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Challenger STS-17 (41-G) Post-Flight Best Estimate Trajectory Products - Development and Summary Results

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TABLE OF CONTENTS

ABSTRACT

Development and summary results from the STS-17 (41-G) post-flight products are presented. Operational Instrumentation recorder gaps, coupled with the limited tracking coverage available for this high inclination entry profile, necessitated selection of an anchor epoch for reconstruction corresponding to an unusually low altitude of h~297 kft. The final inertial trajectory obtained, BT17N26/UN=169750N, is discussed in Section I. Therein are discussions relative to the problems encountered with the OI and ACIP recorded data on this Challenger flight. Atmospheric selection, again in view of the ground track displacement from the remote meteorological sites, constituted a major problem area as discussed in Section II. The LAIRS file provided by Langley was adopted, with NOAA data utilized over the lowermost ~7 kft. As discussed in Section II, the Extended BET, ST17BET/UN=274885C, suggests a limited upper altitude (h<230 kft) for which meaningful flight extraction can be expected. This is further demonstrated, though not considered a limitation, in Section III wherein summary results from the AEROBET (NJ0333 with NJ0346 as duplicate) are presented. GTFILEs were generated only for the selected IMU (IMU2) and the Rate Gyro Assembly/Accelerometer Assembly data due to the loss of ACIP data. Flight summary data for future reference are:

Epoch: October 13, 1984 ($57525^{s}.0$ GMT), h_o = 297 kft

Event	Time from epoch(sec)	Altitude(kft)
Entry interface	N/A	400
Maximum Mach number (31.6)	100	257
M25	422	225
Initial flight extraction	450	224
M20	654	208
M15	802	185
M10	948	168
M5	1146	121
M2	1324	75
M1	1418	48
Main gear deployment	1651	.1
Weight on wheels (WOW)	1669	-.2
Weight on nose (WONG)	1685	-.2
Stop time	1729	-.2

Appendices attached present inputs for the generation of the post-flight products (Appendix A), final residual plots (Appendix B), a two second spaced listing of the relevant parameters from the Extended BET (Appendix C), and an archival section (Appendix D) denoting input (source) and output files and/or physical reels.

I. Entry Trajectory Reconstruction

Special Considerations

IMU data pre-processing for this flight presented problems unlike any encountered for the first twelve entries. First, a large gap of approximately four(4) minutes in the Operational Instrumentation recorded data occurred. This gap spanned the approximate altitude interval from 415 kft to 297 kft during descent. Loss of the Aerodynamic Coefficient Identification Package (ACIP) measurements due to a power problem precluded filling in the "equivalent" IMU measurements of spacecraft dynamics in this interval, a work around for an earlier flight (STS-7). Since the High Resolution Accelerometer Package (HiRAP) data were also lost due to the same power problem, and in view of the fact that there was no tracking coverage at the uppermost altitudes, an anchor epoch was selected immediately after the major gap. Thus, the post-flight analysis for STS-17 (41-G) was restricted to altitudes below h~297 kft. Though this does not present any limitations for the purposes of aerodynamic and aerothermodynamic research investigations, even over this more "restricted" time interval, many IMU problems surfaced. Discussions were held with various analysts at the JSC re the apparent IMU downlist problems. No obvious mechanism was identified, though a flight software change did affect the data during the launch phase. In any event, the recorded data during descent contained many off-scale measurements, non-orthogonal quaternions, and data gaps. Suggested were indications of non-homogeneity in the down-list, something which should not occur as these data are write-protected. Given the preceding statements as background, the remainder of this Section summarizes the IMU comparisons and selection process, tracking coverages, and the resulting trajectory solution for STS-17.

I.a. Dynamic Data

IMU2 was selected as the dynamic data source for STS-17 reconstruction principally because there were significantly less blunder points associated with this unit. This is best exemplified by referring to the following table of required manual deletions during the preprocessing activity.

MANUAL DELETIONS DURING STS-41G PRETM PROCESSING

IMU	TIME AFTER TEPOCH	CHANNEL
1	420.51	Vx, Vy, Vz
	897.47	Vz
	1041.47	Vx, Vy, Vz
	1097.47	Vz
	1147.71	Q(1), Q(2), Q(3), Q(4)
	1148.51	Vy
	1184.19	Q(1), Q(2), Q(3), Q(4)
	1229.31	Q(1), Q(2), Q(3), Q(4)
	1312.51	Vx, Vy, Vz
	1424.51	Vx, Vy
	1500.03	Q(1), Q(2), Q(3), Q(4)
	1501.47	Vx, Vy, Vz
	1567.55	Vz
	1571.55	Vx, Vy, Vz
	1572.51	Vz
	1586.43	Q(1), Q(2), Q(3), Q(4)
	1615.55	Vy, Vz
	1617.15	Q(1), Q(2), Q(3), Q(4)
	1642.11	Q(1), Q(2), Q(3), Q(4)
2	1097.47	Vz
3	1074.59	Vz
	1263.55	Vy
	1506.75	Q(1), Q(2), Q(3), Q(4)
	1578.59	Vy
	1633.47	Q(1), Q(2), Q(3), Q(4)
	1658.43	Q(1), Q(2), Q(3), Q(4)
	1664.51	Vx
	1682.43	Q(1), Q(2), Q(3), Q(4)

On the basis of mid-value selection criteria, selection of IMU2 can only be substantiated based on accelerometer performance. Gyro performance, in terms of mid-value selection, was marginally better for IMU2 (except for the important total angle, Γ, which is independent of alignment) as indicated by the following:

Accelerometer Comparisons Based on 1492 Points

Percentage mid-value measurement

	IMU1	IMU2	IMU3
$\Delta V_{X_{M50}}$	92	2	6
$\Delta V_{Y_{M50}}$	9	90	1
$\Delta V_{Z_{M50}}$	9	91	0

Gyro Comparisons Based on 1552 Points

Percentage mid-value measurement

	IMU1	IMU2	IMU3
Euler Ψ	14	85	1
Euler θ	79	21	0
Euler Φ	10	52	38
Total angle, Γ	85	15	0
Total angular rate, $\dot{\Gamma}$	33	34	33

Of interest in the preceding table is the rather large number of points rejected by the IMU comparison software. Given that the data are ~1 Hz, essentially 1775 records were compared over the time interval. Unless all three IMUs contain acceptable data at the respective homogeneous times, i.e., all three ΔV components or all four quaternions for each of the IMUs, data are rejected. This test is necessary for IMU comparisons and is a somewhat more stringent requirement than the other pre-processors utilized to develop body axes dynamic data using spline methods.

There were some thirteen(13) non-orthogonal quaternions encountered during the data processing, at least in terms of the criterion of 1.E-5. These occurrences were split between the various IMUs as follows:

IMU1	6 times
IMU2	5 times
IMU3	2 times

Except for one occurrence for IMU1, the tests marginally violated the criterion. However, 1.E-5 is the usual criterion which has been utilized on all preceding flights and has never indicated any problems. These results are somewhat disconcerting since the data otherwise appear valid, causing one to speculate on data staleness, at least in some components. This should not occur since these words are write-protected.

There were various data gaps encountered during the processing. Most significant of these were ~15 second and ~7 second gaps in all measurements that occurred 326 and 1431 seconds from epoch, respectively. On a positive note, each of the IMU accelerometers sensed the same total (magnitude) ΔV change over the arc to within ±0.5 fps.

Figure I-1 shows a time history of the derived body axes rates and accelerations during descent. These data are based on the final, edited, IMU2 data which were, as stated, utilized for trajectory reconstruction.

Ib. Tracking coverage

Tracking data taken during STS-17 entry flight were limited to only those available sites in Florida as can be seen in the ground track plot of Figure I-2. Table I defines the actual stations utilized which included four C-band stations and one S-band tracker. Thus, the altitude range over which external tracking measurements were available for reconstruction was limited to the lowermost 145 kft. Details of this tracking geometry are depicted in Figures I-3, (a) and (b). Use of a five(5) degree minimum elevation constraint results in some 4370 data points for trajectory determination. Thus, the tracking arc provides good geometry in the terminal area, and, hopefully, sufficient geometry throughout the entry in view of the rather low altitude for the selected anchor epoch due to the OI gap as discussed previously.

Ic. Reconstruction results

The final inertial trajectory, BT17N26/UN=169750N, is based on a state only fit to the tracking data and utilizes IMU2 data as the source for deterministic integration. The BET solution is summarized in Table II herein. It is seen that the degree of fit corresponds to ~1.8 weighted standard deviation fit to all the data included. Inclusion of instrument parameters in the solution set did little to improve the goodness of fit. Shown also on Table II are comparisons of the BT17N26 solution at epoch to the on/board Nav estimate as well as the JSC/TRW BET results. Though comparisons with the Nav state are in good agreement, it is observed that there are some differences versus the TRW results. Of significance is the ~3800 ft altitude discrepancy. Since there are no tracking data available over the uppermost altitudes it is difficult to resolve this difference. This is a situation very similar to STS-9, the previous high inclination entry flight which also provided for no coverage at the higher altitudes (latitudes). However, at h~160 kft the differences in altitude between the two post-flight BETs is approximately 500 ft, converging to near zero at touchdown.

Table III presents a summary of the fit statistics by station and data type. Composite range, azimuth, and elevation residuals are presented as Figures I-4, I-5, and I-6, respectively. Annotated on each of the figures are the mean and 1σ results of the fit obtained, to include the weighted statistics as well. Individual residual plots are attached as Appendix B herein. Figure I-7 presents comparisons between the BET and survey values during rollout on Runway 33 at KSC. Actual values in runway coordinates at vehicle stop ($t=1729^s$) are:

	Survey	BT17N26
X, ft	+11535	+11516
Y, ft	0	-10
$h-h_{RW}$, FT	+16	+10
$\dot{X}$, fps	0.	-0.10
$\dot{Y}$, fps	0.	+0.01
$\dot{h}$, fps	0.	-0.16

TYPE	STATION NO.	STATION NAME	LATITUDE (GEOD.) (DEG)	LONGITUDE (DEG)	ALT (ABOVE REF.) (FT)	MODULUS OF REFRACTION	SCALE HEIGHT (M)
S-BAND, E-W	6	MLXS	28.50831	279.30727	-183.1400	356.	6701.
C-BAND, MCBR	7	MLMC	28.62609	279.31723	-173.9800	N/A	N/A
C-BAND, FPQ-14	8	MLAC	28.42486	279.33564	-172.0100	N/A	N/A
C-BAND, MBR-17	9	CNMC	28.52888	279.40982	-195.1800	N/A	N/A
C-BAND, FPS-16	10	CNVC	28.48176	279.42353	-163.9100	N/A	N/A

Table I. STS-17 station locations and refraction data.

