NASA CR 114740

NOISE MEASUREMENTS AT STOCKTON AIRPORT OBTAINED DURING ENGINEERING EVALUATION OF TWO-SEGMENT APPROACHES IN A DC-8-61 AIRCRAFT

By Ray E. Glass
Hydrospace-Challenger, Inc.

Prepared under Contract No. NAS2-7369 by
HYDROSPACE-CHALLENGER, INC.
San Diego, California

for

AMES RESEARCH CENTER
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SUMMARY

A series of noise measurements were made during engineering evaluation tests of the two-segment approach using a DC-8-61. The two approaches evaluated were: 1) ILS, 2.9° glide slope using 50° flaps, and 2) two-segment 5.5°/2.9° glide slope, using 50° flaps and lower segment intercept altitude of 575 feet. Measurements were made at twelve sites underneath and to the side of the flight path.

INTRODUCTION

This report presents the results of acoustic measurements made on a DC-8-61 aircraft during standard ILS and two-segment approaches. The aircraft was equipped with an area navigation system with its computer modified to provide the capability of making two-segment noise abatement approaches. For upper segment computations, the computer used barometric-corrected pressure altitude and the slant range to a DME transmitter which was co-located with the glide slope transmitter. The computer used the ILS glide slope deviation for lower segment computations.

The purpose of the acoustical portion of the test was to measure and identify the noise levels during the various approaches. A total of twelve measurement sites were utilized. Six of these were located on or near the extended runway centerline from 1 to 6.5 nautical miles from runway threshold. The remaining six sites were located at positions to the side of the approach centerline. Two of the sites were perpendicular to Site 1, two other sites were perpendicular to Site 4, and the remaining two sites were perpendicular to Site 5.

The acoustic test flights were conducted on 20 and 27 November 1973 at Stockton Metropolitan Airport.

APPARATUS AND METHODS

Aircraft and Test Profiles

The aircraft used for the tests was a McDonnell Douglas DC-8-61 powered by four Pratt & Whitney JT3D-3B jet engines. The aircraft flew two basic test profiles. The first was a standard ILS approach using conventional avionics. The second type was a two-segment approach using area navigation hardware to emulate the two-segment computer concept. These profiles were flown by both the program project pilots and airline guest pilots. Figure 1 illustrates the ILS and two-segment approach paths in terms of altitude versus distance. Also shown are the distances from threshold of the centerline microphone positions.

The aircraft was instrumented to record on-board a number of flight parameters. These data were time synchronized to the radar tracking and acoustic data using an IRIG B time code.

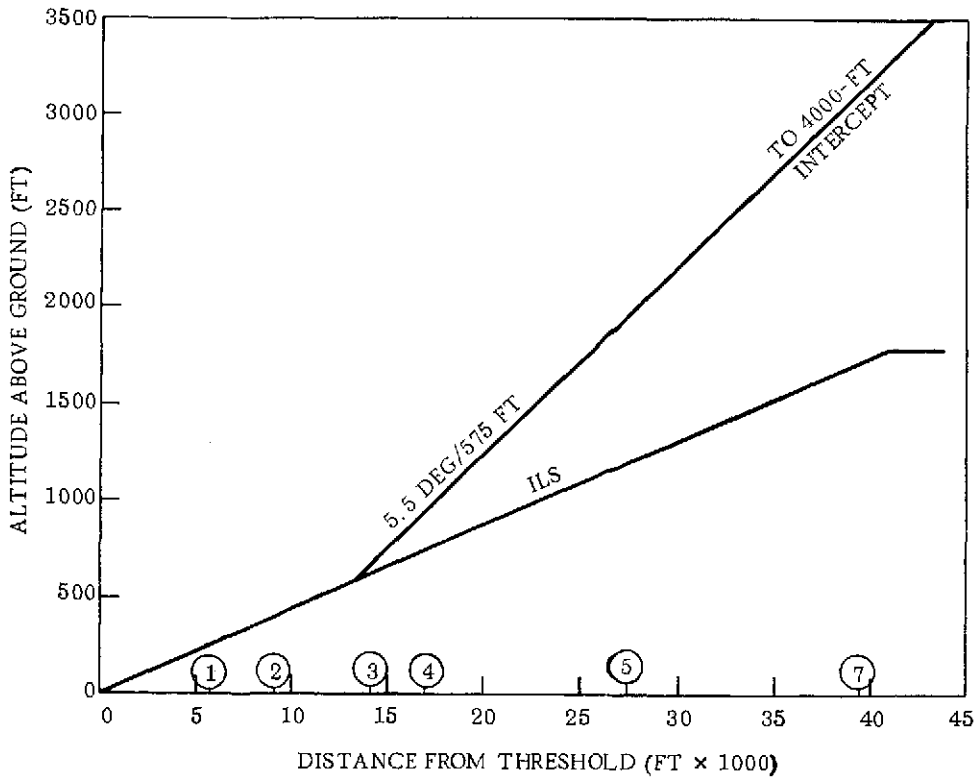

Figure 1. Approach Profiles for DC-8-61 Tests

Acoustic Measurements

Acoustic data were acquired using battery-operated remote-controlled, portable acquisition systems. Figure 2 presents a block diagram of the systems. The typical system utilizes a two-channel analog tape recorder. One channel records acoustic data and the other channel records an IRIG B time signal. The time is broadcast over a radio link at 162.275 MHz (megahertz). The time signal is a 1-kHz (kilohertz) amplitude modulated carrier. The received time signal serves two functions: 1) it provides a common recorded time base for all systems and 2) the 1-kHz carrier operates a tape motion controller built by Hydrospace-Challenger, Inc. (HCI).

Field technicians checked system operation and tape supply as well as administered a single-frequency tone calibration at least once an hour.

Each system was calibrated over a frequency range of 40 to 12 000 Hz using an electrical signal. Figure 3 is a typical total system frequency response. The high frequency pre-emphasis is removed during processing but provides a better signal for analog recording since it compensates for high-frequency sound attenuation due to the atmosphere.

