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David Garrett
Headquarters, Washington, D.C.
(Phone: 202/755-3090)

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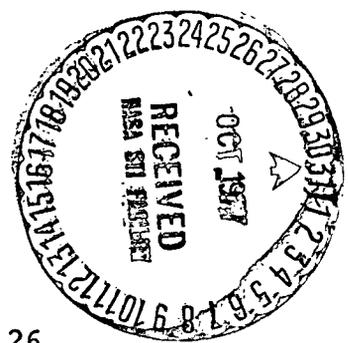
Robert Gordon
Johnson Space Center, Houston, Tex.
(Phone: 713/483-5111)

Ralph B. Jackson
Dryden Flight Research Center, Edwards, Calif.
(Phone: 805/258-8311)

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FIFTH SHUTTLE ORBITER FREE FLIGHT SET FOR OCT. 26

Astronauts Fred W. Haise and C. Gordon Fullerton are scheduled to make a pinpoint landing of the Space Shuttle Orbiter on a hard surface runway at Edwards Air Force Base, Calif., for the first time in the fifth and final free flight in the Shuttle Approach and Landing Tests (ALT). The flight which lasts less than two minutes is scheduled for no earlier than October 26, 1977 with takeoff time set for 11 a.m. EDT.



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(NASA-News-Release-77-224) FIFTH SHUTTLE ORBITER FREE FLIGHT SET FOR 26 OCTOBER (National Aeronautics and Space Administration) 12 p

This is the first time a hard surface runway landing will be attempted and the second time the Orbiter is to be flown without its tailcone. The tailcone provided smooth airflow and reduced drag of the 747/Orbiter combo during mated flight. Without the tailcone the 747/Orbiter combination did experience additional buffeting during its climb to separation altitude. The 747 crew and the Orbiter astronauts reported the level of buffeting was acceptable.

Haise and Fullerton will attempt to land the 75-ton Shuttle Orbiter at a point one third down the 4,578 meters (15,000 feet) concrete runway and bring it to a stop before reaching the 3,048 m (10,000 ft.) mark. Touchdown on the previous flights with landings on dry lakebed runways has ranged from 152 to 305 m (500 to 1,000 ft.) beyond the aim point.

This will be the third free flight and shortest for Haise and Fullerton who brought the Shuttle Orbiter in for successful landings August 12 and September 23, 1977. Flight time from release from the 747 carrier aircraft to touchdown is 1:55 minutes. The fourth flight October 12 was 2:34 minutes in duration.

Flight five, as in the fourth flight with astronauts Joe Engle and Richard Truly at the controls, will closely resemble landings the Space Shuttle Orbiter will experience upon its return from space in 1979.

Three simulated Orbiter main engines have replaced the smooth 2,608 kilograms (5,750 pounds) tailcone. The three Shuttle main engines are only used at launch to orbit in tandem with two solid rocket boosters which furnish liftoff power for the Shuttle. These engines are not used during reentry or during landing.

The Shuttle Orbiter will be prepared for a series of ferry verification flights atop the 747 after this flight. It will be shipped to the NASA Marshall Space Flight Center, Huntsville, Ala., early in 1978 for a year long series of ground vibration tests. It then will be returned in 1979 to the Rockwell International Space Division facility at Palmdale, Calif., where it will be prepared for space flight.

The second Orbiter (102) which is currently under construction at the R-1 Palmdale plant will be the first vehicle to be used in the Shuttle Orbiter Flight Test (OFT) program, scheduled to begin in mid-1979. Six OFT flights are planned to demonstrate the Orbiter's capabilities in Earth orbit before the start of Shuttle operational flights, scheduled to begin in 1980.

The final flight of Shuttle Orbiter will mark the last time Orbiters will land at this desert air base until 1979-80 when the first four OFT flights set down after low Earth orbital flights. Subsequent OFT flights and operational flights will land either at the NASA Kennedy Space Center, Fla., or at Vandenberg Air Force Base, Calif.

Haise and Fullerton will bring the Shuttle Orbiter in on a 22-degree glide path, much like Engle and Truly did during the previous flight. At one point during their flight Engle and Truly were gliding the Orbiter in on a 25-degree glide path. Commercial passenger jets descend at a glide slope of about three degrees.

It will be a straight-in approach for Haise and Fullerton following release from the 747 carrier aircraft. The Shuttle Orbiter will be released from the 747 at about an altitude of 5,180 m (17,000 ft.) when the vehicles are about 18.5 kilometers (11.5 miles) from touchdown.