EPOCH: 10/13/84 $15^h 58^m 45^s$ (57525^s) GMT

DATA TYPES: S-band, 1 radar (MLXS)
C-band, 4 radars (MLMC, MLAC, CNMC, CNVC)
Pseudo Altimeter (Post WONG); Pseudo Doppler (Post STOP)

COMMENTS: 5° Elevation constraint on C, S-band data
Tracking coverage available only from Florida stations, i.e. for altitudes below ~145 kft

SOLUTION SET: State Only

DEGREE OF FIT: $\mu_w = +0.199$ $\sigma_w = 1.781$

PARAMETER	Initial Estimate, NAV		JSC/TRW	Final Solution, BT17N26
V_R, fps	24949.0		24948.0	24950.730
γ_R, deg	-1.100		-1.102	-1.0926011
Ψ_R, deg	70.839		70.815	70.806897
h_D, ft	297365.		300866.	297082.76
Φ_D, deg	55.104		55.098	55.098101
λ, deg	206.911		206.882	206.86970
ψ, deg	70.602	See	70.709	70.573671
θ, deg	40.144	Appendix	40.195	40.168621
ϕ, deg	-0.538	A	-0.302	-0.52173029

Table II. STS-17 solution and comparisons

OBSERVATION STATISTICS BASED ON FINAL STATE

STATION NO.	NAME	OBSERVATION TYPE	OBSERVATIONS ACCEPTED	AVERAGE WEIGHT. RES.	AVERAGE RESIDUAL	STANDARD STAND. DEV.	WEIGHTED STAND. DEV.
0		ALTIMETER	83 OF 83	.13069835E+01	.62735208E+01	.35665466E+01	.74303054E+00
6	MLXS	RANGE	272 OF 272	-.55627516E+00	-.58126951E+01	.14591712E+02	.14241266E+01
6	MLXS	DOPPLER	200 OF 200	.23099101E+00	.23321693E+00	.10388168E+01	.10361065E+01
6	MLXS	X-ANGLE	271 OF 271	.11953500E+01	.16024830E-01	.25738952E-01	.21300241E+01
6	MLXS	Y-ANGLE	270 OF 270	.84003160E+00	.96391045E-02	.13175267E-01	.11483031E+01
7	MLMC	RANGE	244 OF 244	.76374241E+00	.23046634E+02	.33461146E+02	.11079261E+01
7	MLMC	AZIMUTH	262 OF 262	-.18921326E+01	-.21682242E-01	.23336643E-01	.20365063E+01
7	MLMC	ELEVATION	261 OF 261	-.36187908E+00	-.50579337E-02	.18011825E-01	.12691733E+01
8	MLAC	RANGE	256 OF 256	.13103326E+00	.40130919E+01	.34565611E+02	.11441031E+01
8	MLAC	AZIMUTH	263 OF 263	.53653128E+00	.61481956E-02	.18448049E-01	.16098960E+01
8	MLAC	ELEVATION	270 OF 270	.42284459E+00	.57841614E-02	.20663998E-01	.17808799E+01
9	CNMC	RANGE	260 OF 260	-.21614441E+00	-.64516974E+01	.33348017E+02	.11003613E+01
9	CNMC	AZIMUTH	274 OF 274	-.15438122E+00	-.17690785E-02	.31879245E-01	.27819889E+01
9	CNMC	ELEVATION	278 OF 278	.17944159E+01	.23182389E-01	.19166885E-01	.15982667E+01
10	CNVC	RANGE	258 OF 258	-.30237579E+00	-.90959333E+01	.20712414E+02	.68587073E+00
10	CNVC	AZIMUTH	272 OF 272	.34547802E+00	.39588865E-02	.20095666E-01	.17536777E+01
10	CNVC	ELEVATION	275 OF 275	-.23486422E+00	-.30607303E-02	.17497886E-01	.14449298E+01
17	PSBV	DOPPLER	33 OF 33	.25005802E+01	.75017407E+00	.13975876E+00	.46586254E+00
18	PSBN	DOPPLER	33 OF 33	-.11373473E+01	-.34120418E+00	.69194013E-01	.23064671E+00
19	PSBE	DOPPLER	33 OF 33	.96895080E+00	.29068524E+00	.82720056E-01	.27573352E+00

TOTAL WEIGHTED FIT STATISTICS--- NOBS = 4368 WGT. MEAN = .19866866E+00 WGT. STD. DEV. = .17811440E+01

Table III. STS-17 residual summary.

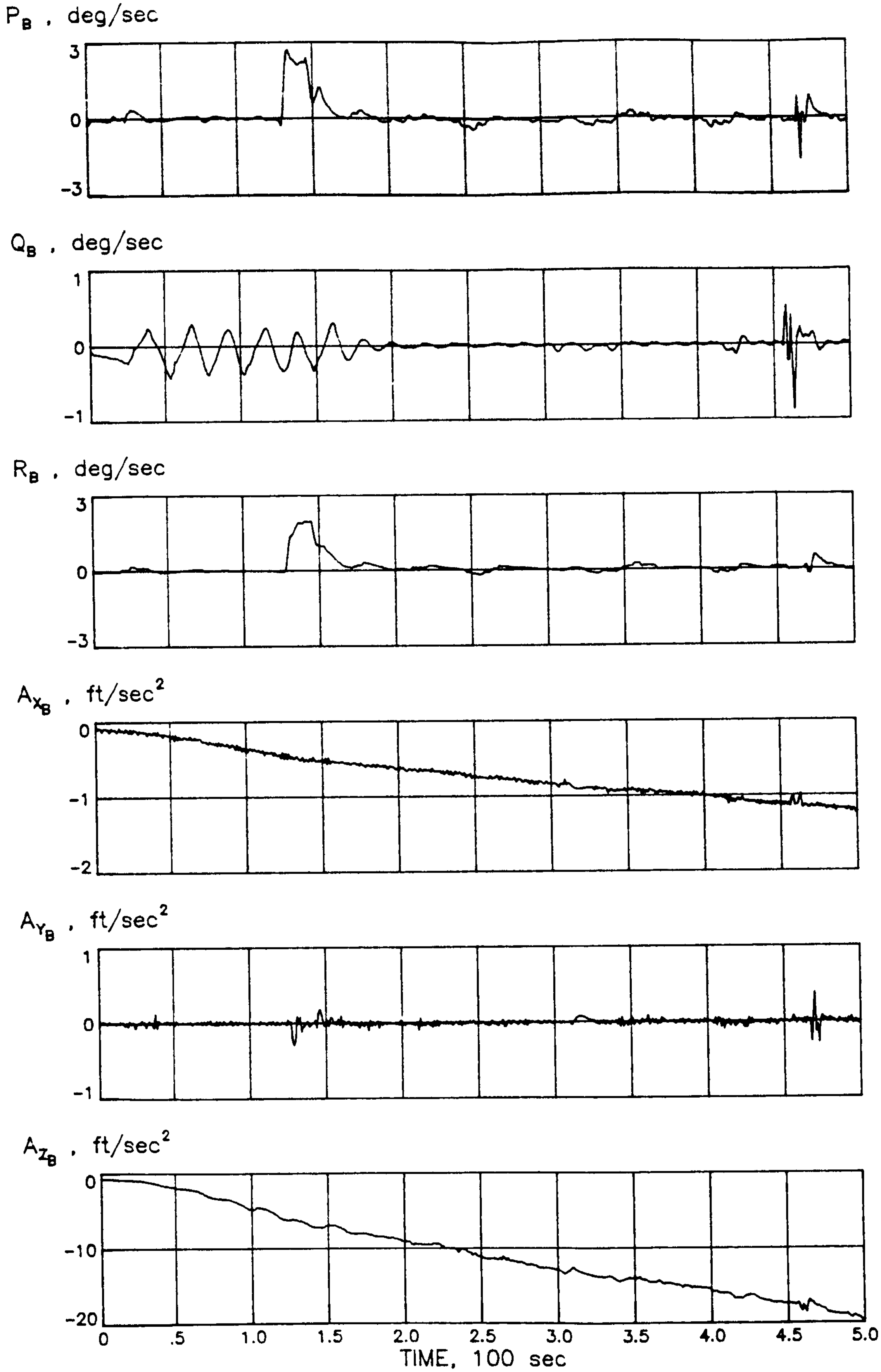


Figure I-1. STS-17 Dynamic data, IMU 2

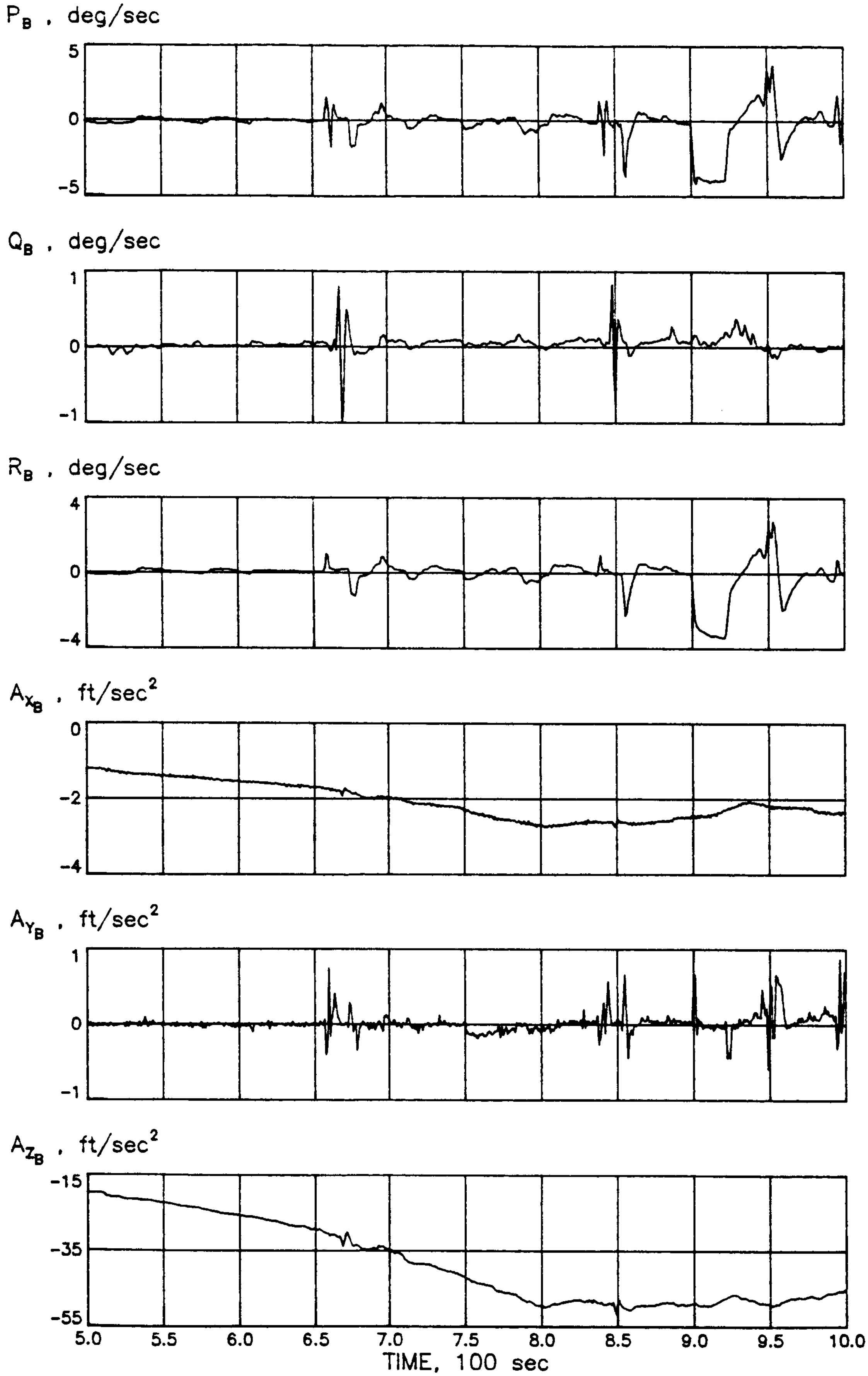


Figure I-1. (continued)

