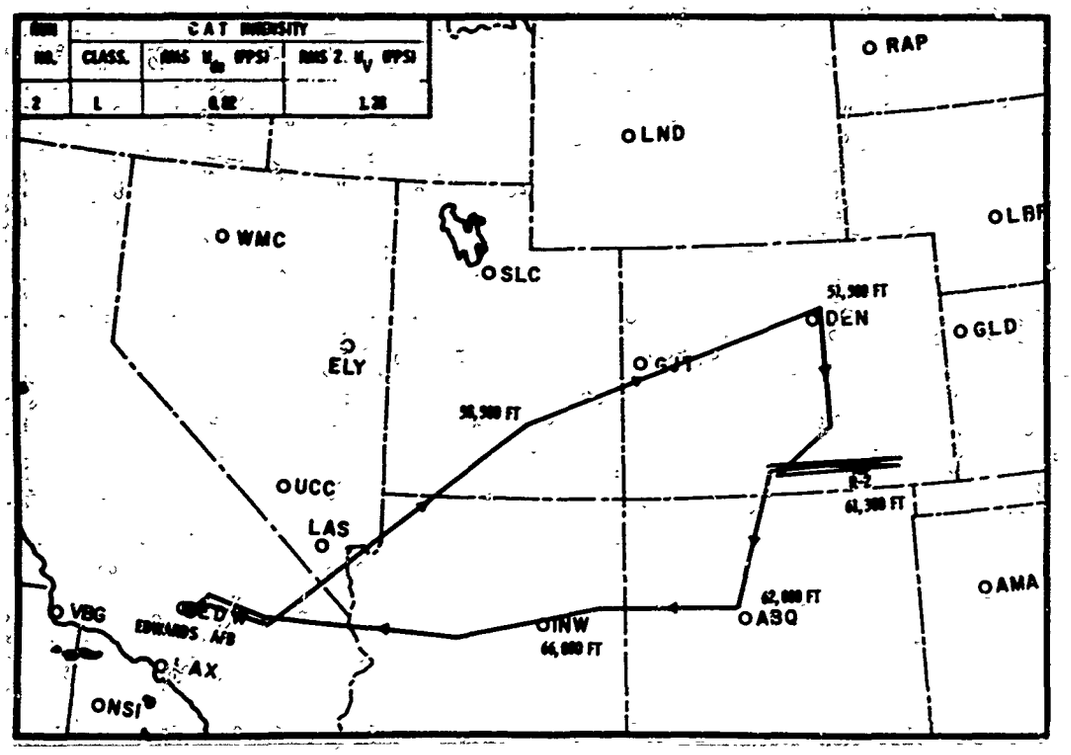
APPENDIX VI

TEST 283

26 and 27 February 1968, 1843-0024Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