After release the flight sequence will be as follows:

- Separation will occur when the mated vehicles are descending at a speed of 454 kilometers per hour (245 knots). Three seconds after release, the Orbiter crew commands a slight right roll for clearance from the 747.

- Twenty seconds after separation and at an altitude of 4,633 m (15,200 ft.) Shuttle Orbiter is commanded to a 22-degree glide slope, increasing its speed to 537 km/h (290 kts.). The Shuttle Orbiter is now 7.4 km (4.6 mi.) from touchdown.

- When the speed of 290 kts is reached, Commander Haise deploys Shuttle Orbiter's speed brakes. This occurs 34 seconds after separation when the craft is at an altitude of 3,566 m (11,700 ft.).

- The speed brakes are closed when the Shuttle Orbiter reaches 610 m (2,000 ft.) when a preflare (final pre-landing maneuver) is performed.

- At 1:42 minutes after separation, when the Shuttle Orbiter is 6 m (200 ft.) above the hard runway, pilot Fullerton lowers the landing gear. The vehicle is now traveling at the speed of 463 km/h (250 kts.)

- Touchdown is expected at 1:55 minutes after release. Speed at touchdown is expected to be about 343 km/hr (185 kts.). Hard braking will be applied after touchdown in an attempt to bring the Shuttle Orbiter to a stop at the 3,048 m (10,000 ft.) runway marker. (On Free Flight 4, Engle and Truly brought the Orbiter to a stop 1,744 m (5,725 ft.) after touchdown.

- Descent rate of Shuttle Orbiter during this flight will vary from an overall average 46.4 miles per second (9,234 feet per minute) to a maximum of 63.5 m/s (12,510 f/min.) between pitch-down and flare.

ALT FREE FLIGHT TIMELINE

<u>Event</u>	<u>Altitude**</u>	<u>T-Time*</u>	<u>PDT a.m.</u>	<u>EDT</u>
Crew Wakeup		T-240	4:00	7:00
Crew Depart Quarters		T-210	4:30	7:30
Crew Arrives Trailer (physical & breakfast)		T-195	4:45	7:45
Crew Departs for Suitup Trailer		T-160	5:20	8:20
Crew Departs Trailer		T-125	5:55	8:55
Start Ingress		T-120	6:00	9:00
Ingress Complete		T-98	6:22	9:22
ALT Ground Team/Flight Team Handover				
Orbiter/SCA Move From MDD***		T-46	7:14	10:14
Orbiter/SCA Tow to NASA Ramp				
SCA Engine Start		T-35	7:25	10:25
SCA Begin Taxi		T-28	7:32	10:32
SCA Arrive Runway		T-13	7:49	10:49
Navigation Update		T-4	7:56	10:56
SCA Brake Release, Takeoff Climbout		T-0	8:00	11:00
		<u>T+00</u>		
Intersect Racetrack	6,000	T+06	8:06	11:06
FCS Checks***	19,000	T+31	8:31	11:31
SCA Begin SRT Climb***	20,000	T+44	8:44	11:44
Pushover	22,000	T+54	8:54	11:54
		<u>Separation Point</u>		
Separation 245 kts (Range to TD 10 nm)	17,700	0:00	8:55:00	11:55:00
Roll Right 20° 235 kts	17,600	0:03	8:55:03	11:55:03
Accelerate to 290 kts	15,900	0:20	8:55:20	11:55:20
Pitchup 2°/sec to 17°; Speed Brake 50%	11,700	0:37	8:55:37	11:55:37
S/B Close; Preflare 290 kts	1,900	1:24	8:56:24	11:56:24
Gear Deploy 250 kts	200	1:42	8:56:42	11:56:42
Touchdown 185 kts	0	1:55	8:56:55	11:56:55
Nosewheel Touchdown, Hard Braking 130 kts		2:05	8:57:05	11:57:05
Orbiter Stop		2:15	8:57:15	11:57:15