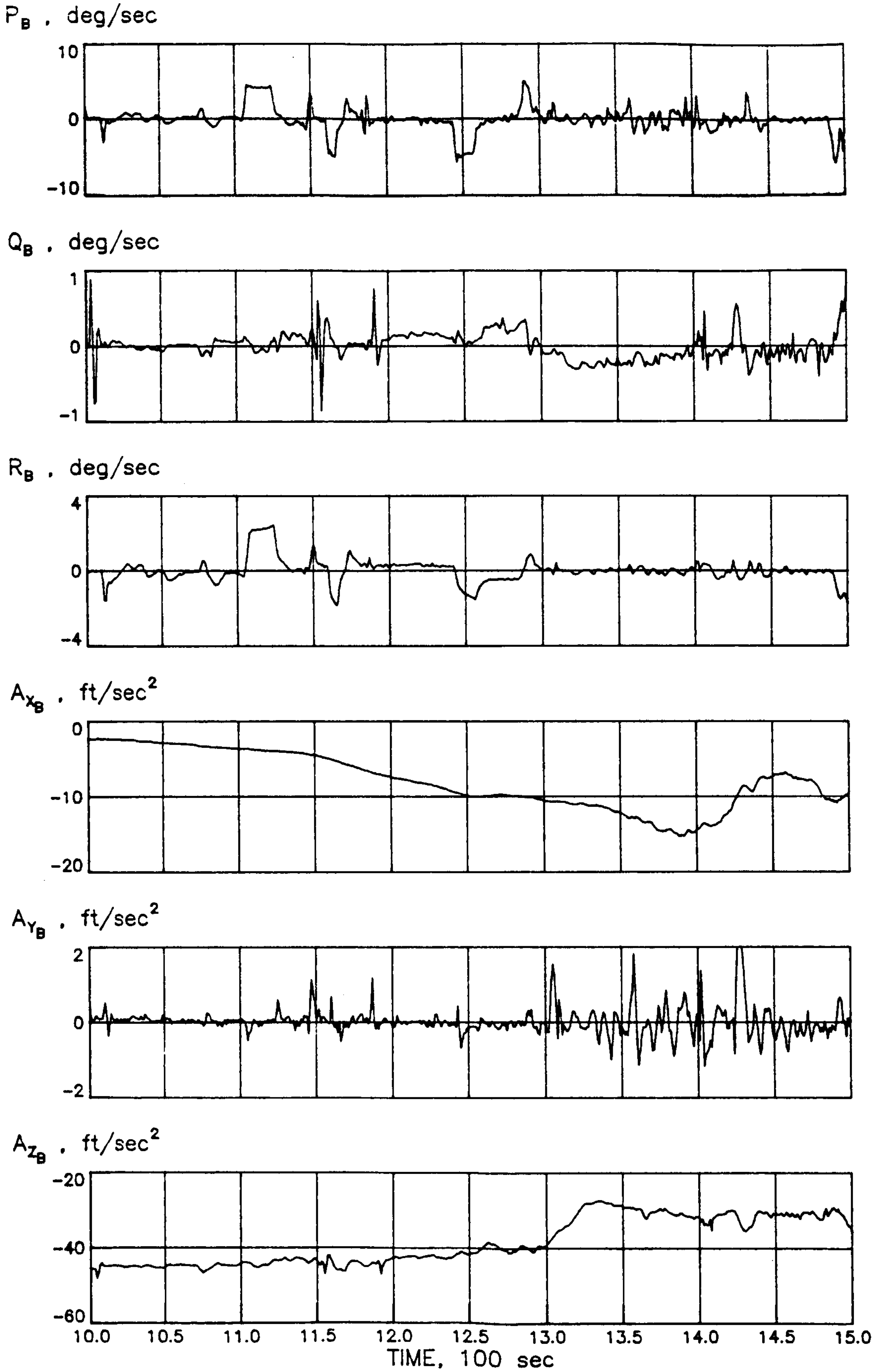
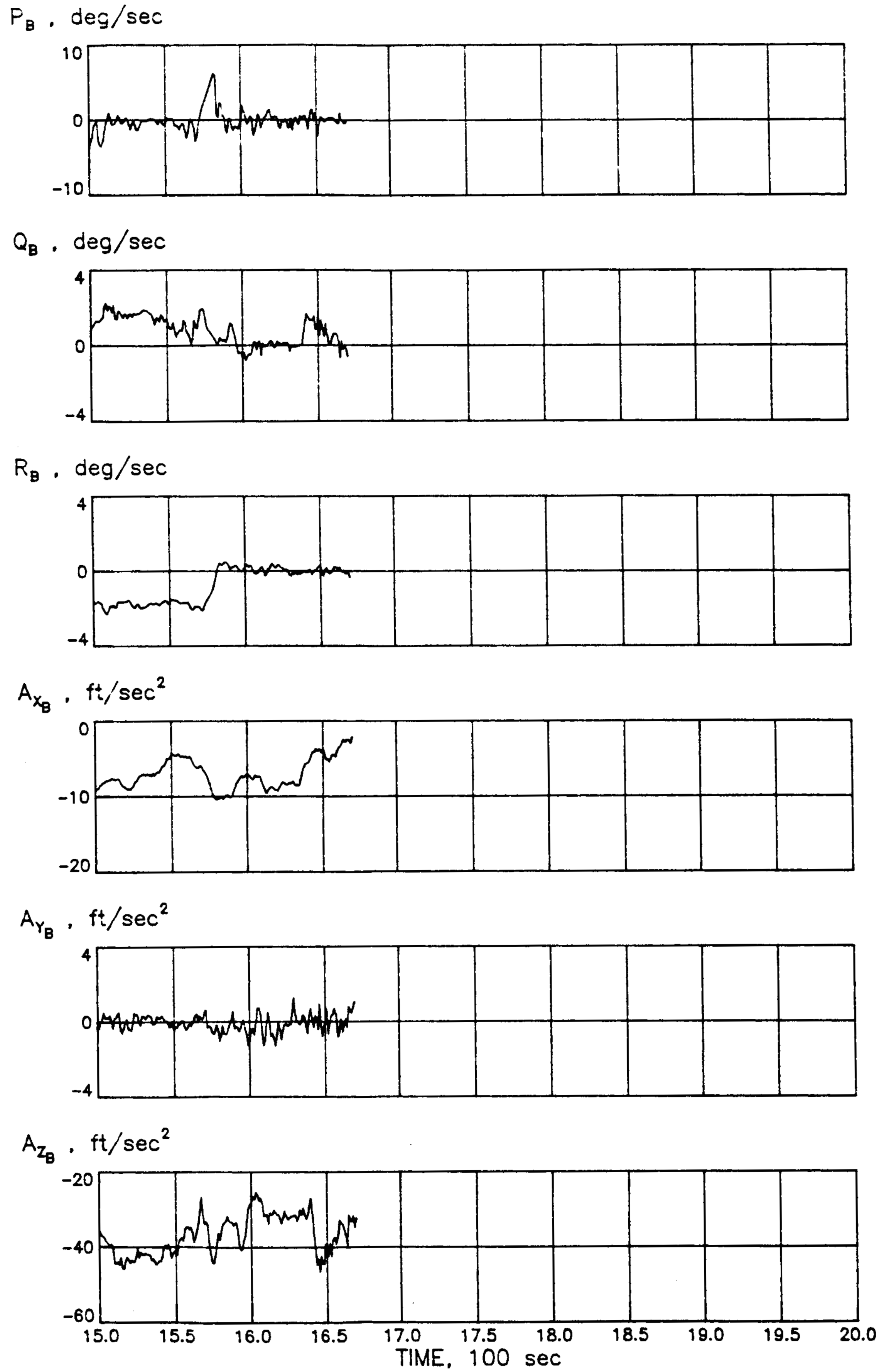


Figure I-1. (continued)



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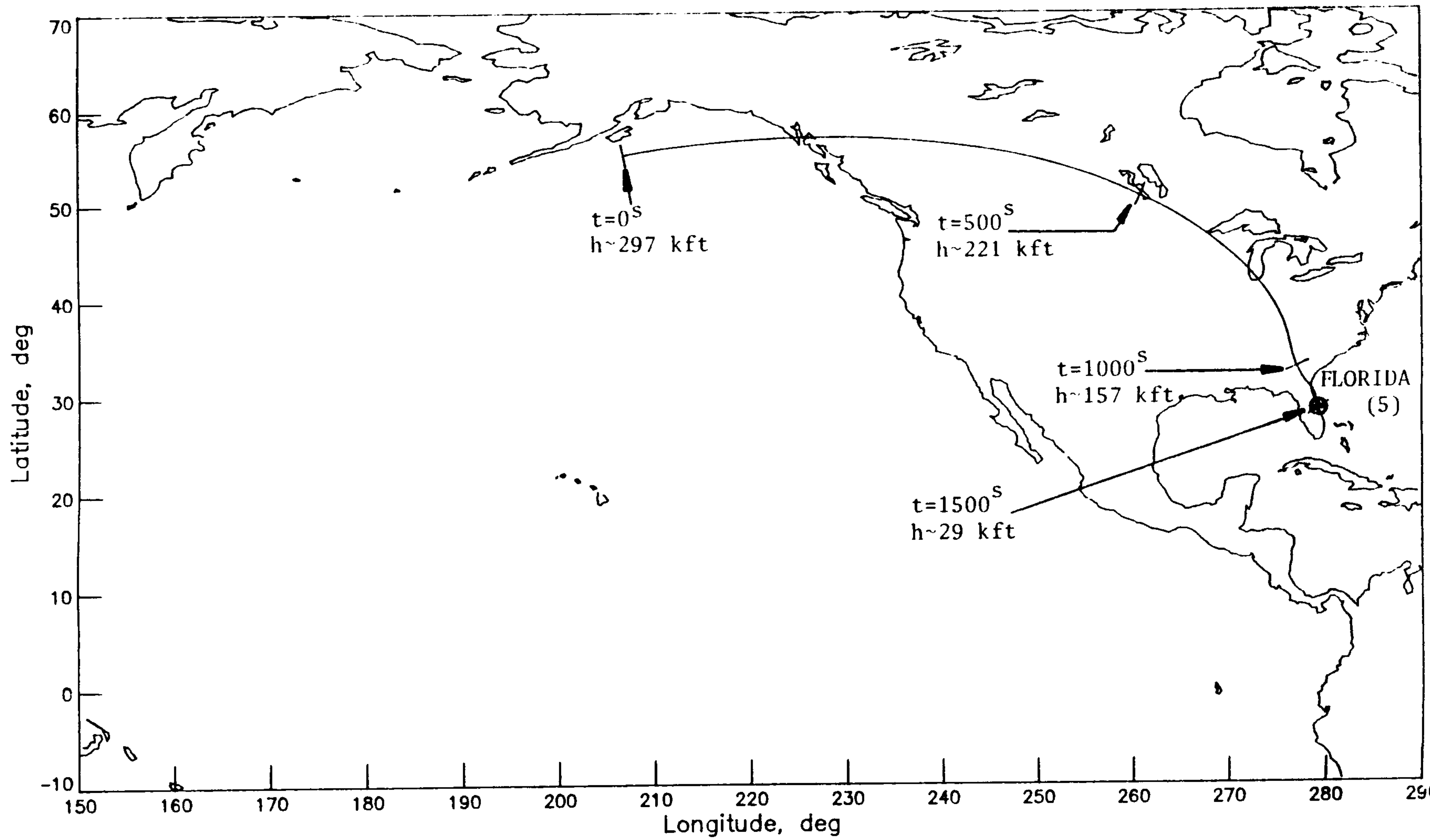
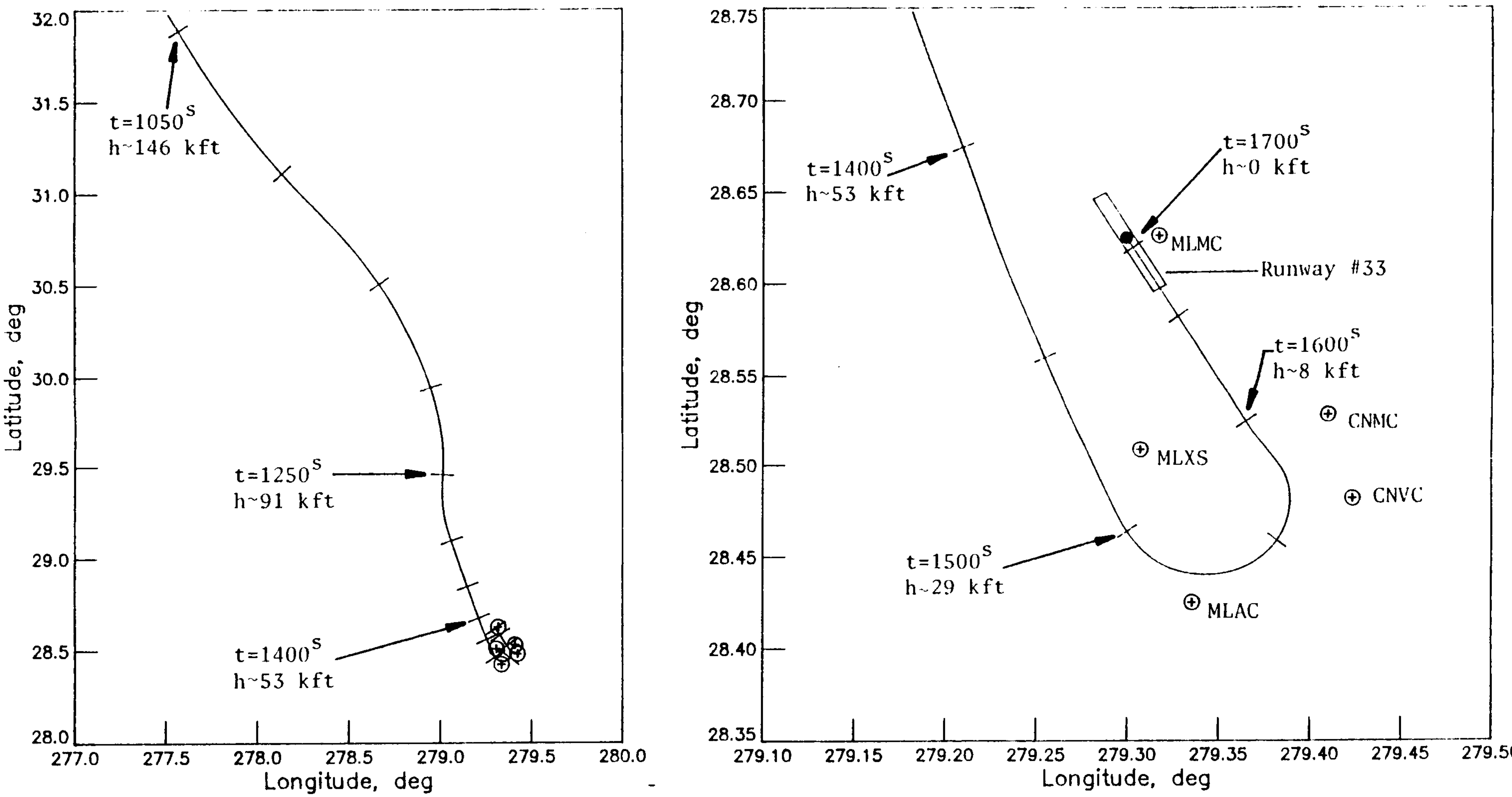


Figure I-2. STS-17 ground track from epoch to touchdown.