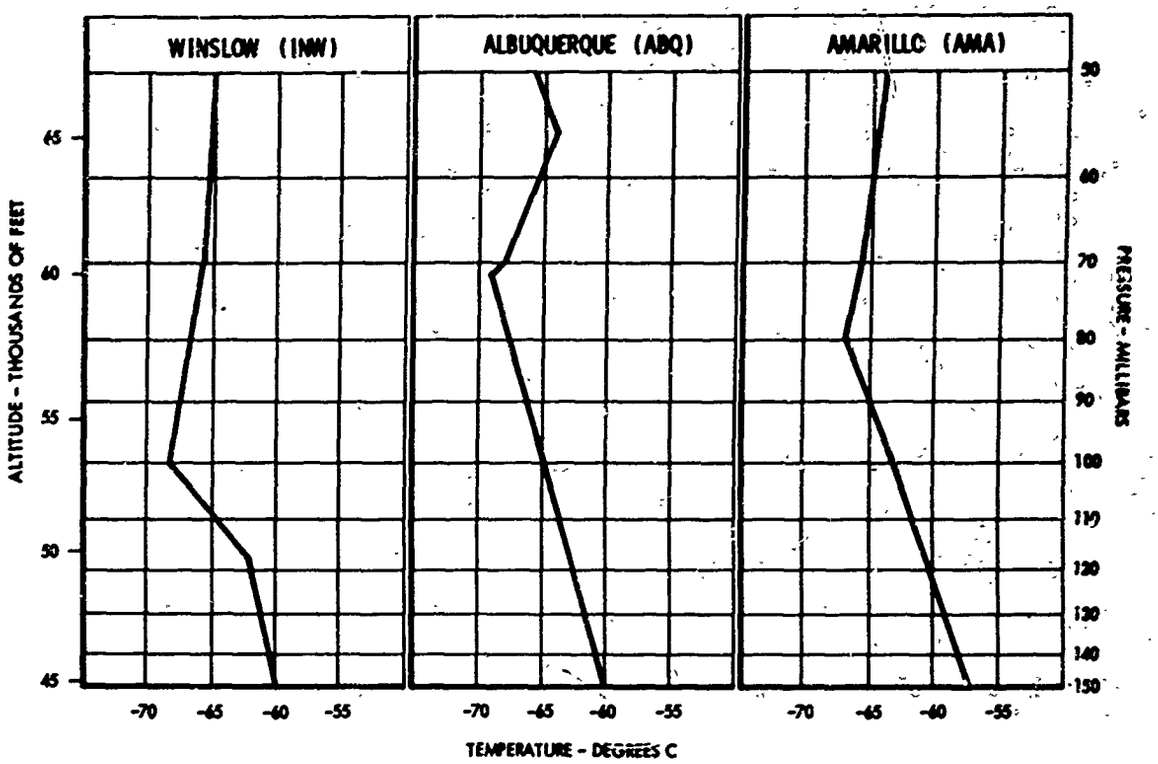
Weak ridges were found both at the surface and aloft throughout most of the West. Winds aloft were very strong at the high elevations. At 45,000 feet ABQ and AMA reported winds of 90 knots. At 50,000 feet ABQ's wind was 65 knots and AMA's 80 knots.

This test was made in conjunction with the mountain wave investigation conducted by NCAR. Part of the lower altitude range below the