Note

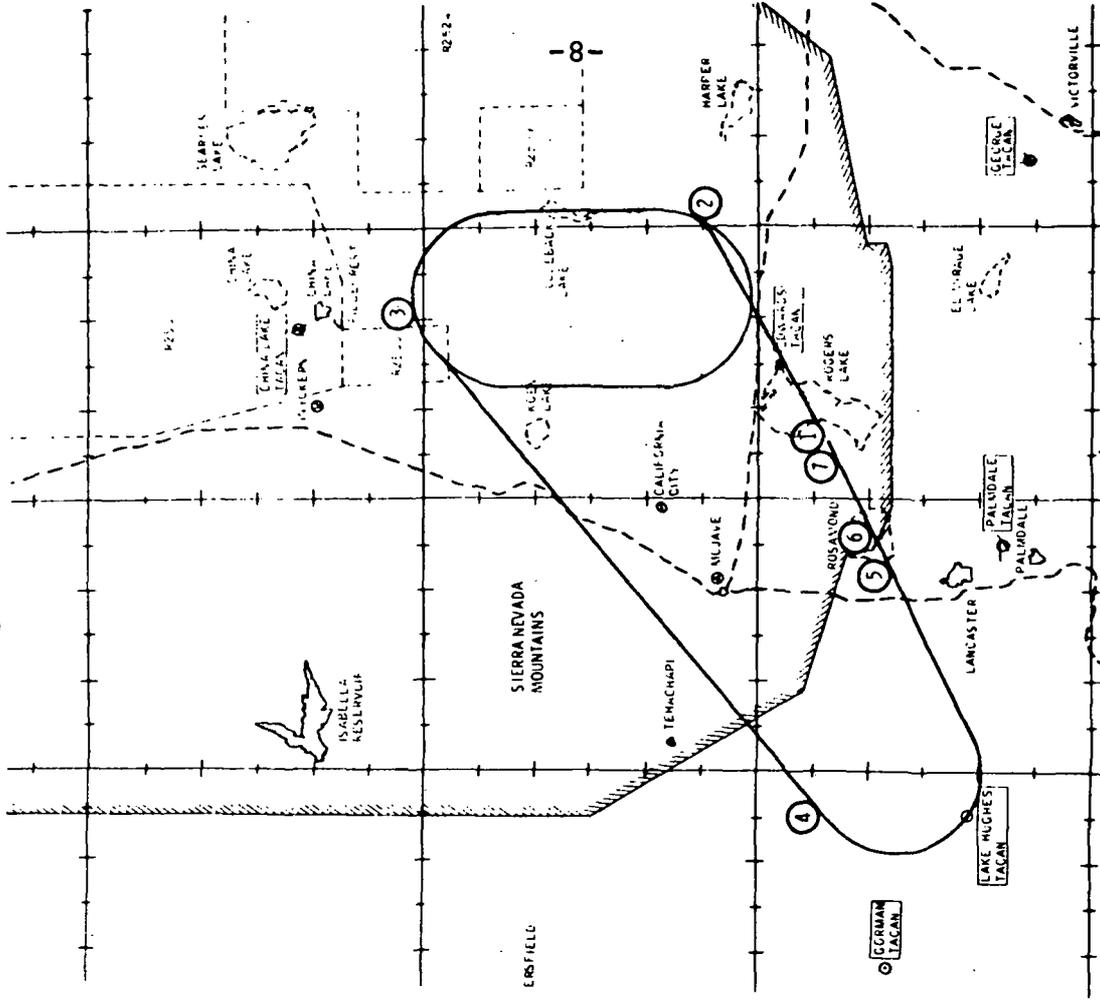
- * Events and times are preliminary and may change prior to and during flight and are dependent upon atmospheric and flight conditions.
- ** Altitudes are Above Ground Level (AGL) and are referenced to Orbiter ground aim point on the runway. Add 2,300 feet to AGL to obtain altitude above Mean Sea Level (MSL).
- *** SCA - Shuttle Carrier Aircraft
MDD - Mate-Demate Device
FCS - Flight Control System (or Forward Crew Station)
SRT - Special Rated Thrust