(a) Florida acquisition to landing

(b) Final approach and landing

Figure I-3. Detailed tracking coverage for STS-17.

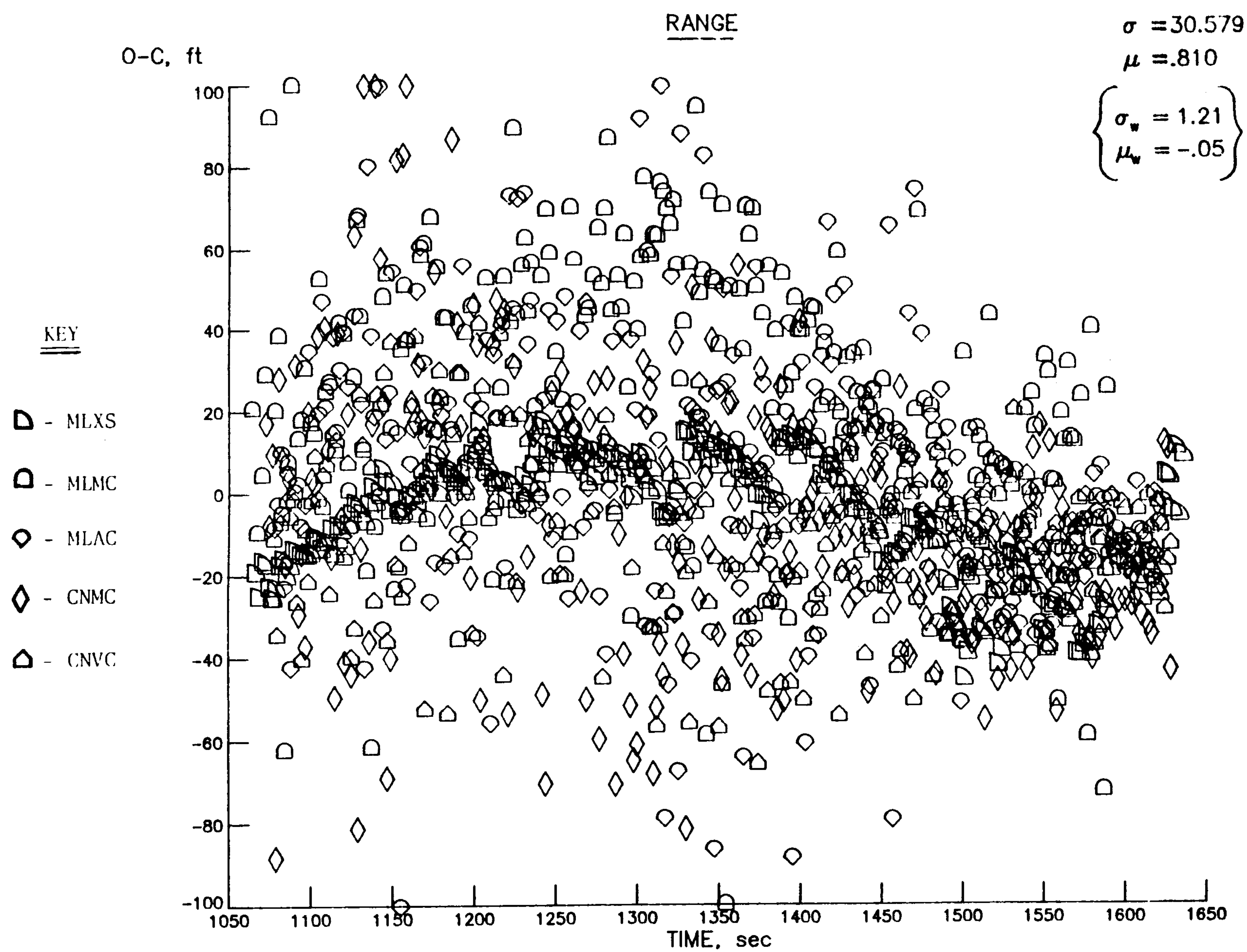


Figure I-4. Composite range residuals for STS-17.

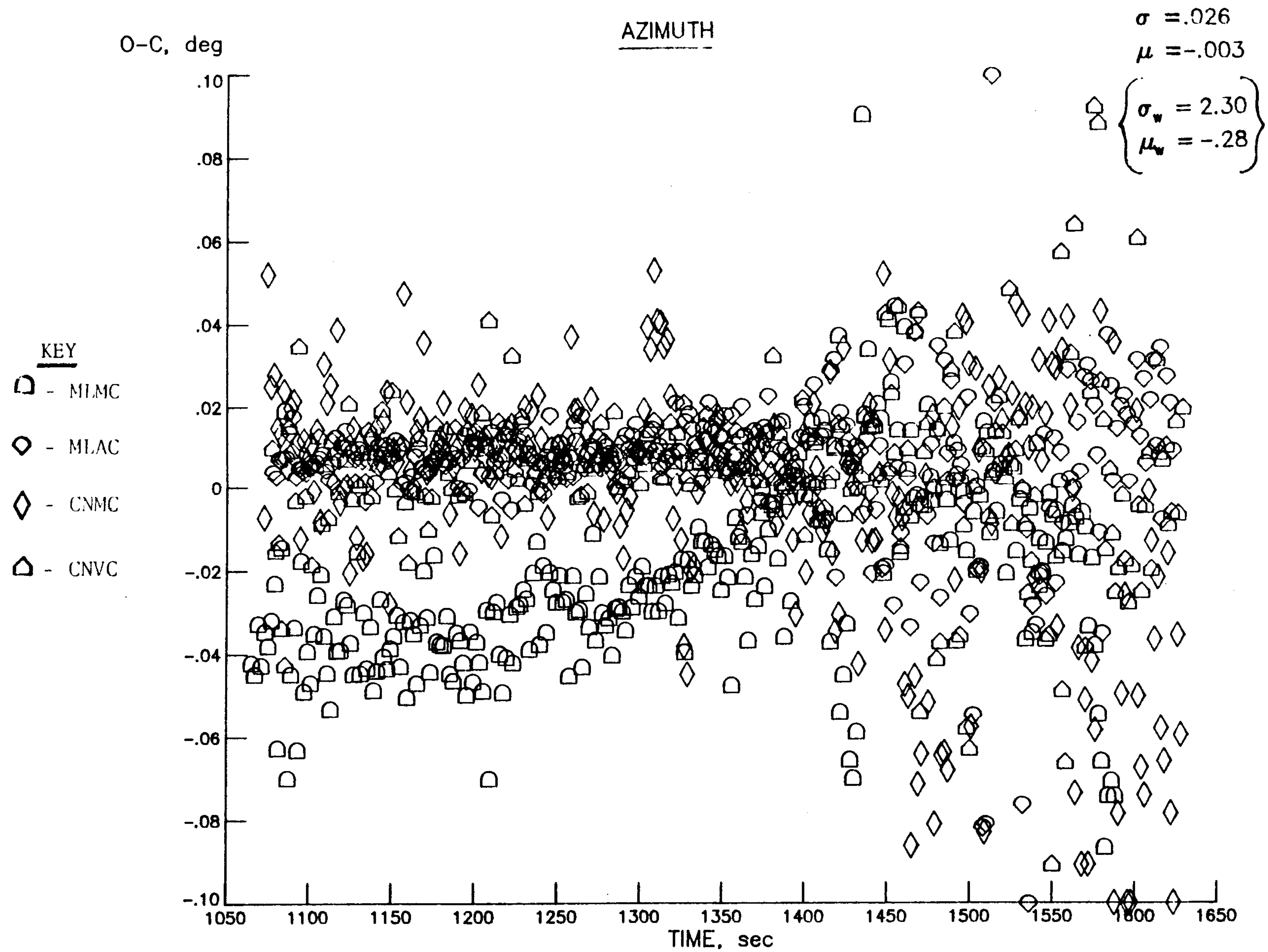


Figure I-5. Composite azimuth residuals for STS-17.

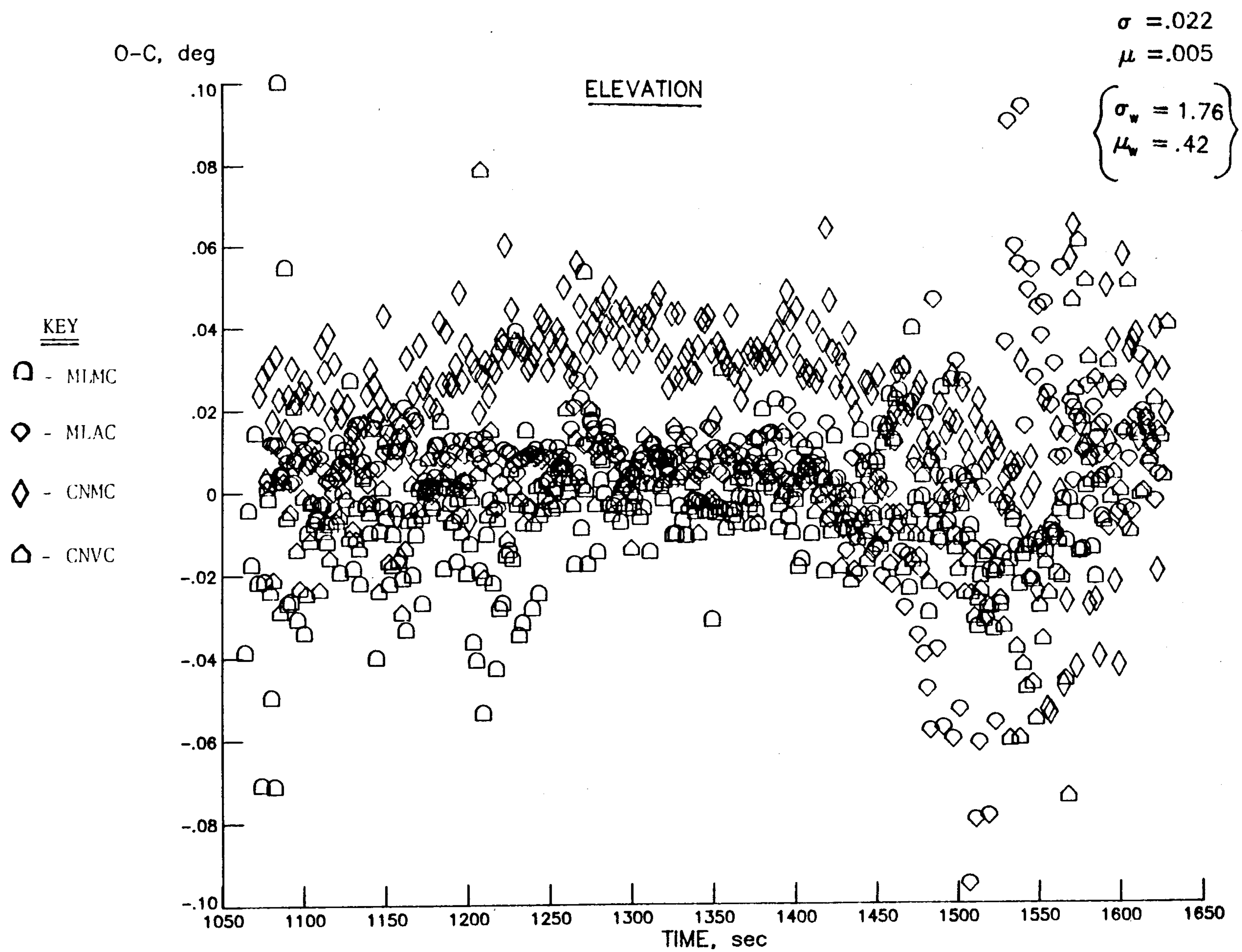


Figure I-6. Composite elevation residuals for STS-17.