U-2 was sampled by the T-33 of the Canadian National Aeronautical Establishment.

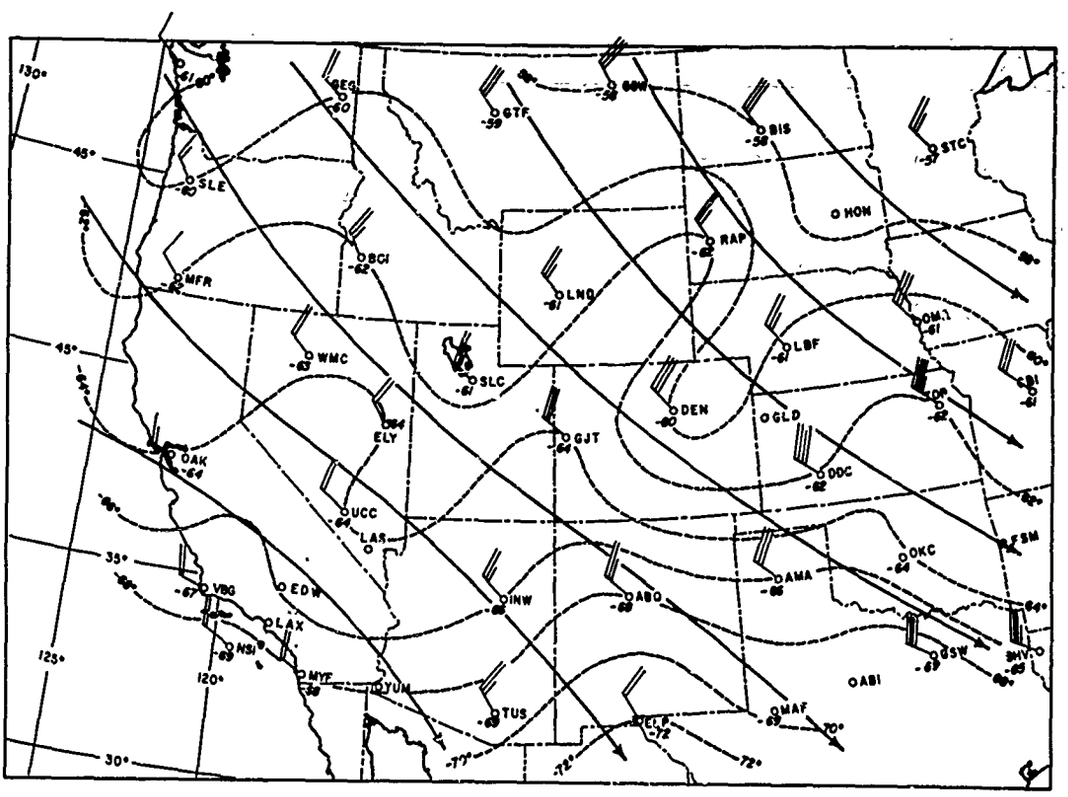
No significant turbulence was reported except in the area about 100 miles south of DEN. The pilot reported a small patch of light turbulence at 55,000 feet; then completed a pattern and reported none at 53,000 feet and 59,000 feet, a patch of light at 56,000 feet and a patch of moderate at 62,000 feet.