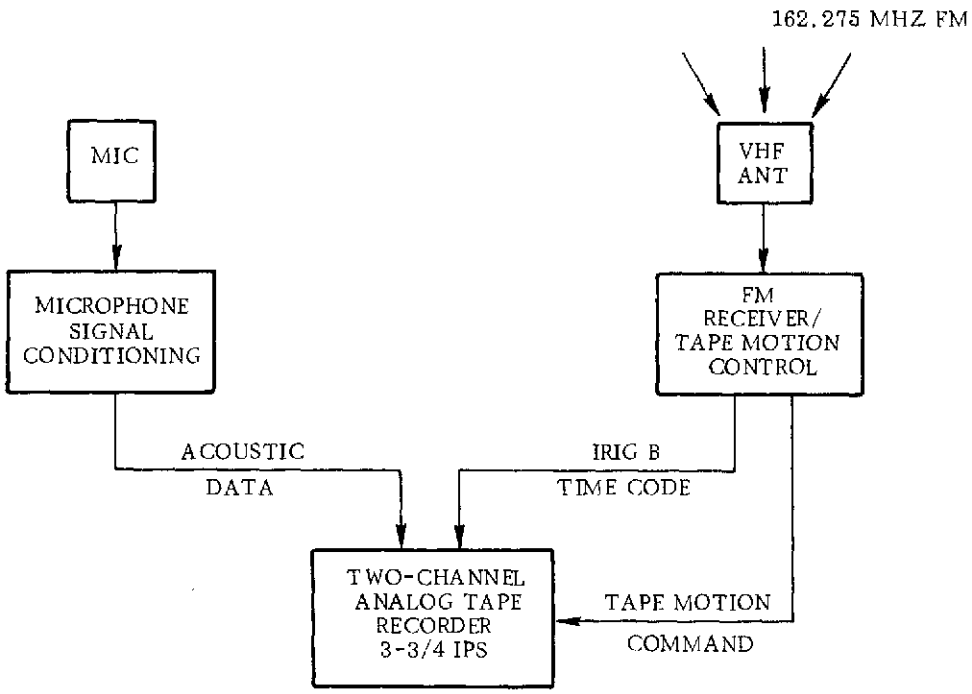

Figure 2. Acoustic Data Acquisition System

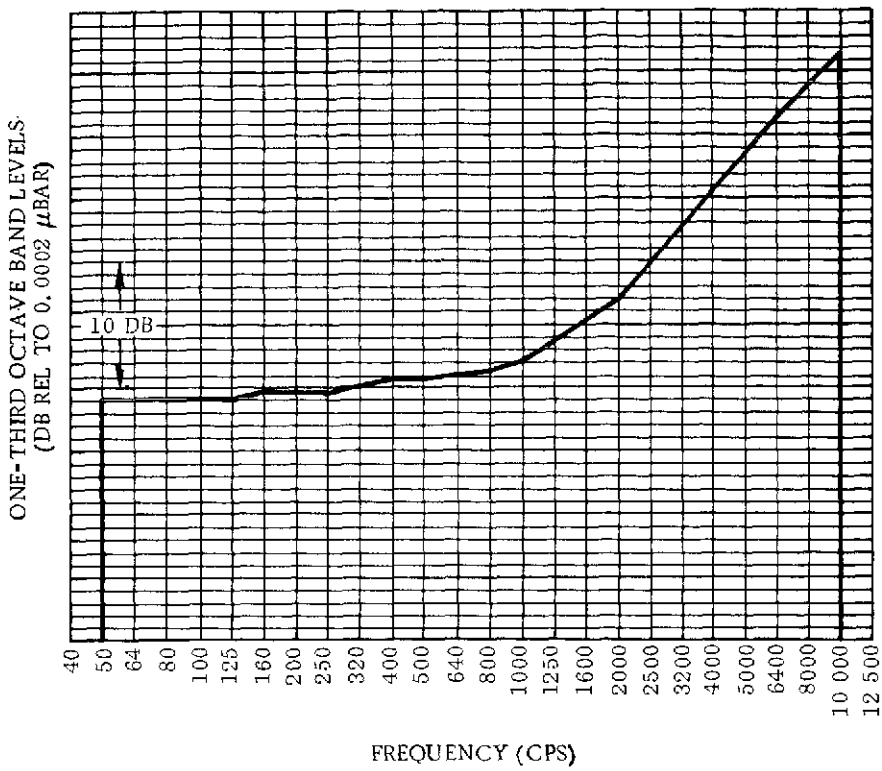

Figure 3. Typical System Response

Table I. Noise Measurement Site Locations

Site	Distance from runway threshold	Distance perpendicular to centerline
1	5 725	0
2	8 440	70 S
3	13 910	132 N
4	16 780	0
5	27 430	100 S
7	39 175	50 N
1b	5 725	2290 S
1c	5 725	3950 S
4b	16 780	3115 S
4c	16 780	4130 S
5b	27 600	2000 N
5c	27 480	3940 N

Acoustical measurements were made at six locations on or near the extended runway centerline and at six sideline locations. Table I presents the positioning of the sites used during the exercise. All distances along the extended centerline are referenced to the runway threshold.

The sites were located using an orthographic map obtained from the U.S. Geological Survey. Each site was staked and located relative to large features such as trees, roadways, etc. The orthographic photograph was then examined to locate the site. Distances were scaled from this photograph. Figure 4 shows the noise measurement site locations and major topographical features.