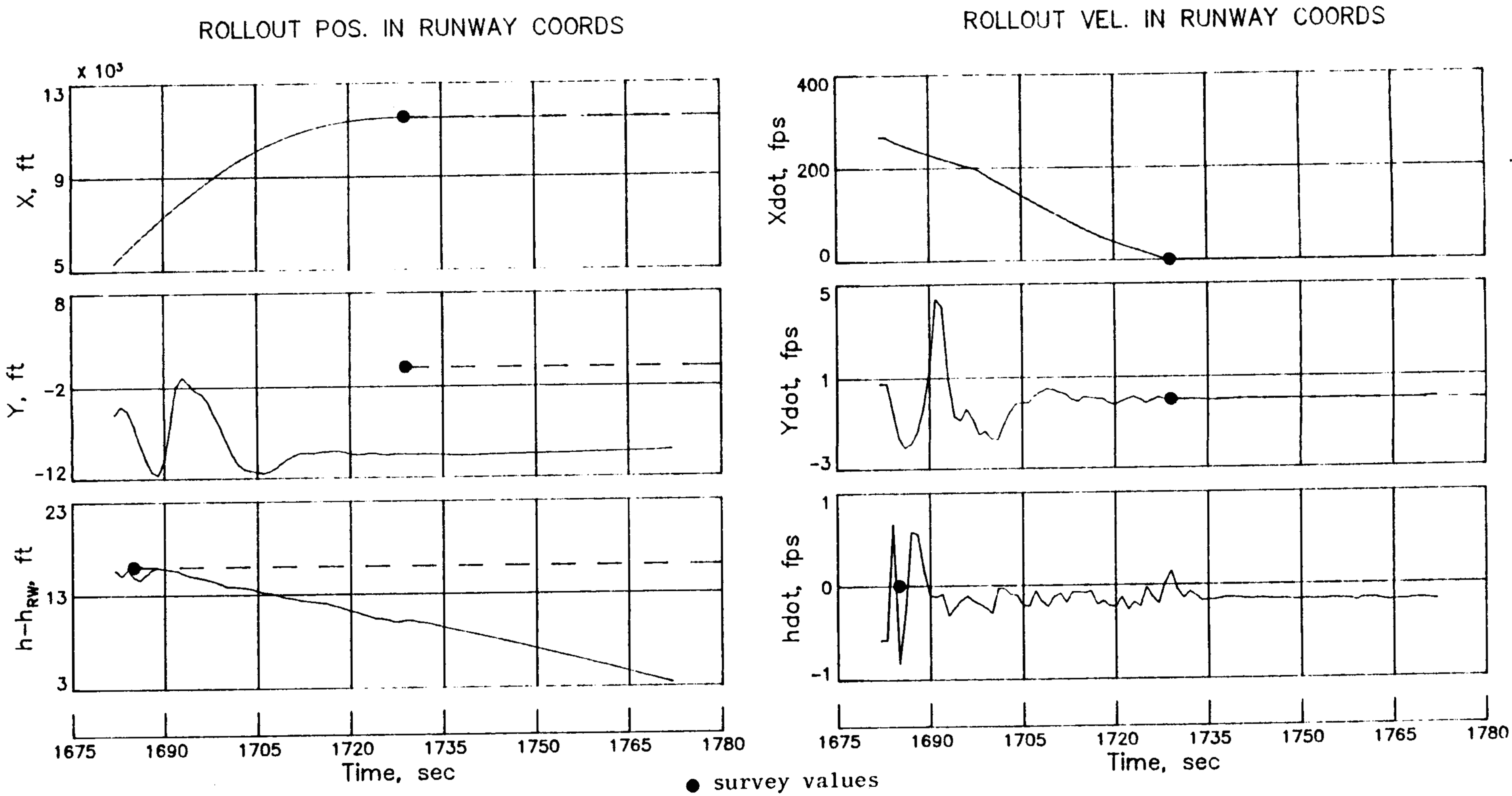


Figure I-7. Rollout position and velocity plots for STS-17.

II. Extended BET Development

Selection of the best atmospheric source to merge with the inertial BET for STS-17, in view of the fact that the entry profile from this high inclination mission (~57°) yields a ground track far removed from the usual meteorological sites, creates a two-fold problem, namely, the necessary latitudinal translation/extrapolation of both measurements and/or models to the Shuttle profile. As was the case for STS-9, the other high inclination entry flight flown to date, the selection process involves consideration of all the available data, giving more credence to whichever source(s) tends to substantiate previous flight experience. Here one must evoke historical (based on twelve flights) flight/data base prediction differences as a test of reasonableness.

The atmospheric sources considered (and plot symbols utilized) are:

	LAIRS (ST17MET)	○ ,
	NOAA "totem-poles" extracted from the JSC/TRW BET	● ,
	MSFC Global Reference Atmosphere Model (GRAM)	△ ,
and	the Air Force Reference Model (AF78)	□ .

Also, included are the Shuttle derived atmospheric parameters based on the measured normal accelerations (from the IMU) and the predicted normal force coefficient (C_{N_p}). The complete atmosphere is obtained from integration of the hydrostatic equation for pressure and utilizes the perfect gas law for temperature.

Density comparisons are presented as Figure II-1. Above 150 kft, all five sources are shown for comparison purposes. The continuation plot below 150 kft only reflects the two remote sources but shows, to within the expected accuracy, that either is viable. In the uppermost altitude region, the LAIRS density profile tends to support the Shuttle derived results, at least below 250 kft. The other sources seem to be better reflections of the overall structure at higher altitudes yet would suggest larger data base prediction errors below h~250 kft, by as much as 20 to 30 percent in some regions. It is noted that the Shuttle derived density for this flight reflects the (reasonably) smooth atmosphere encountered. Absent is the significant shear structure which has generally been evident in the altitude interval, 230 kft$<h<$250 kft. Also, no particularly sharp structure occurs above this layer. Quite evident also is the considerable similarity in the overall structure between this October flight and that derived from the December (1983) STS-9 flight, apart, of course, from the two suggested shears in the latter results. Though two flights do not comprise a statistically significant data base, the similarities obtained so noted, one would hope that available models would more closely reflect the 50 to 60 percent (of Standard) baseline density at altitude for these latitudes. The similarities are perhaps more remarkable considering that throughout the uppermost altitude region STS-17 was over the North American Continent and the STS-9 ground track was over the Pacific.

Temperature and pressure comparisons are presented as Figure II-2 and II-3 respectively to complete the ambient parameters. On the temperature plot the LAIRS data seem to be the outlier, actually above 120 kft, but, more importantly, between 150 kft and 230 kft. However, as seen thereon, LAIRS data are substantiated by the Shuttle derived results. This is also true on the pressure comparison plot for the spread of Shuttle derived values thereon. Thus, selection of the LAIRS (ST17MET/UN-712662N) is indicated. However, the temperature discrepancies above $h\sim220$ kft sets an upper altitude threshold for which meaningful aerodynamic extraction can be expected for this flight. Use of this threshold negates comparisons above Mach$\sim$25 but provides a reasonable alternative below. This is discussed further in Section III of this report. As an alternative, one could have selected the AF'78 Model, as was the case for STS-9, which would have provided smoother aerodynamic comparisons though, as suggested previously, shifted somewhat from that expected.

Atmospheric wind comparisons are shown in Figure II-4 for the North-South component and Figure II-5 for the East-West component. In the upper altitude plots only three sources are shown, namely, NOAA, LAIRS, and the GRAM spherical harmonic model values. Below 150 kft, only the two remote sources are presented. Clearly, the NOAA winds, at least above 200 kft, approach unrealistically large levels. Below this altitude they are, and remain thereafter, virtually zero, never exceeding 50 fps except near 30 kft during subsonic flight. However, over most of the important interval (h<100 kft) the LAIRS and NOAA winds agree quite well. Again, the use of the LAIRS winds is suggested.

Additional evaluations of the winds during subsonic flight are next presented. Here, comparisons versus in situ side probe air data can be made. The results of these comparisons are summarized in two figures herein. Both LAIRS* and NOAA measured winds (magnitude, direction, and components) are superimposed in Figure II-6 to provide direct comparisons with derived winds based on the side-probe (post-flight Rockwell results) measurements of α, β, and true air speed. Both deterministic and batch estimates are shown, the deterministic being a point by point mapping algorithm and the batch a weighted-least-squares estimate assuming a break-point altitude model. Symbols utilized are as noted in the figure. The comparisons shown are well within the expected accuracy of the process. Actual air data parameter differences between the on-board air data system (ADS) and computed values based on the LAIRS measured winds (modified as footnoted) are shown in Figure II-7. Mean differences and the computed (1σ) standard deviation in the differences are notated thereon. Again, it is unreasonable to expect to improve on such differences, thus, the LAIRS (FLAIR17) data were adopted.

The final figures in this Section merely show the selected atmospheric data (from FLAIR17/UN=274885C). The final temperature, density, pressure, and wind profiles are given as Figures II-8 through II-11, respectively. One can observe the curvature below ~7 kft evident in the temperature profile induced wherein the NOAA data were used (necessarily) to replace the LAIRS data.

*The actual LAIRS file provided by the LaRC only contained data above ~260 ft. Moreover, winds were zeroed out below ~7 kft. Thus the LAIRS file was merged with, actually replaced by, the NOAA data below ~7 kft, requiring the notation FLAIR17 on Figure II-6. Above this altitude, the adopted LAIRS winds agreed quite well with the other sources.