MATED PROFILE FREE FLIGHT 5

FLIGHT SEQUENCE

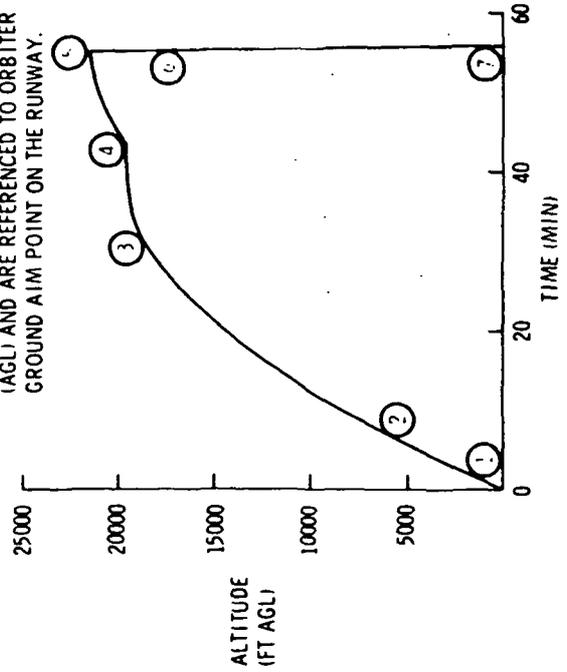
ITEM	TIME	ATL (AGL)	RG (NM)	EVENT
①	0	0	0	SCA TAKE OFF
②	6	6 000	23	INTERSECT RACETRACK
③	31	19 000	37	INFLIGHT FCS CHECK
④	44	20 000	33	SRT
⑤	54	22 000	14	PUSHOVER
⑥	55	17 700	12	SEP
⑦	57	0	0	ORBITER LANDING

GROUNDTRACK



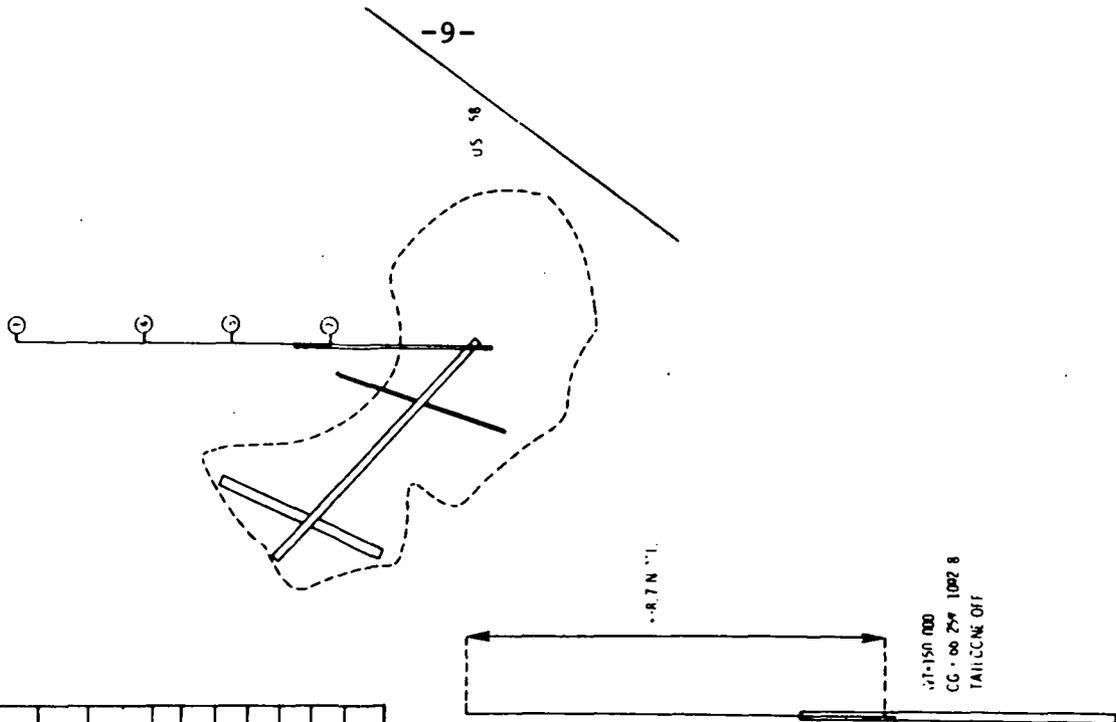
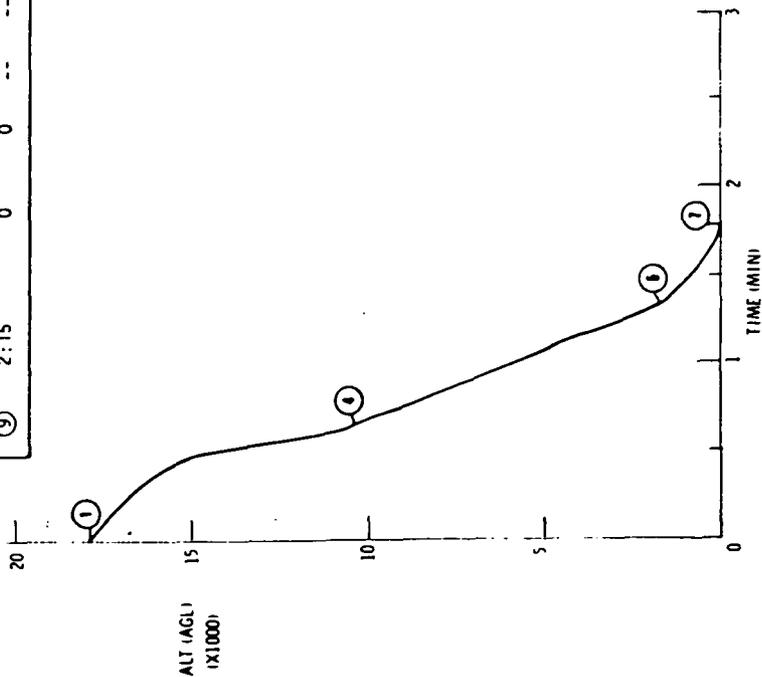
ALTITUDE PROFILE