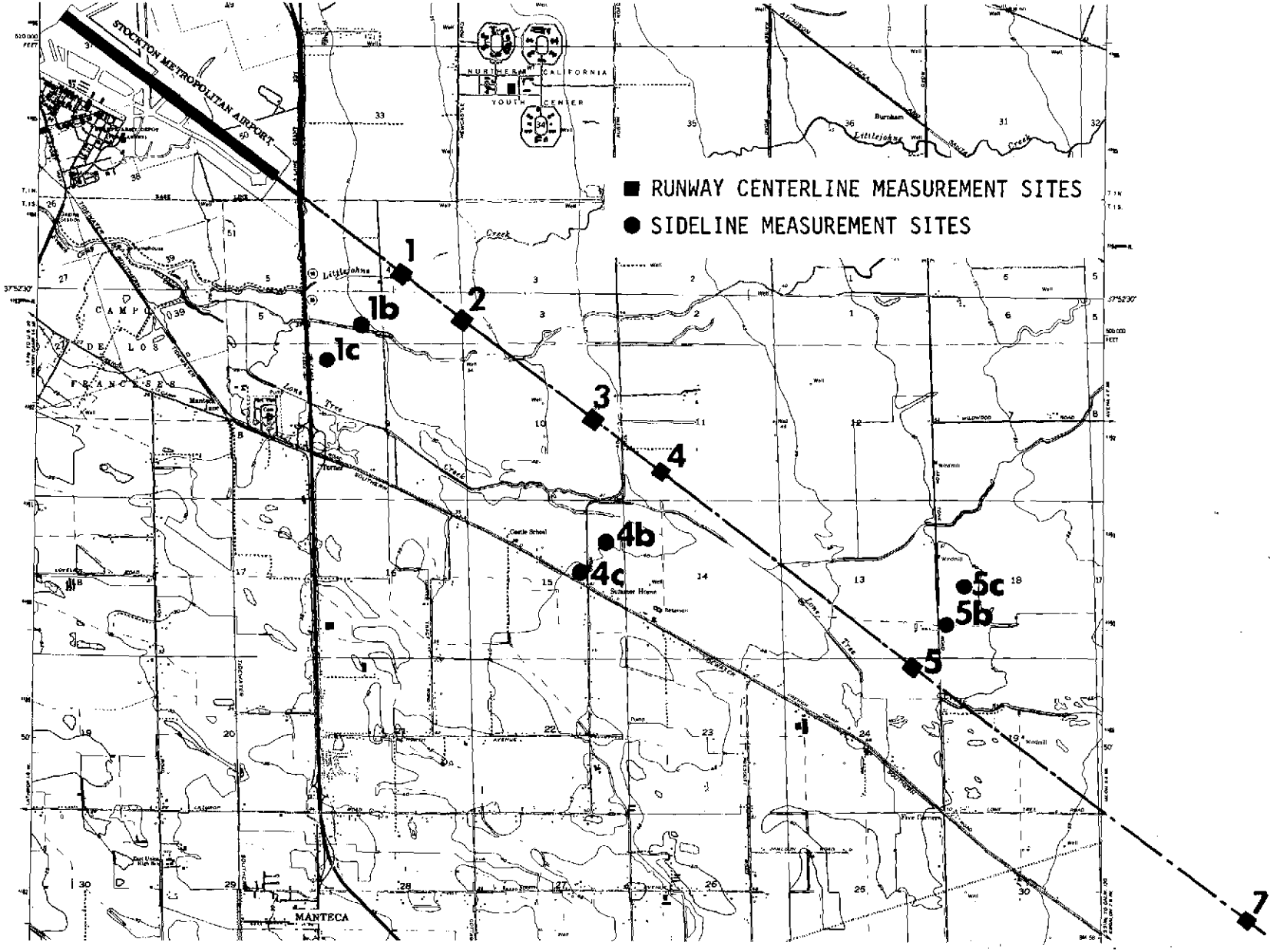

Figure 4. Noise Measurement Site Locations

Meteorological Measurements

Meteorological measurements were obtained from the National Weather Service located at Stockton Metropolitan Airport. Readings of temperature, dew point, and wind speed/direction were taken at hourly intervals. These measurements were taken at a height of 6 feet above the surface of the Stockton airfield. The instruments were within 1 mile of the radar van which also housed the noise acquisition command station. Table II contains a listing of the appropriate meteorological parameters.

Table II. Weather Conditions

Date	Time	Temperature (°F)	Relative humidity (%)	Wind (knot)
11-20-73	0900	42	79	SE 12
11-20-73	1000	45	73	SE 13
11-20-73	1200	48	72	SE 15
11-27-73	1100	53	71	SE 8
11-27-73	1200	56	67	SE 9
11-27-73	1300	58	59	SE 10
11-27-73	1400	59	51	SE 9

Aircraft Tracking

Radar tracking was provided by a Bell Aerospace radar unit. The radar provided both an on-line two-dimensional plot and digital three-dimensional data. Acoustic data processing was performed using the digital radar data.

The digital radar data, which consisted of slant range (SR) from the measurement site to the aircraft as a function of time, was used to obtain the closest point of approach (CPA) range as the minimum range at the site. The range at the time of maximum tone-corrected PNLT was found by simply looking up the SR for the site at the computer-calculated time of $PNLT_{max}$.

Acoustic Data Processing

The acoustic data were processed at HCI's San Diego Operations. The processing equipment and the computer program used conform to the requirements of FAR Part 36. The acoustic data were adjusted for system frequency

response, effect of windscreen, grazing incidence, effects of temperature and humidity, and effects of background. Data were not corrected for gross weight differences. The acoustic data were processed to yield EPNL corrected to a standard day, maximum A-weighted (dBA) level during the flyover based on 1/2-second integration increments, and the A-weighted value during the 1/2-second time increments at the time of $PNLT_{max}$.

No data were available at Sites 1c and 5c on 20 November due to a malfunction of the data acquisition tape recorders. Data were not available at Site 1b on 27 November due to an intermittent microphone. Some data were missed at Site 4c on 20 November due to improper reference adjustment of the tape motion controller. Remaining data points were missed at various measurement sites due to noise from external sources (cars, trucks, people, animals, etc).

Aircraft Performance Data

Flight, control, and engine parameters were recorded on a digital recording system aboard the aircraft. A flight data entry panel was provided on the flight deck and a time code generator enabled synchronization of the airborne recorder with data recorded at the ground radar and noise data. Column 9 in Tables III through XIV lists the engine pressure ratio (EPR) for the approaches on 27 November 1973, as available. Engine data for 20 November 1973 was not available due to data acquisition problems.

Time Synchronization

Timing between the radar and acoustic data was provided with a single time code generator synchronized daily to WWV. The time code generator was located in the radar van. The radar van also housed the noise measurement command station. The time code generator output signal (IRIG B) was connected in parallel to both the radar recorder and the noise measurement timing and command transmitter. There is no timing error between radar and acoustic data.