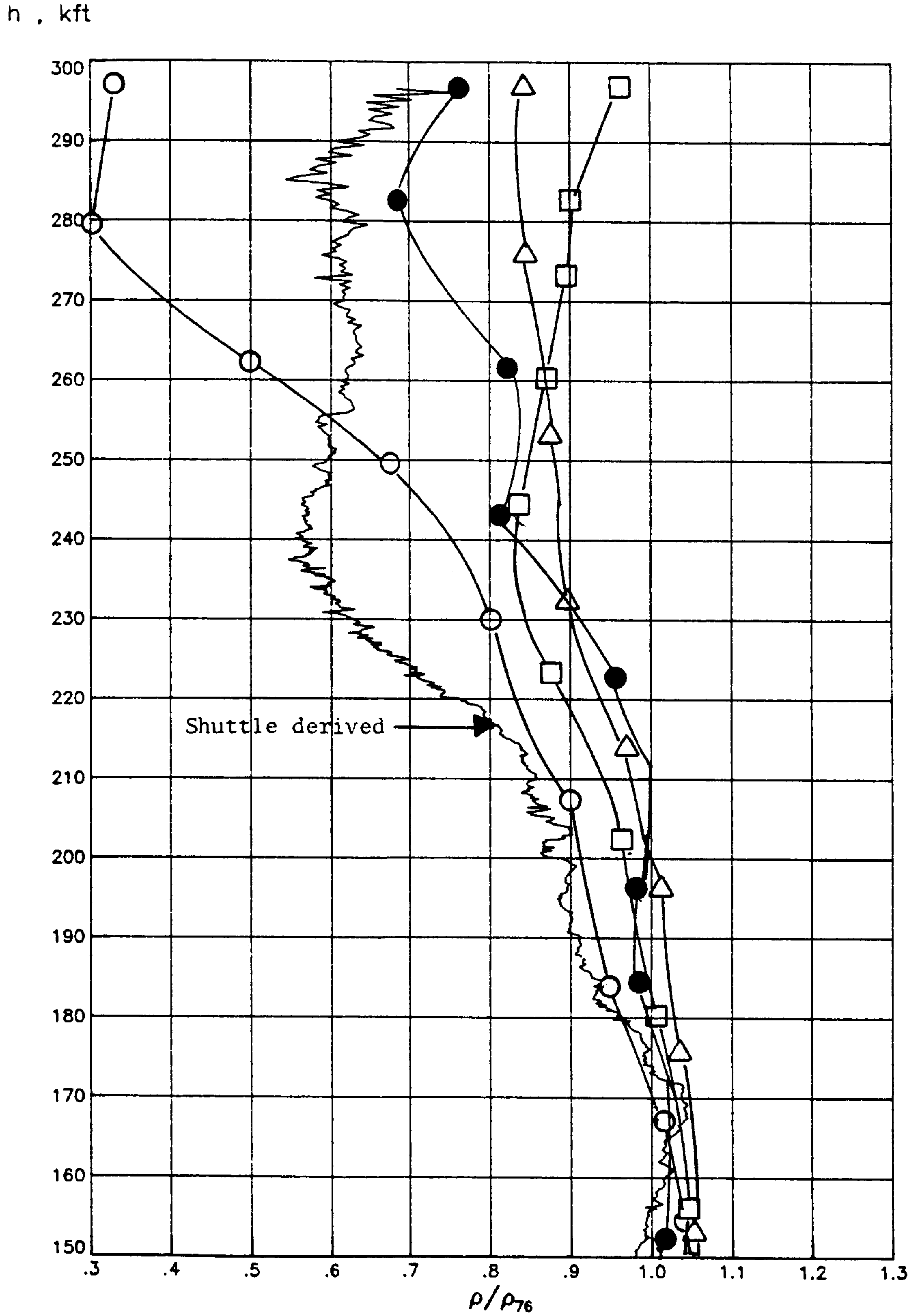


Fig. II-1. STS-17 (41-G) density comparisons.

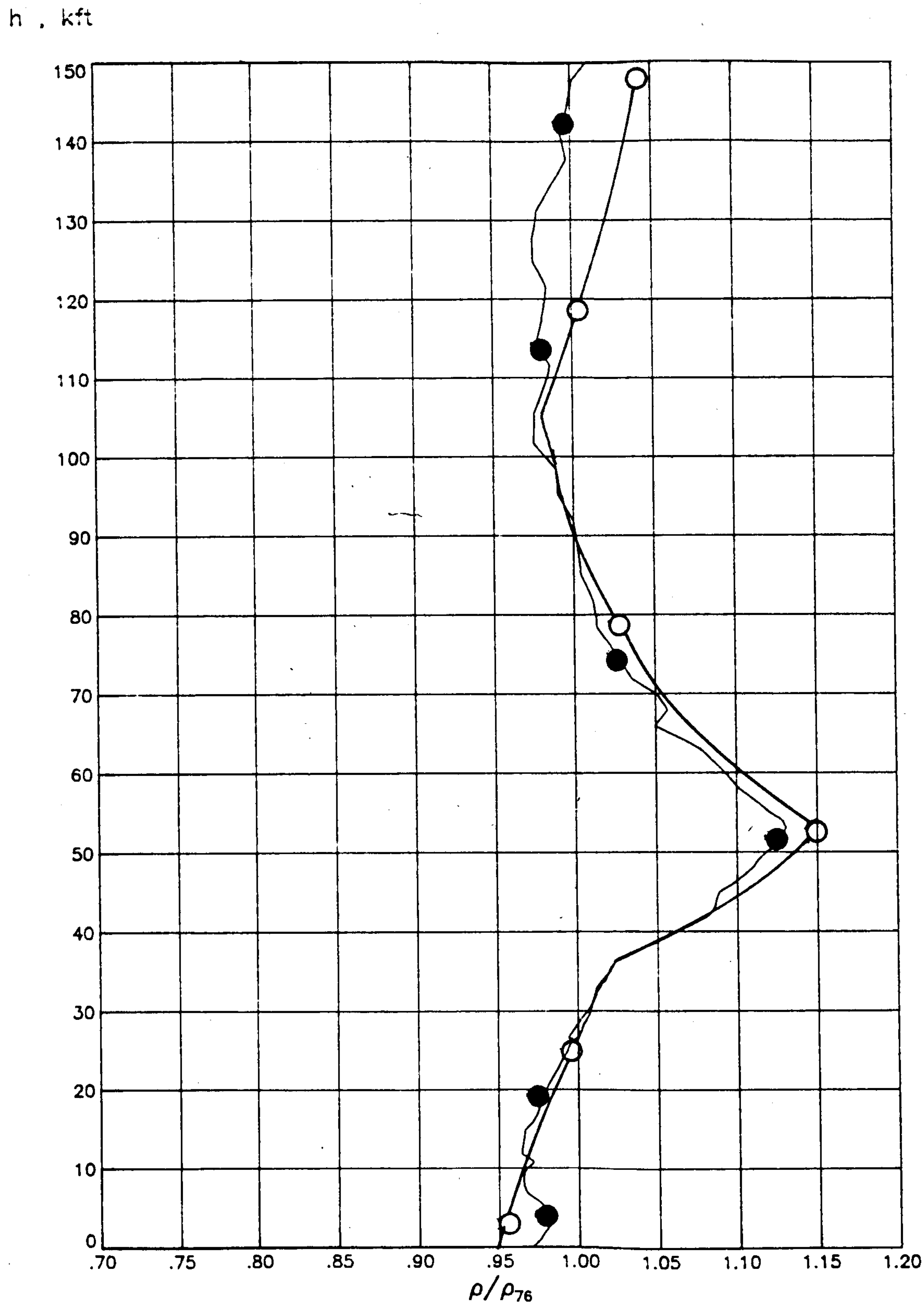


Fig. II-1. (Concluded)

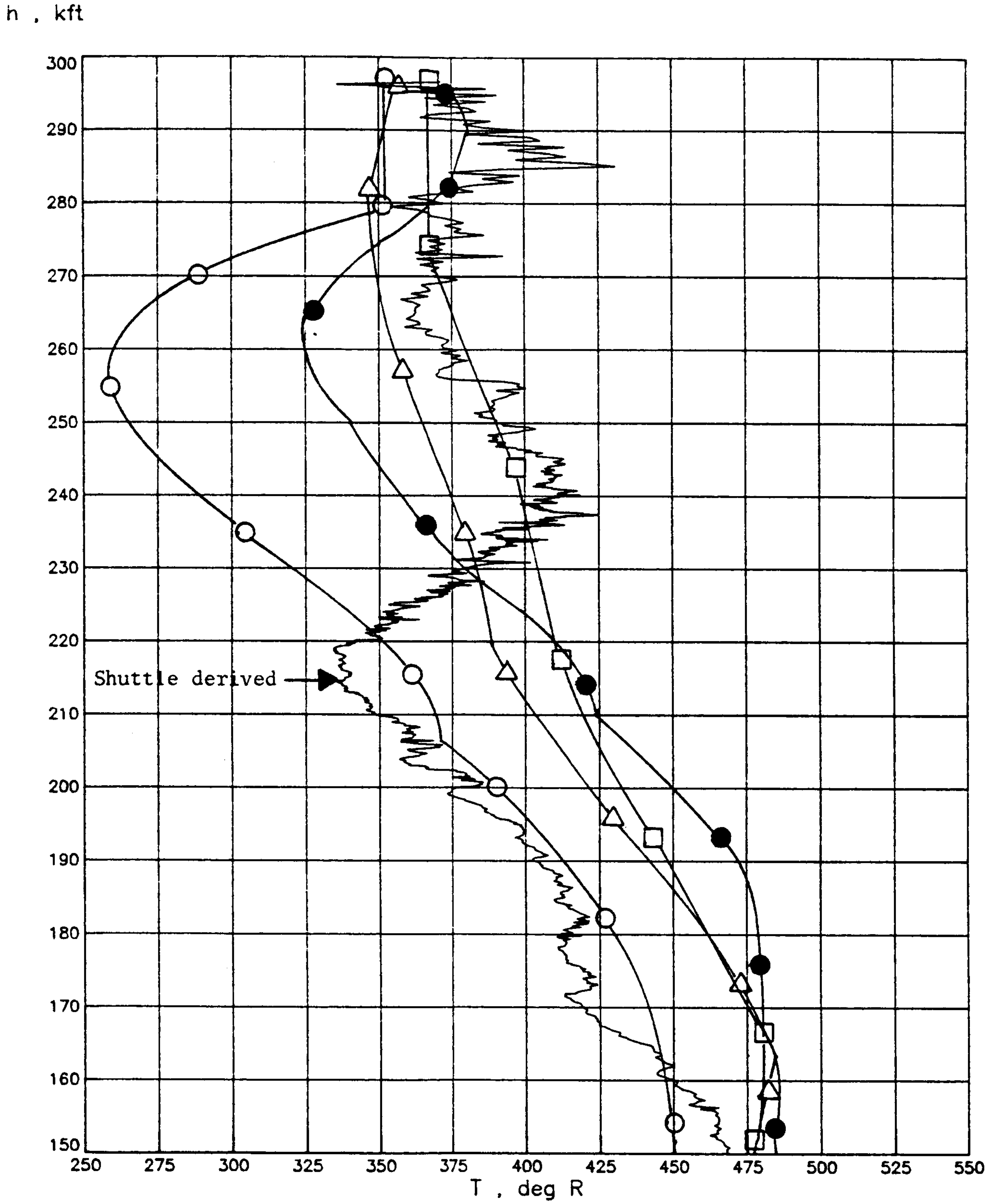


Fig. II-2. STS-17 (41-G) temperature comparisons.

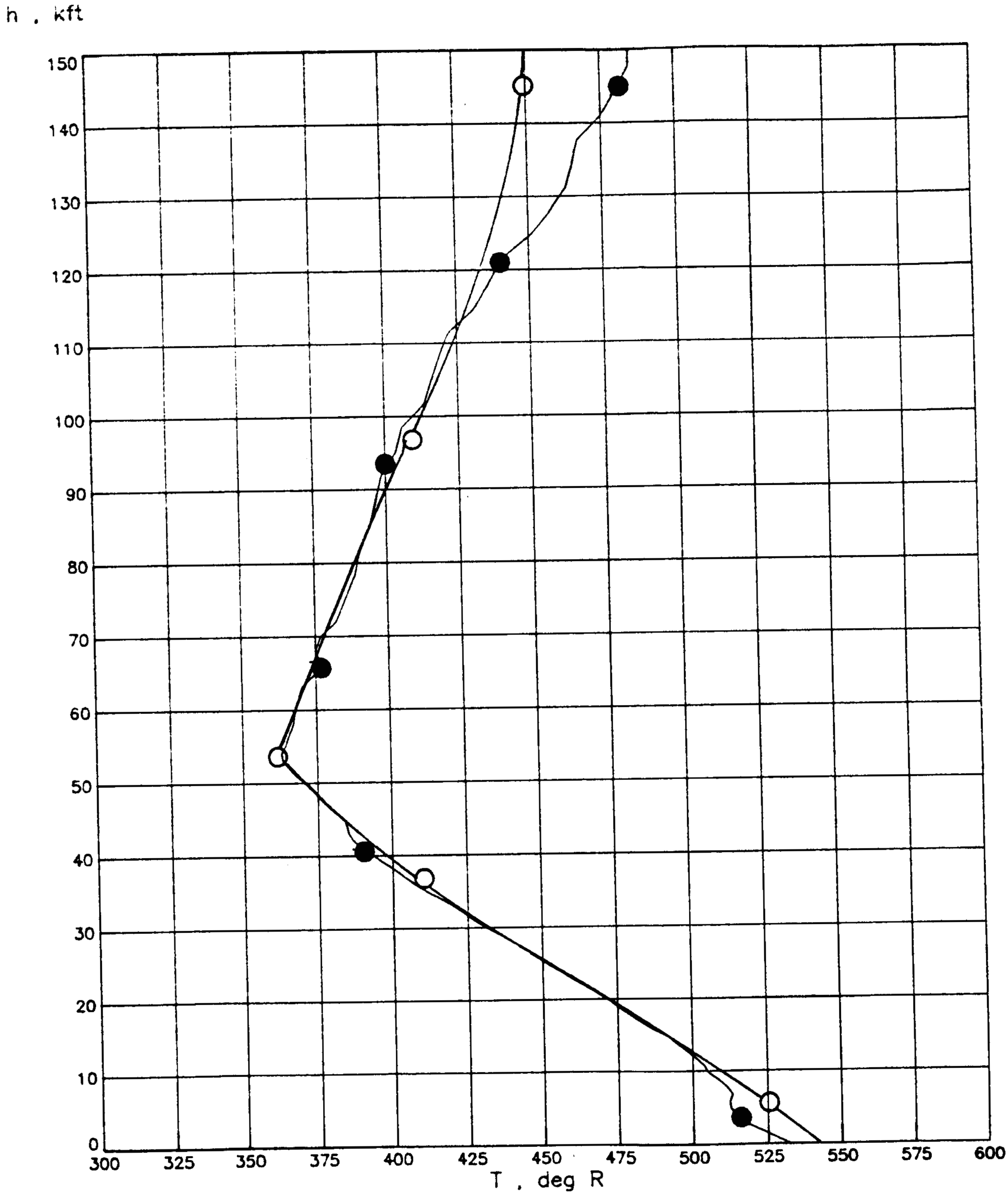


Fig. II-2. (Concluded).