No radiosonde stations are located near this area. The closest ones (RAOB chart) show no significant vertical temperature gradients. A small northwest-southeast oriented horizontal temperature gradient (1°C/35 nm) is present in the turbulence area at 70 mb.

RAOB CHARTS (0000Z, 27 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 27 Feb 1968)



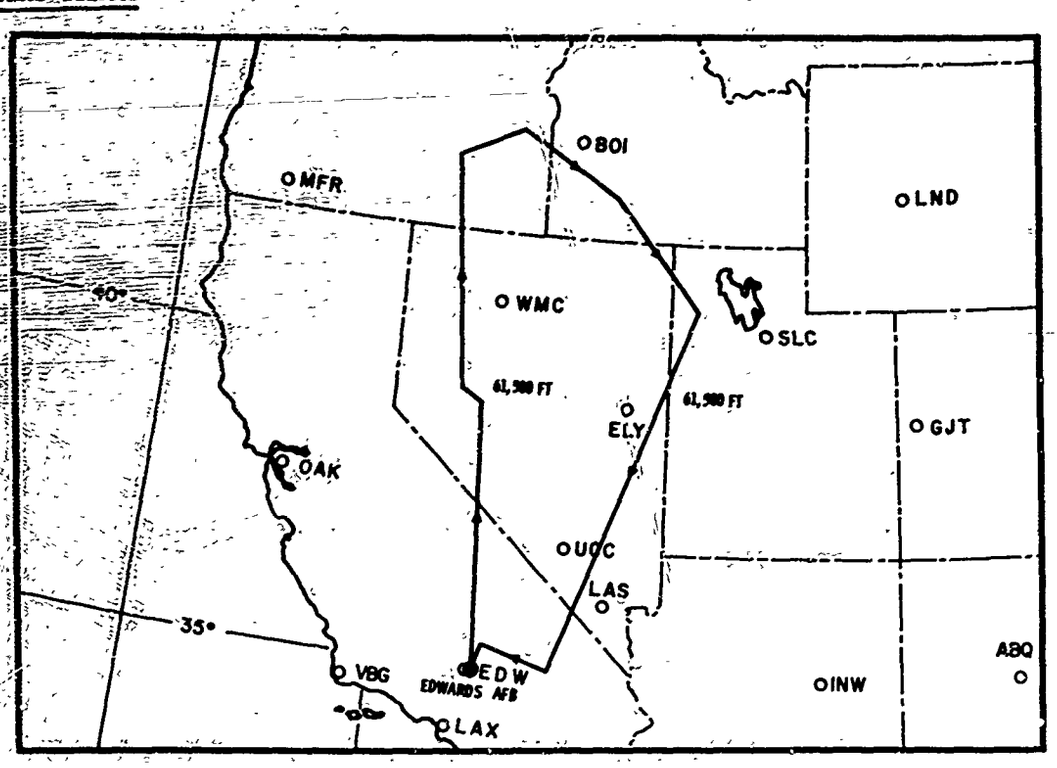
APPENDIX VI

TEST 284

28 February 1968, 1729-2116Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

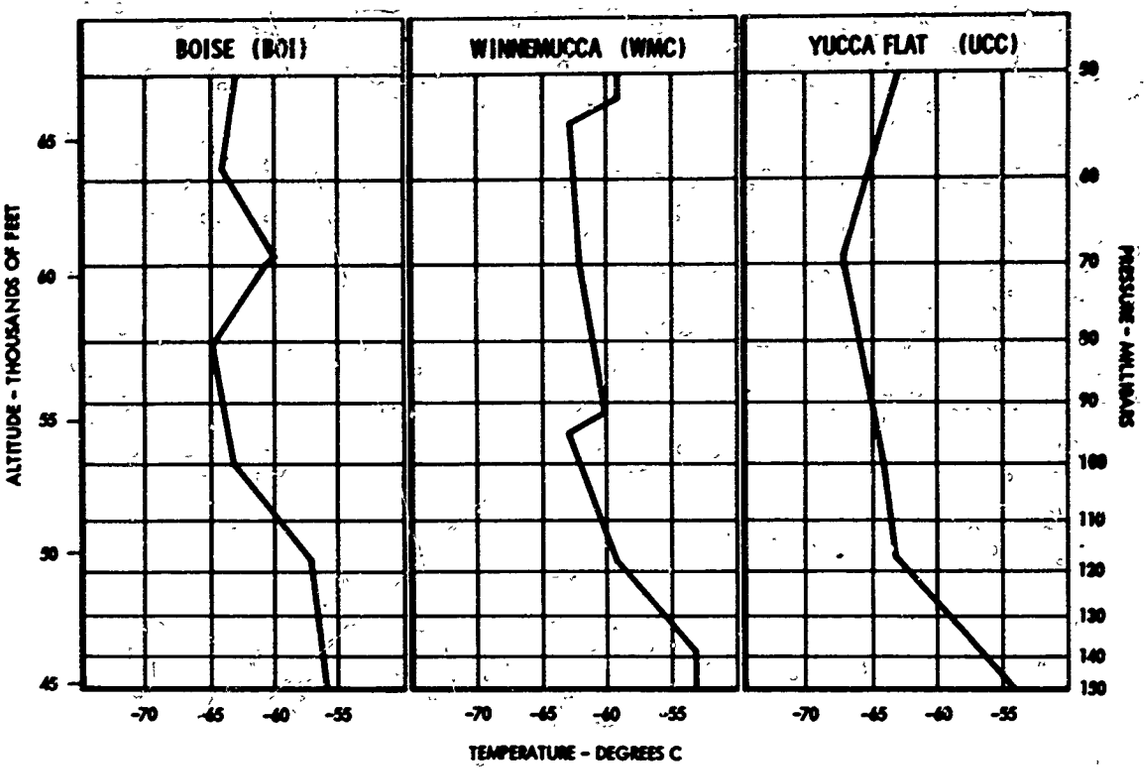
The surface high was located over the Great Basin with strong ridges aloft, west of Colorado. Winds were relatively light at all levels in the flight area. Only a few high thin clouds were present.

There was a brief run of light turbulence reported by the pilot west-southwest of WMC at 61,500 feet but otherwise the flight was smooth.