RESULTS

Tables III through XIV present noise levels at the measurement sites arranged according to the profile flown. "Slant range at CPA" is the closest distance the test aircraft came to the measurement site during the particular flyover. This distance is obtained from NASA-furnished digital radar data. The "time of PNLTM" is a computer determined time for maximum tone-corrected perceived noise level. This time is used to find "slant range at PNLTM" from NASA-furnished digital radar data. This slant range is then used to correct effective perceived noise level to a standard day as specified in FAR Part 36. The corrected quantity is "$EPNL_C$" in units of EPNdB.

A-weighted levels were calculated in two ways. First, the "max dBA" was obtained by applying an A-weighting to each 1/2-second spectrum in a flyover and then picking the highest value. The "dBA at PNLTM" is the A-weighted spectrum level at the "time of PNLTM." The difference between the two quantities "ΔdBA (⑤ - ⑥)" is an indication whether or not the maximum A-weighted level corresponds to the noise increment which is maximum when applying the noisiness and tone criteria of PNLT. Column 8 (ΔdB) shows the variation in the approximate constant used to convert between dBA and EPNL.

Figure 5 shows the noise reductions achieved by the two-segment approach, both beneath the flight path and sideline to the flight path. Figure 6 shows the averaged profiles flown during the test.

EPNL reductions are achieved from 1.4 to 6.5 miles from runway threshold. These reductions range from 2 to 12 EPNdB. The reduction in A-weighted level follows the EPNdB reductions except for a small difference which is a function of slant range.

Hydrospace-Challenger, Inc.
1360 Rosecrans Street
San Diego, California, February 4, 1974

Table III. 20,27 November 1973, Stockton – Site 1

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ ΔdBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2001	08:36:32	364	379	115.2	103.5	103.5	0	11.7	-
	2002	08:48:36	373	526	115.6	104.9	104.9	0	10.7	-
	2007	09:44:50	362	474	110.1	99.1	98.8	0.3	11.0	-
	2008	09:55:10	387	471	117.5	106.1	106.1	0	11.4	-
	2701	11:04:58	367	501	115.8	104.0	104.0	0	11.8	-
	2703	11:22:34	380	500	116.7	105.5	105.5	0	11.2	1.16
	2707	12:32:36	341	458	114.8	104.3	104.3	0	10.5	-
	2713	13:57:44	346	399	116.3	104.7	104.7	0	11.6	-
Two segment 4000'/5-1/2°/ 575'	2003	09:00:29	374	374	117.3	105.7	105.7	0	11.6	-
	2004	09:11:46	375	391	112.6	102.0	102.0	0	10.6	-
	2005	09:23:00	381	599	117.3	105.7	105.7	0	11.6	-
	2006	09:34:10	380	577	115.8	103.9	103.9	0	11.9	-
	2009	10:07:24	385	439	116.5	104.5	104.5	0	12.0	-
	2010	12:01:02	359	403	112.9	102.9	102.9	0	10.0	-
	2705	12:07:45	363	632	117.9	107.9	107.6	0.3	10.0	1.28
	2706	12:20:55	383	459	110.2	98.7	98.7	0	11.5	1.07
	2708	12:44:32	326	432	109.5	99.1	99.1	0	10.4	1.14
	2710	13:07:59	382	432	117.3	105.3	105.3	0	12.0	1.20
	2711	13:23:31	391	540	114.2	101.4	101.4	0	12.8	1.10
	2712	13:47:11	366	461	117.7	105.8	105.7	0.1	11.9	1.19
	2715	14:13:59	339	339	111.0	100.0	99.0	1.0	11.0	1.12
	2716	14:24:49	345	384	119.7	108.2	108.2	0	11.5	1.19
	2717	14:34:38	370	458	120.1	107.2	107.2	0	12.9	1.16

Table IV. 20,27 November 1973, Stockton – Site 2

		①	②	③	④	⑤	⑥	⑦	⑧	⑨
Type run	Run No.	Time of PNLTM	Slant range at CPA (ft)	Slant range at PNLTM (ft)	$EPNL_c$ (EPNdB)	Max dBA	dBA at PNLTM	Δ dBA (⑤ - ⑥)	Δ dB (④ - ⑤)	EPR
ILS 50° flaps	2001	08:36:22	490	847	112.3	99.9	99.9	0	12.4	-
	2002	08:48:27	489	532	109.8	97.8	97.8	0	12.0	-
	2007	09:44:48	517	626	112.9	100.5	100.5	0	12.4	-
	2008	09:55:07	506	637	113.6	100.8	100.8	0	12.8	-
	2701	11:04:48	510	532	116.4	103.8	103.7	0.1	12.6	-
	2703	11:22:24	514	563	115.3	102.5	102.5	0	12.8	1.15
	2707	12:32:25	540	651	112.3	100.0	99.7	0.3	12.3	1.12
	2713	13:57:32	519	634	111.2	98.2	98.1	0.1	13.0	1.11
Two segment 4000'/5-1/2°/ 575'	2003	09:00:19	521	521	110.7	99.3	99.3	0	11.4	-
	2004	09:11:36	483	588	111.5	100.3	100.3	0	11.2	-
	2005	09:22:50	536	669	110.0	97.8	97.4	0.4	12.2	-
	2006	09:34:01	531	548	109.8	98.0	98.0	0	11.8	-
	2009	10:07:14	526	553	112.3	99.6	98.7	0.9	12.7	-
	2010	12:00:53	498	555	108.6	-	-	-	-	-
	2705	12:07:34	511	941	109.4	96.5	96.3	0.2	12.9	1.06
	2706	12:20:43	518	899	112.1	99.2	98.1	1.1	12.9	1.16
	2708	12:44:22	503	503	110.1	97.8	97.7	0.1	12.3	1.07
	2710	13:07:47	498	653	112.7	101.9	101.5	0.4	10.8	1.17
	2711	13:23:21	533	533	112.4	100.3	100.3	0	12.1	1.14
	2712	13:47:00	523	553	116.4	103.6	103.6	0	12.8	1.19
	2715	14:13:48	507	507	108.3	95.2	95.2	0	13.1	1.07
	2716	14:24:39	497	497	110.8	97.9	97.9	0	12.9	1.17
	2717	14:34:27	511	537	115.1	102.6	102.6	0	12.5	1.19