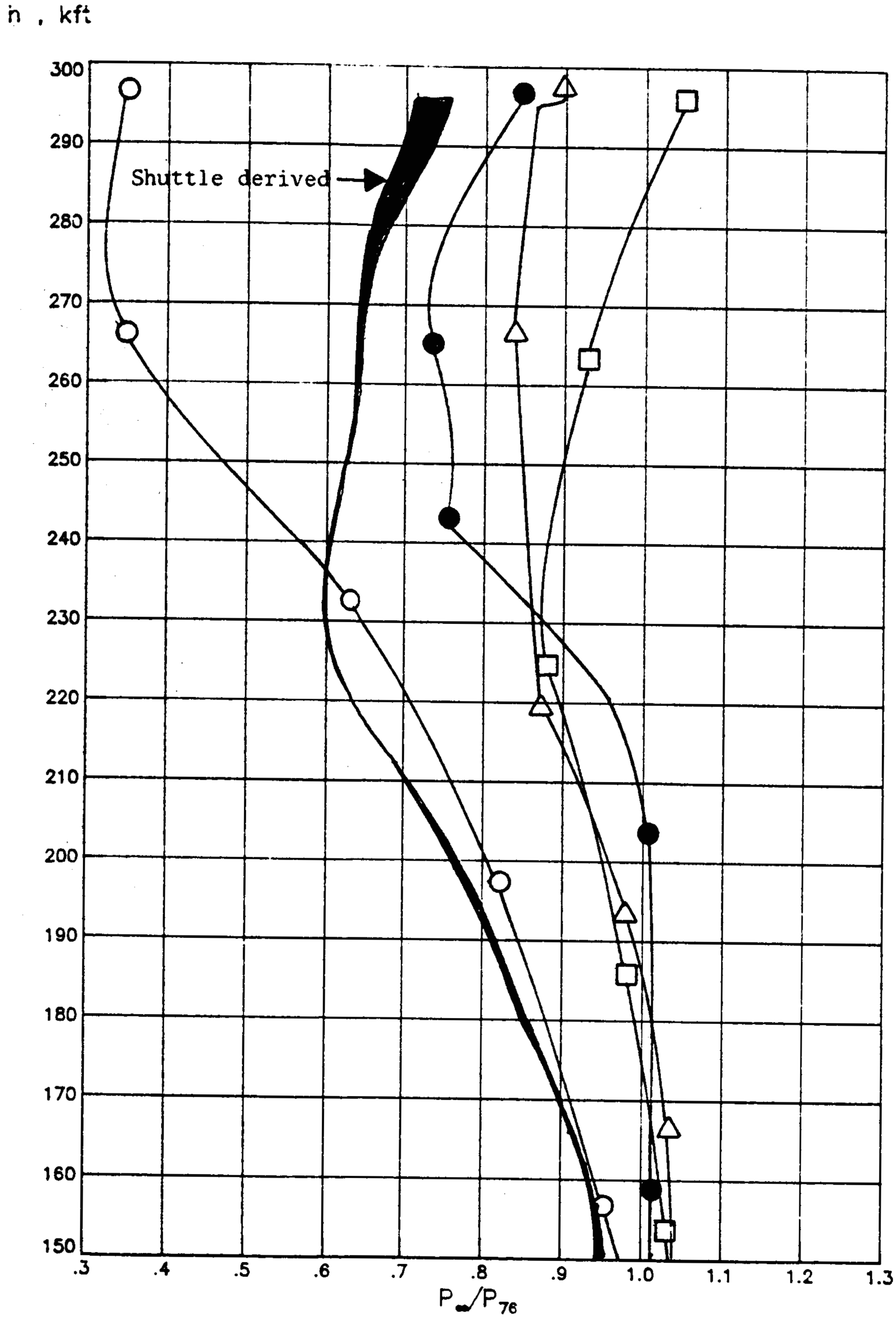


Fig. II-3. STS-17 (41-G) atmospheric pressure comparisons.

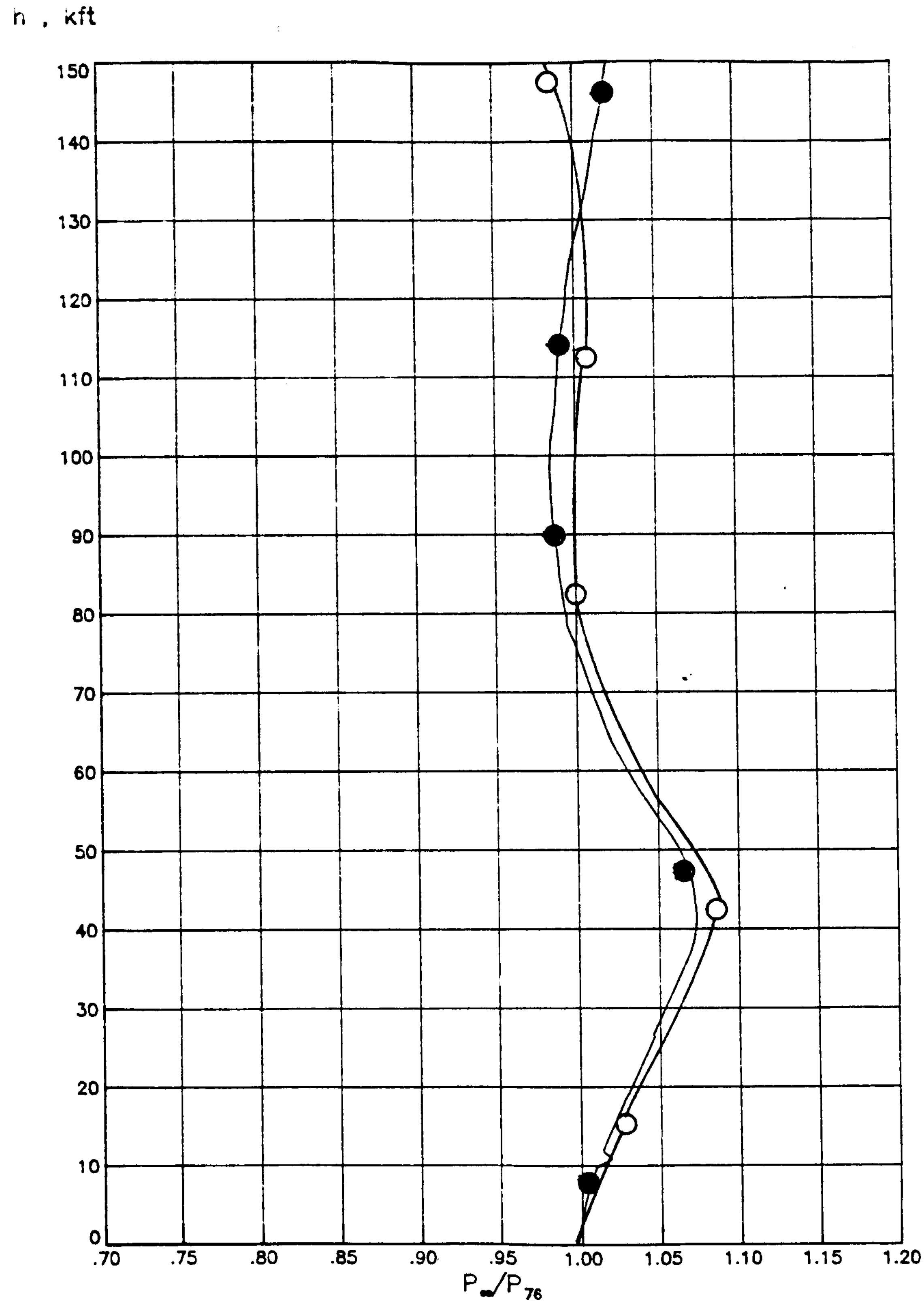


Fig. II-3. (Concluded).

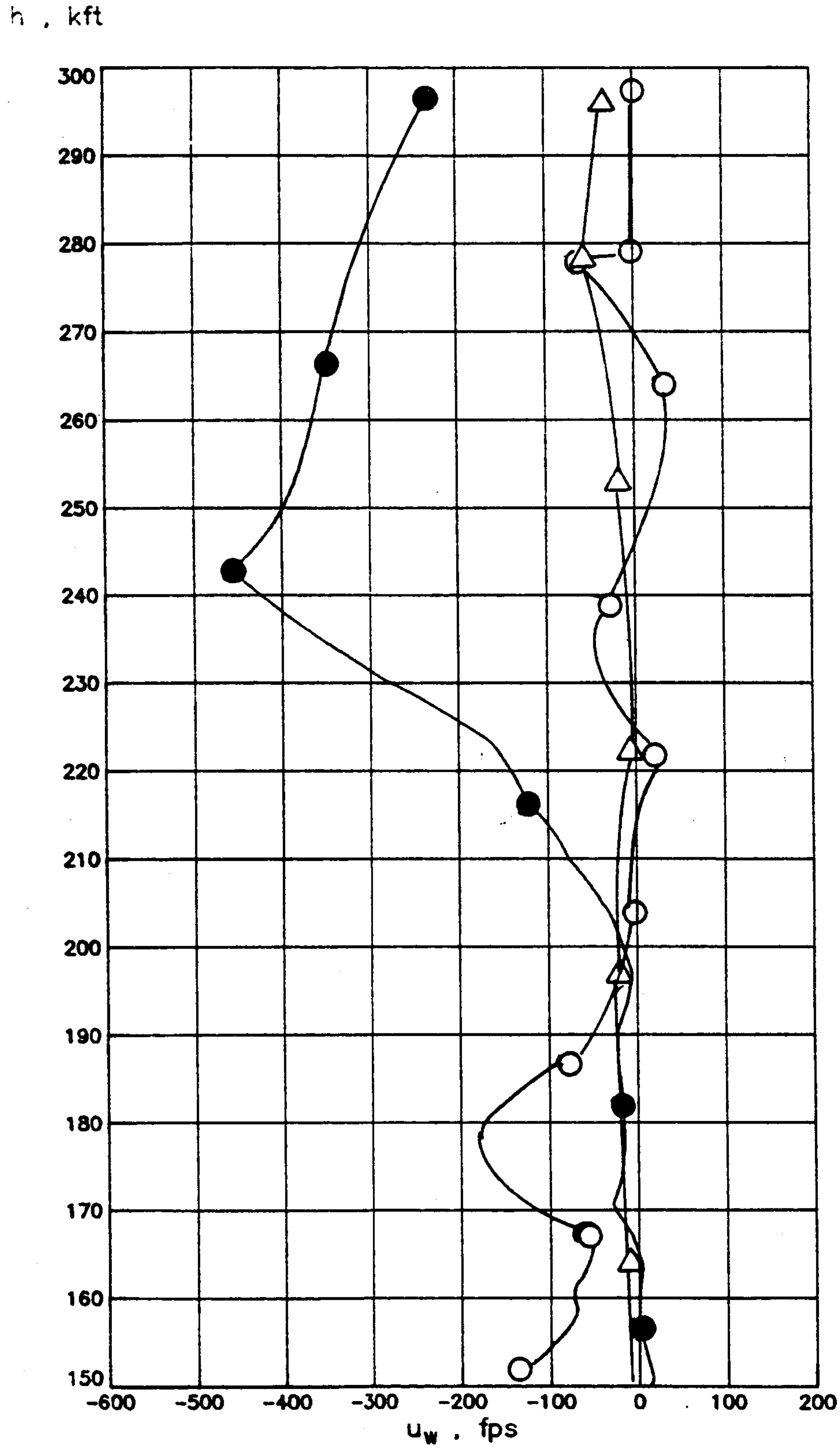


Fig. II-4. North-South wind comparisons for STS-17 (41-G).