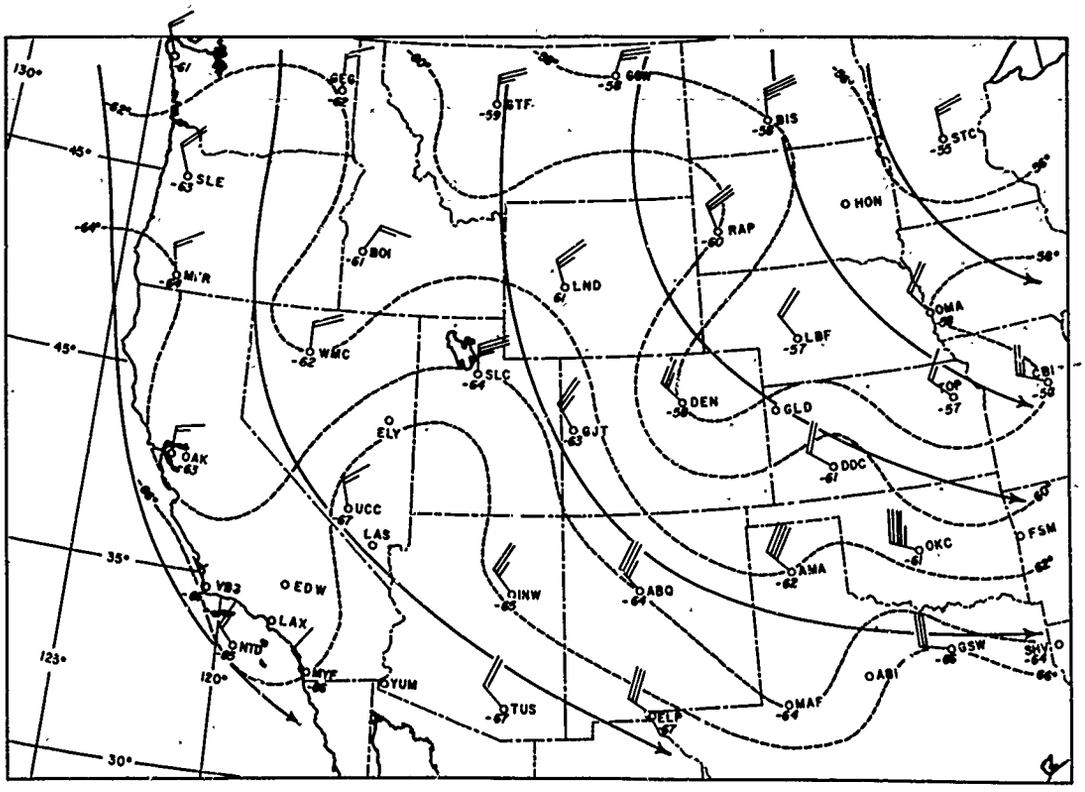
The sounding for WMC shows nearly isothermal conditions at this level.

A cold tongue appears on the 70 mb thermal analysis in the vicinity of the inbound flight path where no turbulence was found. However, warm air seems to be moving into the WMC area.

RAOB CHARTS (0000Z, 29 Feb 1968)



70 MB TEMPERATURES AND WINDS CHART (0000Z, 29 Feb 1968)



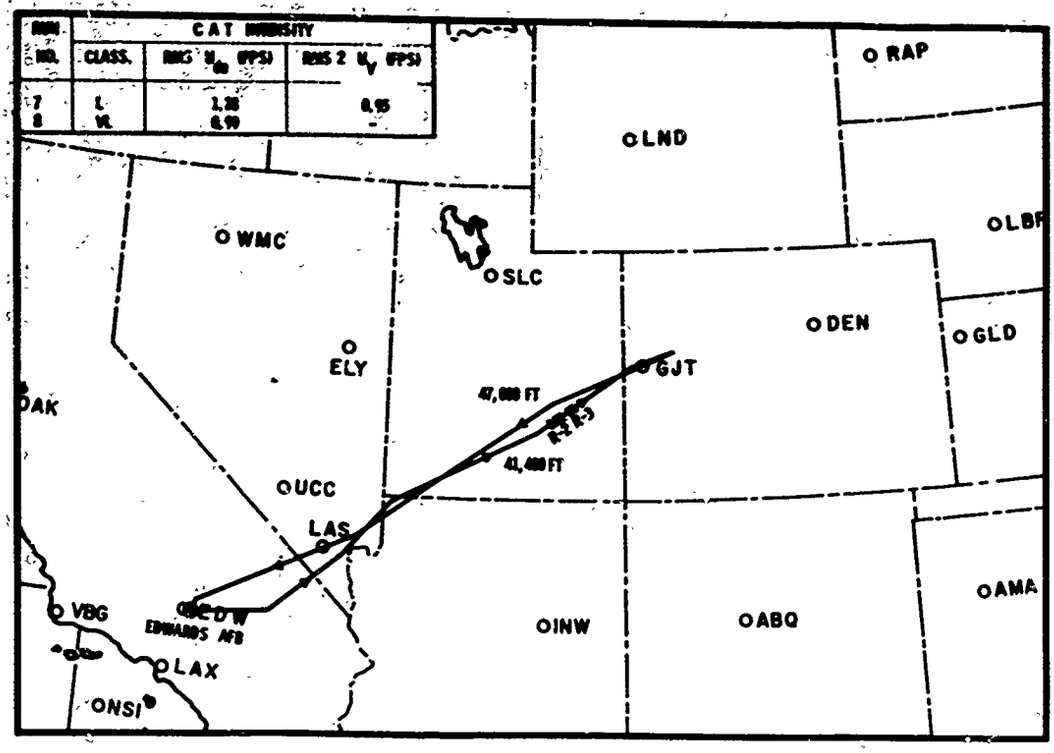
APPENDIX VI

TEST 285

29 February 1968, 2009-2337Z

Edwards AFB, Edwards, California, U.S.A.