Table V. 20,27 November 1973, Stockton – Site 3

		①	②	③	④	⑤	⑥	⑦	⑧	⑨
Type run	Run No.	Time of PNLTM	Slant range at CPA (ft)	Slant range at PNLTM (ft)	$EPNL_c$ (EPNdB)	Max dBA	dBA at PNLTM	Δ dBA (⑤ - ⑥)	Δ dB (④ - ⑤)	EPR
ILS 50° flaps	2002	08:48:08	791	800	109.8	96.6	96.6	0	13.2	-
	2007	09:44:29	774	789	110.3	98.3	98.3	0	12.0	-
	2008	09:54:47	795	889	109.2	96.8	96.8	0	12.4	-
	2701	11:04:27	801	827	110.8	98.3	98.0	0.3	12.5	-
	2703	11:22:03	819	819	111.2	98.6	98.6	0	12.6	1.17
	2707	12:32:04	772	821	109.8	98.9	98.9	0	10.9	1.23
	2713	13:57:11	846	853	106.9	94.1	94.1	0	12.8	1.15
Two segment 4000'/5-1/2°/ 575'	2003	08:59:58	924	1028	104.4	90.7	89.6	1.1	13.7	-
	2004	09:11:17	951	977	104.6	91.2	90.6	0.6	13.4	-
	2005	09:22:31	933	933	102.7	89.8	89.0	0.8	12.8	-
	2006	09:33:42	942	942	102.3	90.4	90.3	0.1	11.9	-
	2009	10:06:55	872	872	103.4	90.1	90.1	0	13.3	-
	2705	12:07:19	960	1104	104.1	90.6	89.4	1.2	13.6	1.05
	2706	12:20:24	979	979	103.4	90.6	90.6	0	12.8	1.05
	2708	12:44:00	959	959	104.5	92.3	92.3	0	12.2	1.09
	2710	13:07:27	967	973	101.0	88.7	88.5	0.2	12.3	1.02
	2711	13:22:58	944	978	105.3	93.1	93.1	0	12.2	1.09
	2712	13:46:39	967	987	103.2	88.0	87.6	0.4	15.2	1.05
	2715	14:13:26	1009	1009	103.5	89.4	89.4	0	14.1	1.06
	2716	14:24:17	993	993	104.9	90.0	89.8	0.2	14.9	1.07
	2717	14:34:04	931	931	103.5	-	-	-	-	1.04

Table VI. 20,27 November 1973, Stockton – Site 4

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ ΔdBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2002	08:47:58	945	952	107.8	94.3	94.3	0	13.5	-
	2007	09:44:17	934	1062	109.5	95.7	95.7	0	13.8	-
	2008	09:54:30	947	1691	110.8	97.1	97.1	0	13.7	-
	2701	11:04:17	933	933	110.5	96.9	96.5	0.4	13.6	-
	2703	11:21:51	931	992	109.7	96.5	96.5	0	13.2	1.17
	2707	12:31:54	896	896	109.7	96.6	96.6	0	13.1	1.23
	2713	13:57:02	944	1077	108.8	93.2	92.8	0.4	15.6	1.08
Two segment 4000'/5-1/2°/ 575'	2003	08:59:50	1169	1195	103.9	88.8	88.8	0	15.1	-
	2004	09:11:07	1214	1214	103.1	88.3	88.3	0	14.8	-
	2005	09:22:22	1187	1225	101.3	88.3	88.3	0	13.0	-
	2006	09:33:30	1195	1217	103.2	89.5	89.2	0.3	13.7	-
	2009	10:06:45	1131	1154	103.7	88.4	88.2	0.2	15.3	-
	2010	12:00:23	1239	1445	98.1	85.1	85.1	0	13.0	-
	2705	12:07:07	1212	1252	100.5	88.6	88.6	0	11.9	1.07
	2706	12:20:15	1246	1336	100.0	85.3	85.2	0.1	14.7	1.05
	2708	12:43:50	1211	1247	100.7	87.1	87.1	0	13.6	1.06
	2710	13:07:17	1218	1342	98.7	84.3	84.1	0.2	14.4	1.02
	2711	13:22:49	1214	1294	103.0	87.9	87.7	0.2	15.1	1.06
	2712	13:46:28	1236	1267	100.8	85.4	84.9	0.5	15.4	1.05
	2715	14:13:16	1276	1350	102.7	87.1	87.0	0.1	15.6	1.07
	2716	14:24:04	1266	1294	103.9	87.6	87.3	0.3	16.3	1.07
	2717	14:33:52	1217	1217	99.9	85.2	84.8	0.4	14.7	1.04