NOTE: ALTITUDES ARE ABOVE GROUND LEVEL (AGL) AND ARE REFERENCED TO ORBITER GROUND AIM POINT ON THE RUNWAY.



ALT FREE FLIGHT 5

ITEM	TIME	ATL (AGL)	KEAS	α	ϵ	ACTION
①	0:00	17 700	245	10	.5	SEP; $\dot{\theta} = 20^\circ/\text{SEC}$, 3 SEC; $\dot{\theta} = 0$
②	0:03	17 600	235	9	6	ROLL RIGHT $\phi = 20^\circ$; AT 'CHASE TWO CLEAR,' $\dot{\theta} = -20^\circ/\text{SEC}$ TO $\theta = -22^\circ$, ROLL TO $\psi = 045^\circ$
③	0:20	15 900	235	4	-22	ACCELERATE TO 290
④	0:37	11 700	290	4	-17	$\dot{\theta} = 20^\circ/\text{SEC}$ TO $\theta = -17^\circ$; S/B = 50%
⑤	1:24	1 900	290	4	-17	S/B-CLOSE; PREFLARE
⑥	1:42	200	250	6	0	GEAR DEPLOY
⑦	1:55	0	185	8	8	TOUCHDOWN
⑧	2:05	0	130	--	--	AT NOSEHEEL TOUCHDOWN, HARD BRAKING
⑨	2:15	0	0	--	--	ORBITER STOP



APPROACH AND LANDING TESTS SUMMARY RESULTS

PHASE I APPROACH AND LANDING TESTS
(Orbiter unmanned and systems inactive)

TAXI TESTS: February 15, 1977

Three taxi tests assessed the mated capability of the Shuttle Orbiter piggyback atop the 747 in ground handling and control characteristics up to the flight takeoff speed. The tests also validated the 747 steering and braking.

FLIGHT #1: February 18, 1977

Duration: 2 hr 5 min
Maximum Speed: 287 mph
Maximum Altitude: 16,000 ft

FLIGHT #2: February 22, 1977

Duration: 3 hr 13 min
Maximum Speed: 328 mph
Maximum Altitude: 22,600 ft

Flight #2 accomplished a series of flutter and stability control tests. During this flight, the two right engines of the 747 were reduced to idle thrust. The flight was termed "super."

FLIGHT #3: February 25, 1977

Duration: 2 hr 28 min
Maximum Speed: 425 mph
Maximum Altitude: 26,600 ft

This flight concluded the flutter tests and concentrated on stability/control/flight evaluation and airspeed calibration. Stability and control were evaluated by idling the #4 engine of the 747 to simulate an engine failure.

At the completion of this flight, it was stated that if flights #4 and #5 follow the same successful pattern, flight #6 would not be necessary.

Flight #4: February 28, 1977

Duration: 2 hr 11 min
Maximum Speed: 425 mph
Maximum Altitude: 28,565 ft

This flight simulated emergency descent of the mated vehicles and a missed landing approach, as well as maneuvers required of the 747 when the mated vehicles enter the separation flight phase.

FLIGHT #5: March 2, 1977

Duration: 1 hr 39 min
Maximum Speed: 474 mph
Maximum Altitude: 30,000 ft

PHASE II APPROACH AND LANDING TESTS
(Orbiter manned, systems active)

FLIGHT #1: June 18, 1977

SCA/Orbiter Brake Release:	8:06 a.m. (PDT)
SCA/Orbiter Landing:	9:01:46 a.m. (PDT)
SCA/Orbiter Weight:	263,088 kilograms (580,000 lbs)
Flight Duration:	55 min 46 sec
Maximum Speed:	181 KEAS (208 mph)
Maximum Altitude:	4562 meters (14,970 ft)

Spacecraft Commander Fred Haise and Pilot Gordon Fullerton were at the controls of the Space Shuttle Orbiter during this first manned captive flight. This flight was a once around a racetrack-like flight path which measured approximately 125 kilometers (78 statute miles) on the "straight-a-ways" with 16 kilometer (10 statute mile) curves.