FLIGHT TRACK



FLIGHT SUMMARY

The HICAT airplane flew in close proximity to the T-33 of the Canadian National Aeronautical Establishment in order to obtain simultaneous turbulence recordings.

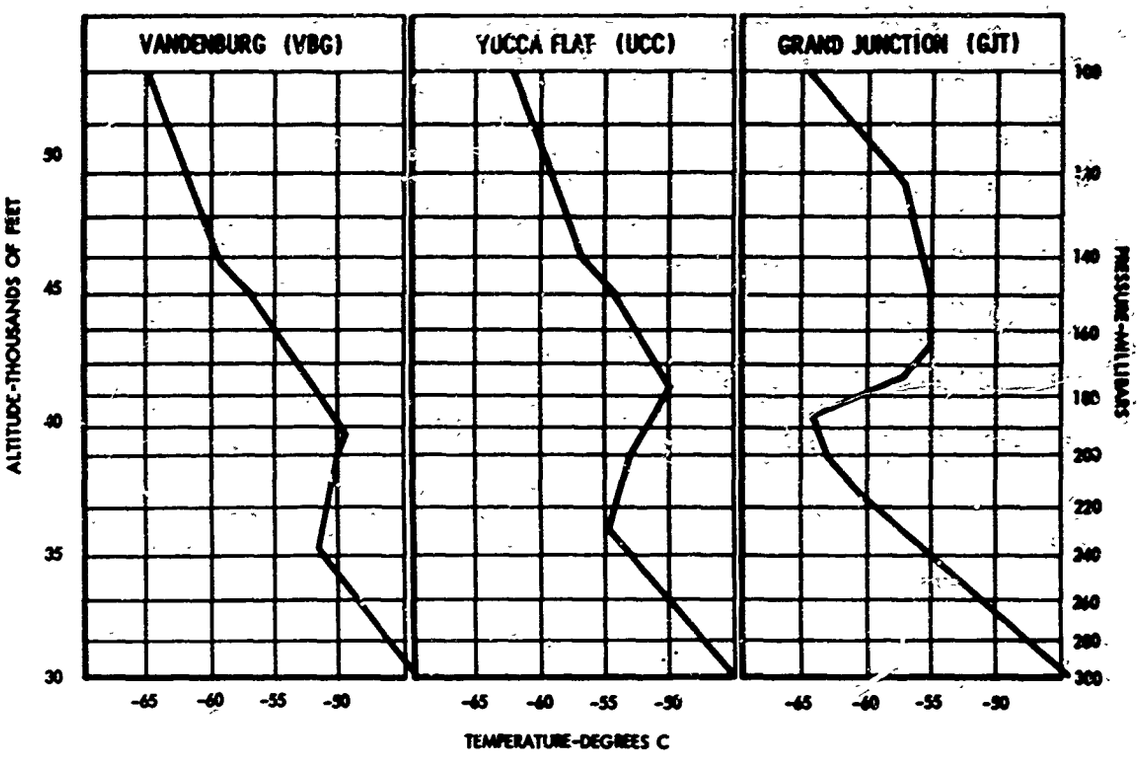
The persistent surface high and ridge aloft pattern continued in the West. Winds aloft were fairly light, only 10 knots at 500 mb, in the flight area. Mostly clear skies prevailed.

The planes flew at 39,000 feet on the outward leg. The HICAT airplane flew at 49,000 feet returning to EDW. The flight was uneventful except for some very light turbulence 100 miles southwest of GJT on both legs.