Table VII. 20,27 November 1973, Stockton – Site 5

		①	②	③	④	⑤	⑥	⑦	⑧	⑨
Type run	Run No.	Time of PNLTM	Slant range at CPA (ft)	Slant range at PNLTM (ft)	$EPNL_c$ (EPNdB)	Max dBA	dBA at PNLTM	ΔdBA (⑤ - ⑥)	ΔdB (④ - ⑤)	EPR
ILS 50° flaps	2002	08:47:00	1490	2950	100.3	84.3	84.3	0	16.0	-
	2008	09:53:52	1475	2396	99.2	84.8	84.8	0	14.4	-
	2701	11:03:36	1518	1518	99.3	83.8	83.5	0.3	15.5	-
	2703	11:21:12	1528	1528	100.0	85.1	85.0	0.1	14.9	1.13
	2707	12:31:13	1584	1594	103.4	87.2	86.3	0.9	16.2	1.19
	2713	13:56:15	1586	1845	100.6	83.8	83.8	0	16.8	1.11
Two segment 4000'/5-1/2°/ 575'	2003	08:58:47	2199	4220	86.3	73.3	71.7	1.6	13.0	-
	2004	09:10:33	2179	2832	90.5	74.9	74.9	0	15.6	-
	2005	09:21:31	2229	2995	93.9	78.8	78.8	0	15.1	-
	2006	09:32:36	2235	4114	88.8	73.3	72.9	0.4	15.5	-
	2009	10:06:01	2187	2265	92.5	76.2	76.2	0	16.3	-
	2705	12:06:30	2257	2380	91.1	77.1	76.8	0.3	14.0	1.07
	2708	12:43:02	2244	2659	88.8	74.3	74.1	0.2	14.5	1.07
	2710	13:06:36	2244	2302	92.7	77.8	77.8	0	14.9	1.08
	2711	13:21:57	2272	2928	91.6	76.5	76.5	0	15.1	1.06
	2712	13:45:44	2255	2255	92.6	74.4	73.8	0.6	18.2	1.06
	2715	14:12:29	2259	2430	92.0	76.8	76.8	0	15.2	1.07
	2716	14:23:24	2279	2289	92.7	77.0	77.0	0	15.7	1.08
	2717	14:33:01	2250	2968	90.4	74.0	73.9	0.1	16.4	1.04

Table VIII. 20,27 November 1973, Stockton – Site 7

Type run	Run No.	(1) Time of PNLTM	(2) Slant range at CPA (ft)	(3) Slant range at PNLTM (ft)	(4) $EPNL_c$ (EPNdB)	(5) Max dBA	(6) dBA at PNLTM	(7) Δ dBA ((5) - (6))	(8) Δ dB ((4) - (5))	(9) EPR
ILS 50° flaps	2002	08:46:38	1884	1884	98.4	85.2	85.2	0	13.2	-
	2008	09:53:16	2040	2080	96.6	82.9	82.9	0	13.7	-
	2701	11:02:54	1731	1731	100.8	86.4	86.4	0	14.4	-
	2707	12:30:34	1748	1977	96.9	77.6	76.4	1.2	19.3	1.17
Two segment 4000'/5-1/2°/ 575'	2003	08:58:23	3375	3421	84.3	73.2	72.3	0.9	11.1	-
	2004	09:09:40	3445	3503	84.2	71.8	71.8	0	12.4	-
	2005	09:20:51	3392	3397	82.8	67.9	67.9	0	14.9	-
	2006	09:32:02	3394	3394	86.5	72.4	70.9	1.5	14.1	-
	2009	10:05:18	3303	3402	86.4	74.4	72.6	1.8	12.0	-
	2705	12:05:47	3367	3473	90.1	77.5	77.5	0	12.6	-
	2708	12:42:20	3557	3643	84.9	68.9	68.9	0	16.0	1.07
	2710	13:05:47	3455	3490	85.2	71.2	71.2	0	14.0	1.06
	2711	13:21:19	3397	3482	89.1	76.7	77.7	0	12.4	1.14
	2712	13:45:01	3422	3513	90.4	77.7	77.5	0.2	12.7	1.06
	2715	14:11:59	3974	4899	83.3	67.8	67.3	0.4	15.5	1.07

Table IX. 20 November 1973, Stockton – Site 1b

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ ΔdBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2002	08:48:39	2331	2371	100.5	86.1	86.1	0	14.4	-
	2007	09:44:55	2341	2612	100.1	-	-	-	-	-
Two segment 4000'/5-1/2°/ 575'	2003	09:00:31	2338	2384	102.3	88.3	87.9	0.4	14.0	-
	2004	09:11:43	2348	2463	100.0	84.0	84.0	0	16.0	-
	2005	09:23:01	2335	2345	101.2	85.9	84.0	1.9	15.3	-
	2006	09:34:12	2317	2317	100.3	84.3	83.5	0.8	16.0	-

Table X. 20,27 November 1973, Stockton – Site 1c

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ ΔdBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2701	11:05:00	3958	3958	84.5	68.3	68.3	0	16.2	-
	2703	11:22:40	3963	4423	89.0	74.7	74.5	0.2	14.3	1.13
	2707	12:33:03	4032	5704	90.4	75.9	75.9	0	14.9	-
	2713	13:57:51	3986	4236	89.5	73.3	72.8	0.4	16.2	1.17
Two segment 4000'/5-1/2°/ 575'	2705	12:07:52	3966	4191	86.8	71.4	71.4	0	15.4	1.20
	2706	12:20:54	4043	4063	84.1	68.8	67.7	1.2	15.3	1.06
	2710	13:08:03	3999	4059	84.2	71.4	71.4	0	12.8	1.20
	2711	13:23:37	3951	4085	84.7	73.0	73.0	0	11.7	1.11
	2712	13:47:15	3985	4061	87.9	72.3	70.6	1.7	15.6	1.20
	2715	14:14:07	4014	4452	88.1	73.3	73.1	0.2	14.8	-
	2716	14:24:52	3942	3998	89.1	72.5	72.5	0	16.6	1.19
	2717	14:34:50	3984	5126	93.4	78.8	78.3	0.5	14.6	-