FLIGHT #2: June 28, 1977

SCA/Orbiter Brake Release:	7:49:50 a.m. (PDT)
SCA/Orbiter Landing:	8:52 a.m. (PDT)
SCA/Orbiter Weight:	253,018 kilograms (557,800 lbs)
Flight Duration:	1 hr 2 min
Maximum Speed:	270 KEAS (310 mph)
Maximum Altitude:	6714 meters (22,030 ft)

Spacecraft Commander Joe Engle and Pilot Dick Truly were at the controls of the Space Shuttle Orbiter during this second manned captive flight. This flight consisted of a modified racetrack-like trajectory as well as a "Grand Prix" roadrace-like trajectory.

FLIGHT #3: July 26, 1977

SCA/Orbiter Weight:	565,000 lbs
Duration:	59 min 53 sec
Maximum Speed:	312 mph
Maximum Altitude:	27,992 ft (AGL)

Spacecraft Commander Haise and Pilot Fullerton were at the controls of Enterprise during this third and final captive flight, a full dress rehearsal of the planned August 12 free flight. The SCA/Orbiter reached a maximum altitude of 27,992 ft (AGL) at which time pitch over was performed. The carrier aircraft landing gear was deployed to simulate the free flight approach and landing profile. A practice separation run was normal and "abort separation" was performed one minute after pushover. Enterprise landing gear was deployed for the first time after the SCA landed on runway 22. The final approach profile was identical to that planned for the first free flight.

PHASE III APPROACH AND LANDING TESTS

(Free Flight)

ACTUAL TIMES/ALTITUDES TIMELINE

Free Flight 1 (Haise & Fullerton)

August 12, 1977

<u>Event</u>	<u>PDT</u>	<u>Altitude, AGL</u>	<u>Speed, knots</u>
SCA/Orbiter Brake Release, Takeoff	8:00:00		
Intersect Racetrack	8:15:30	19,500	
Flight Control Systems Check	8:22:14	22,500	
Begin Special-Rated Thrust	8:36:43	26,200	
Pushover for Orbiter Separation	8:47:40	28,000	
Orbiter Separation	8:48:29	24,000	270
Orbiter Landing	8:53:51	0	185

Total Orbiter Free Flight Time: 5 min 22 sec

Average Rate of Sink: 4615 fpm

Touchdown was about .75 mile beyond predicted TD point

Touchdown-to-stop rollout approximately 11,000 feet

Free Flight 2 (Engle & Truly)

September 13, 1977

<u>Event</u>	<u>PDT</u>	<u>Altitude, AGL</u>	<u>Speed, knots</u>
Takeoff	8:00:00		
Pushover	8:48:34	28,300	
Separation	8:49:24	24,000	
Main Gear	8:54:55		
Nose Gear	8:55:10		
Stop	8:56:10		

Highest Speed: 300 knots

Lowest Speed: 185 knots

Touchdown: 194 knots

Free Flight Total: 5 min 31 sec

Touchdown 680 feet past aim point

Free Flight 3 (Haise & Fullerton)

September 23, 1977

<u>Event</u>	<u>PDT</u>	<u>Altitude, AGL</u>	<u>Speed, knots</u>
Takeoff	8:00:47		
Pushover	8:44:58	26,700	
Separation	8:45:37	21,400	250 (287 mph)
Touchdown (main)	8:51:12		191 (219 mph)
Nose Gear	8:51:23		

Total Free Flight: 5 min 34 sec

Autoland System: 45 sec

Touchdown 786 feet beyond aim point

Rollout: 9,147 feet

Free Flight 4 (Engle & Truly)
October 12, 1977

<u>Event</u>	<u>PDT</u>	<u>Altitude, AGL</u>	<u>Speed, knots</u>
Takeoff	7:45:51		
Pushover	8:49:37	23,000 feet	
Separation	8:50:14	20,536 feet	240
Touchdown (main)	8:52:48		
Touchdown (Nose gear)	8:52:54		
Rollout	8:53:33	(5,000 feet runout)	

- end -