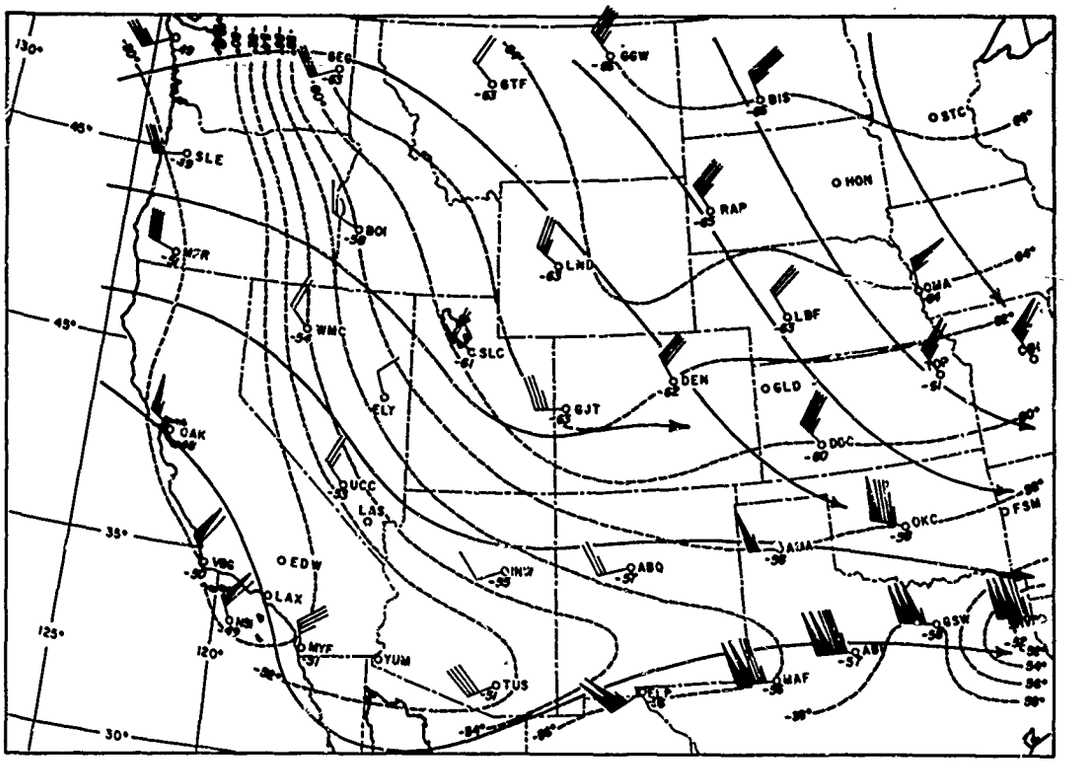
The RAOB chart shows that an inversion above 40,000 feet at GJT falls in between the two flight levels.

The 200 mb temperature gradient, although moderately strong along the flight path, is oriented more or less at right angles to the wind indicating little advection.

RAOB CHARTS (0000Z, 1 Mar 1968)



200 MB TEMPERATURES AND WINDS CHART (0000Z, 1 Mar 1968)



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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Air Force Systems Command Air Force Flight Dynamics Laboratory Wright-Patterson Air Force Base, Ohio

13. ABSTRACT

This report describes the high altitude clear air turbulence (HICAT) measurements and meteorological correlations derived from Air Force U-2 flights with emphasis upon the results achieved since 13 March 1967, the program extension date. The program effort required the measurement of CAT velocity components at altitudes of 45,000 to 70,000 feet in 6 geographic areas. Instrumentation carried aboard the U-2, consisted of a PCM system, an inertial navigation system, aerodynamic and aircraft response sensors including a fixed vane gust probe, oscillograph recorder, and a digital magnetic tape recorder. Instrumentation capabilities permitted CAT measurements in the wavelength range from about 100 to 50,000 feet. The program objective was to determine the statistical characteristics of high altitude CAT so as to improve structural design criteria. In addition, meteorological forecasts and analyses were to be correlated with the CAT measurements to improve CAT forecast procedures. In the Extended Program, 18.3 hours of high altitude CAT were located and recorded in flights covering over 156,000 miles from bases in England, Louisiana, Maine, Panama, Florida, and California. Actual vertical, lateral, and longitudinal gust velocity time histories and power spectra were determined and analyzed. Peak counts of true vertical gust velocity and derived equivalent gust velocity were obtained. A practical procedure for forecasting high altitude CAT was developed. The pilot's log, gust velocity time histories and power spectra, as well as flight tracks and meteorological descriptions of all the tests appear in Volume II of this report.

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