Table XI. 20,27 November 1973, Stockton – Site 4b

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ Δ dBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2002	08:48:01	3317	3399	87.6	74.2	74.2	0	13.4	-
	2007	09:44:26	3335	3860	88.0	74.3	72.3	2.0	13.7	-
	2008	09:54:40	3327	3381	89.6	73.5	73.3	0.5	16.1	-
	2701	11:04:23	3233	3654	90.3	79.1	77.3	1.8	11.2	-
	2703	11:21:55	3221	3289	89.5	74.9	74.9	0	14.6	1.16
	2707	12:31:57	3440	3500	87.8	75.2	74.1	1.1	12.6	1.23
	2713	13:57:04	3208	3412	88.8	74.7	74.7	0	14.1	1.10
Two segment 4000'/5-1/2°/ 575'	2003	08:59:45	3380	3546	86.1	75.4	75.4	0	10.7	-
	2004	09:11:08	3455	3462	85.7	70.8	68.6	2.3	14.9	-
	2005	09:22:24	3314	3446	86.0	72.8	71.8	1.0	13.2	-
	2006	09:33:45	3350	4637	85.4	73.5	72.8	0.7	11.9	-
	2009	10:06:47	3329	3446	86.8	73.2	73.2	0	13.6	-
	2010	12:00:36	3357	4198	88.6	75.9	74.8	1.1	12.7	-
	2705	12:07:14	3354	3978	84.3	71.6	71.5	0.1	12.7	1.07
	2706	12:20:06	3397	3866	81.7	70.3	70.3	0	11.4	1.05
	2708	12:43:55	3411	3676	84.9	72.2	71.9	0.3	12.7	1.07
	2710	13:07:21	3358	3671	81.4	67.8	67.8	0	13.6	1.02
	2711	13:22:52	3368	3536	85.5	71.4	71.4	0	14.1	1.07
	2712	13:46:33	3378	3706	83.7	68.0	66.9	1.1	15.7	1.05
	2715	14:13:20	3322	3682	85.8	70.5	70.5	0	15.3	1.06
	2716	14:24:05	3446	3446	84.3	70.2	70.2	0	14.1	1.07
	2717	14:33:46	3399	3687	84.6	69.4	69.3	0.1	15.2	1.05

Table XII. 20, 27 November 1973, Stockton – Site 4c

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_C$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ Δ dBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2701	11:04:19	4215	4264	86.2	72.5	72.5	0	13.7	-
	2703	11:21:57	4203	4360	86.1	72.1	71.8	0.3	14.0	1.16
	2707	12:32:03	4229	4701	85.4	71.3	71.3	0	14.1	1.23
	2713	13:57:04	4187	4388	83.9	70.9	70.9	0	13.0	1.10
Two segment 4000'/5-1/2°/ 575'	2009	10:06:59	4297	5858	83.7	70.7	68.3	2.3	13.0	-
	2010	12:00:27	4316	4347	82.3	73.9	73.4	0.5	8.4	-
	2705	12:07:15	4316	4817	84.7	73.0	71.9	1.1	11.7	1.07
	2706	12:20:17	4358	4470	79.5	68.8	68.8	0	10.7	1.05
	2708	12:44:01	4370	5192	82.9	69.4	66.8	2.4	13.5	1.09
	2710	13:07:19	4319	4449	78.5	66.3	65.8	0.5	12.2	1.03
	2711	13:22:54	4330	4615	82.8	70.9	70.6	0.3	11.9	1.08
	2712	13:46:44	4338	6030	81.0	68.5	67.2	1.3	12.5	1.05
	2715	14:13:23	4277	4891	82.3	68.9	67.8	1.1	13.4	1.06
	2716	14:24:11	4406	4637	84.6	70.1	68.5	1.6	14.5	1.07
	2717	14:33:33	4362	5994	83.2	70.8	68.6	2.2	12.4	1.05

Table XIII. 20, 27 November 1973, Stockton – Site 5b

		①	②	③	④	⑤	⑥	⑦	⑧	⑨
Type run	Run No.	Time of PNLTM	Slant range at CPA (ft)	Slant range at PNLTM (ft)	$EPNL_c$ (EPNdB)	Max dBA	dBA at PNLTM	Δ dBA (⑤ - ⑥)	Δ dB (④ - ⑤)	EPR
ILS 50° flaps	2002	08:47:24	2495	2701	93.8	78.0	78.0	0	15.8	-
	2008	09:54:02	2660	3589	90.3	77.7	77.7	0	12.6	-
	2701	11:03:36	2566	2566	92.8	78.6	78.2	0.4	14.2	-
	2703	11:21:12	2598	2598	93.6	79.3	79.3	0	14.3	1.13
	2707	12:31:18	2715	3043	97.2	82.3	82.2	0.1	14.9	1.17
	2713	13:56:24	2397	2915	93.6	76.8	76.1	0.7	16.8	1.14
Two segment 4000'/5-1/2°/ 575'	2003	08:59:12	2943	3150	81.3	65.6	65.6	0	15.7	-
	2004	09:10:20	2995	3232	84.4	69.3	66.8	2.5	15.1	-
	2005	09:21:43	2956	3147	91.8	75.5	75.5	0	16.3	-
	2006	09:32:50	2983	3017	86.6	72.9	72.9	0	13.7	-
	2009	10:06:11	2848	3448	89.1	74.4	74.4	0	14.7	-
	2010	11:59:45	2898	3059	85.1	70.0	70.0	0	15.1	-
	2705	12:06:29	3023	3076	87.2	73.7	73.7	0	13.5	1.07
	2708	12:43:02	3064	3309	84.9	71.6	71.6	0	13.3	1.07
	2710	13:06:38	3005	3255	88.6	73.6	73.3	0.3	15.0	1.08
	2711	13:21:59	3017	3232	86.0	70.9	69.3	1.6	15.1	1.03
	2712	13:45:39	3013	3210	87.2	72.3	71.1	1.2	14.9	1.06
	2715	14:12:35	2963	3040	92.9	75.7	75.6	0.1	17.2	1.07
	2716	14:23:26	2957	3072	87.8	71.5	71.5	0	16.3	1.08
	2717	14:33:05	2983	3076	87.4	74.5	74.5	0	12.9	1.04

Table XIV. 20,27 November 1973, Stockton – Site 5c

Type run	Run No.	① Time of PNLTM	② Slant range at CPA (ft)	③ Slant range at PNLTM (ft)	④ $EPNL_c$ (EPNdB)	⑤ Max dBA	⑥ dBA at PNLTM	⑦ Δ dBA (⑤ - ⑥)	⑧ ΔdB (④ - ⑤)	⑨ EPR
ILS 50° flaps	2701	11:03:34	4279	4322	84.9	70.2	70.2	0	14.7	-
	2703	11:21:24	4306	5207	86.8	73.7	73.7	0	13.1	1.13
	2707	12:31:20	4445	4773	88.5	76.0	76.0	0	12.5	1.17
	2713	13:56:19	4069	4082	86.9	69.8	69.6	0.2	17.1	1.11
Two segment 4000'/5-1/2°/ 575'	2705	12:06:35	4529	4994	81.9	69.9	69.9	0	12.0	1.07
	2708	12:43:02	4594	4792	81.1	67.5	67.1	0.4	13.6	1.07
	2710	13:06:38	4510	4666	82.9	71.3	71.3	0	11.6	1.08
	2711	13:22:03	4529	4531	81.8	66.7	61.7	5.0	15.1	1.04
	2712	13:45:37	4530	4810	82.3	68.1	66.0	2.1	14.2	1.06
	2715	14:12:38	4459	4627	84.8	69.4	68.0	1.4	15.4	1.07
	2716	14:23:25	4440	4472	83.3	70.2	69.4	0.8	13.1	1.08
	2717	14:33:04	4494	4656	84.1	67.6	67.5	0.1	16.5	1.04

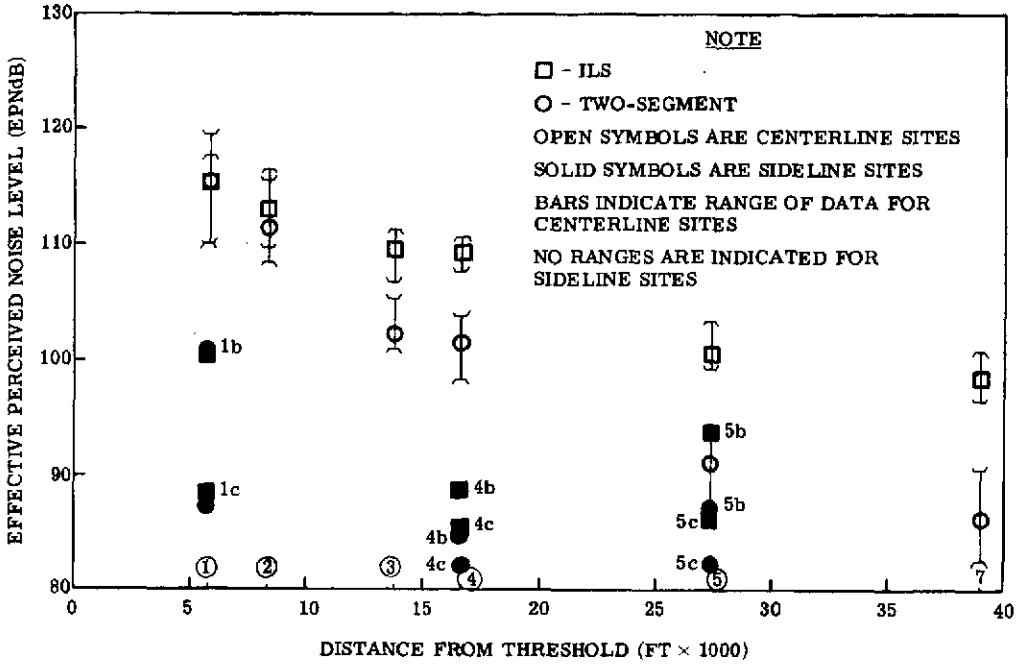

Figure 5. Noise Reductions

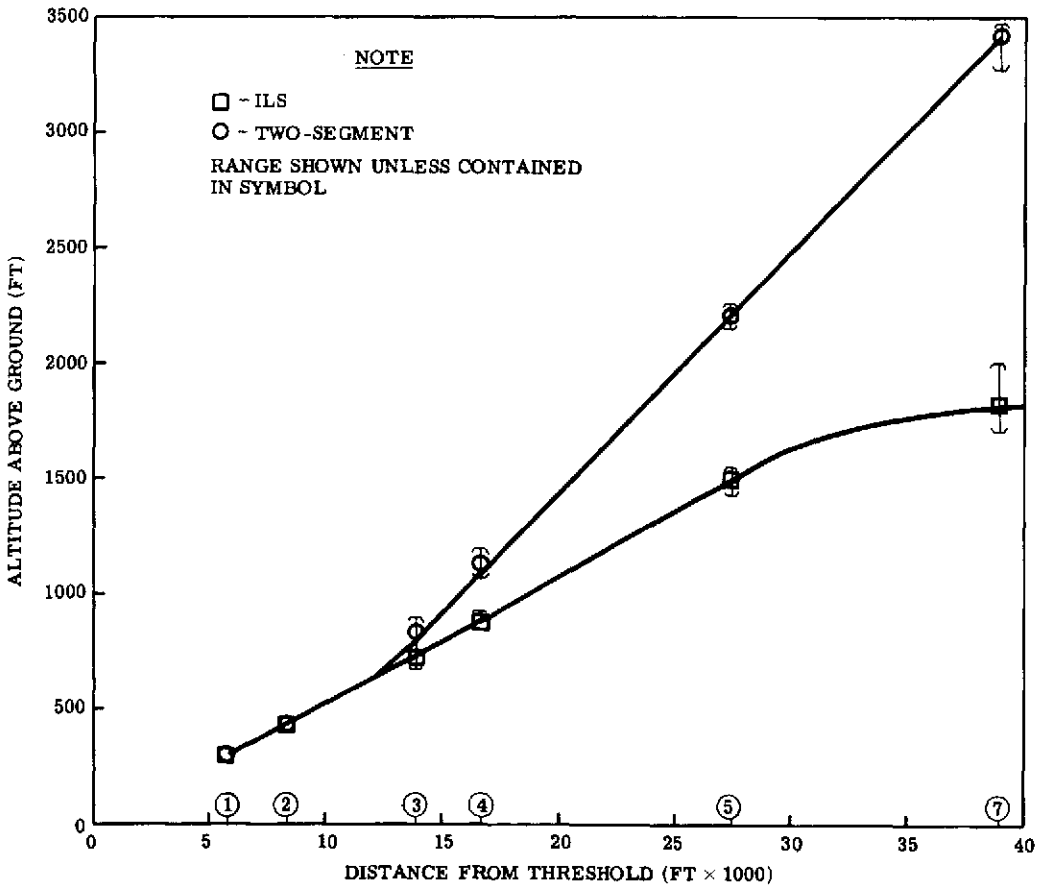

Figure 6. Averaged Flight Profiles