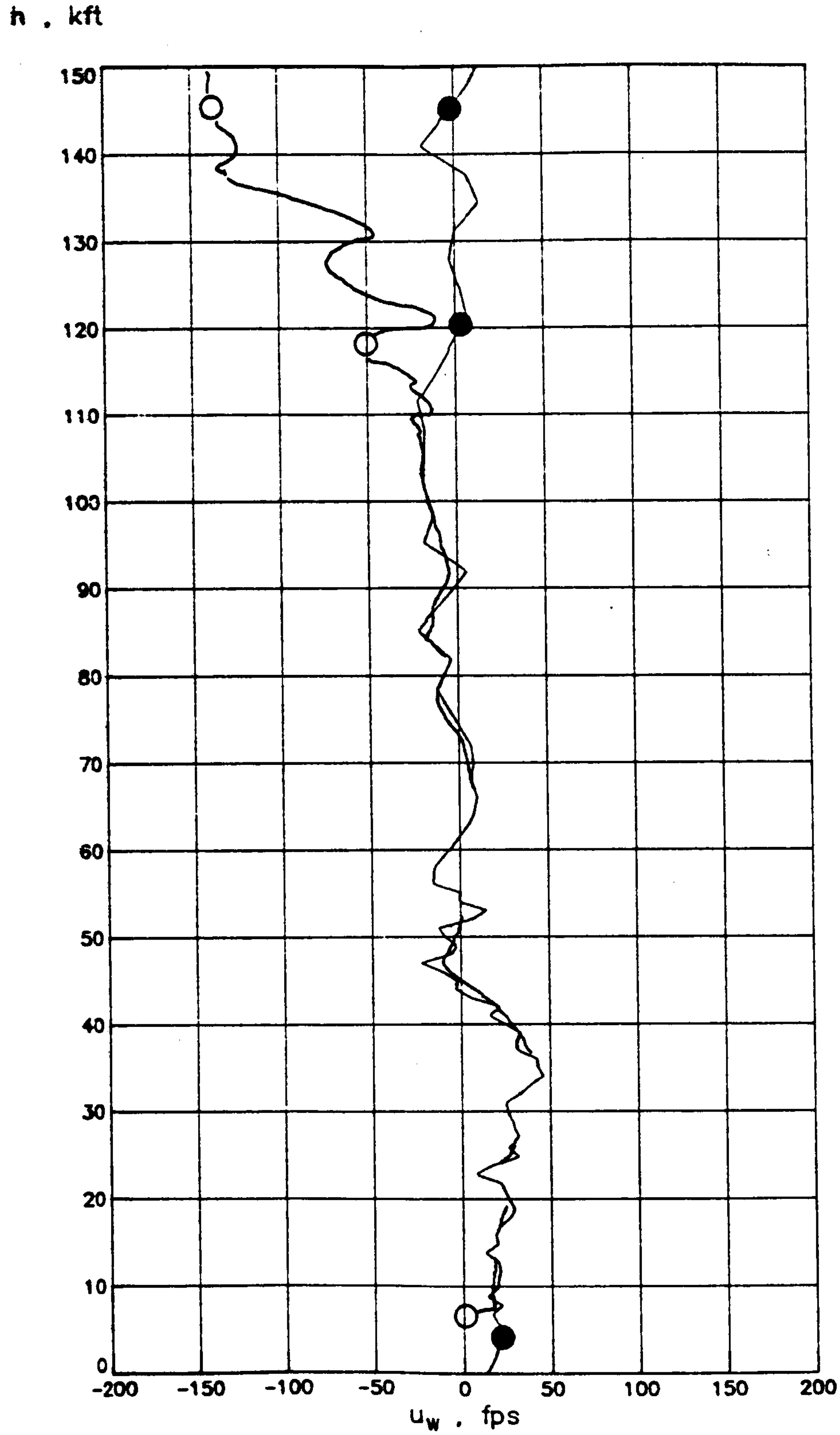


Fig. II-4. (Concluded).

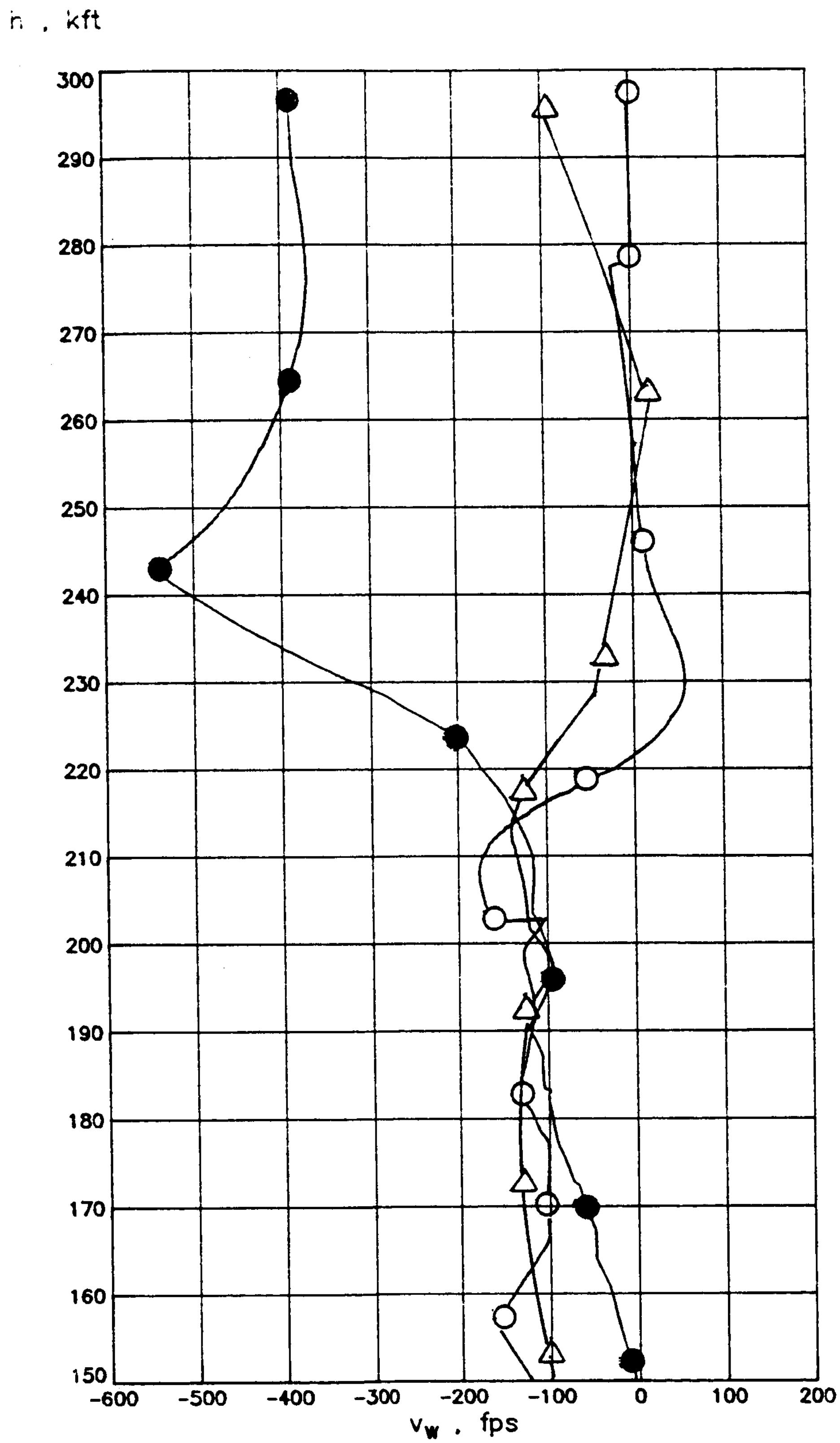


Fig. II-5. East-West wind comparisons for STS-17 (41-G).

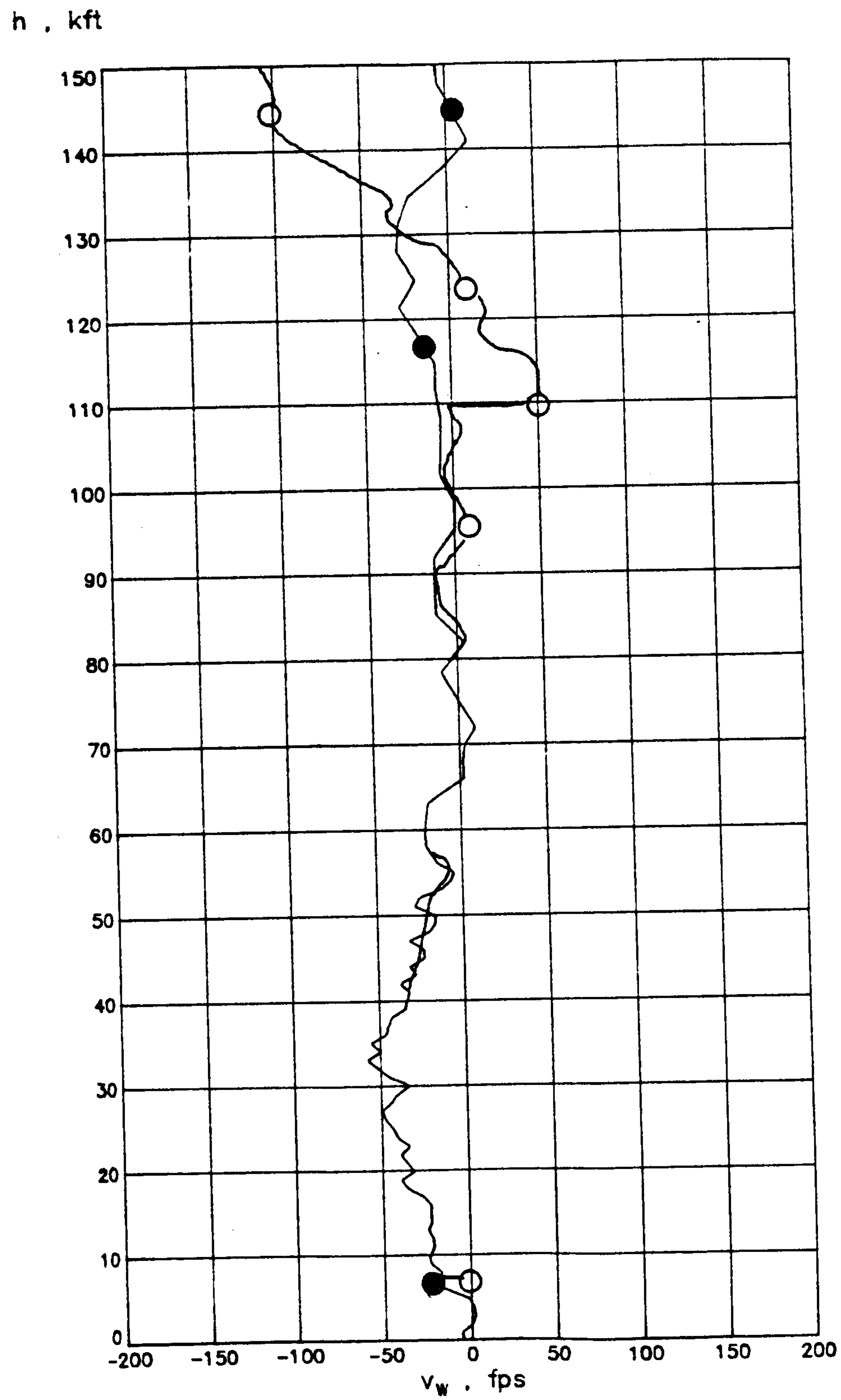


Fig. II-5. (Concluded).

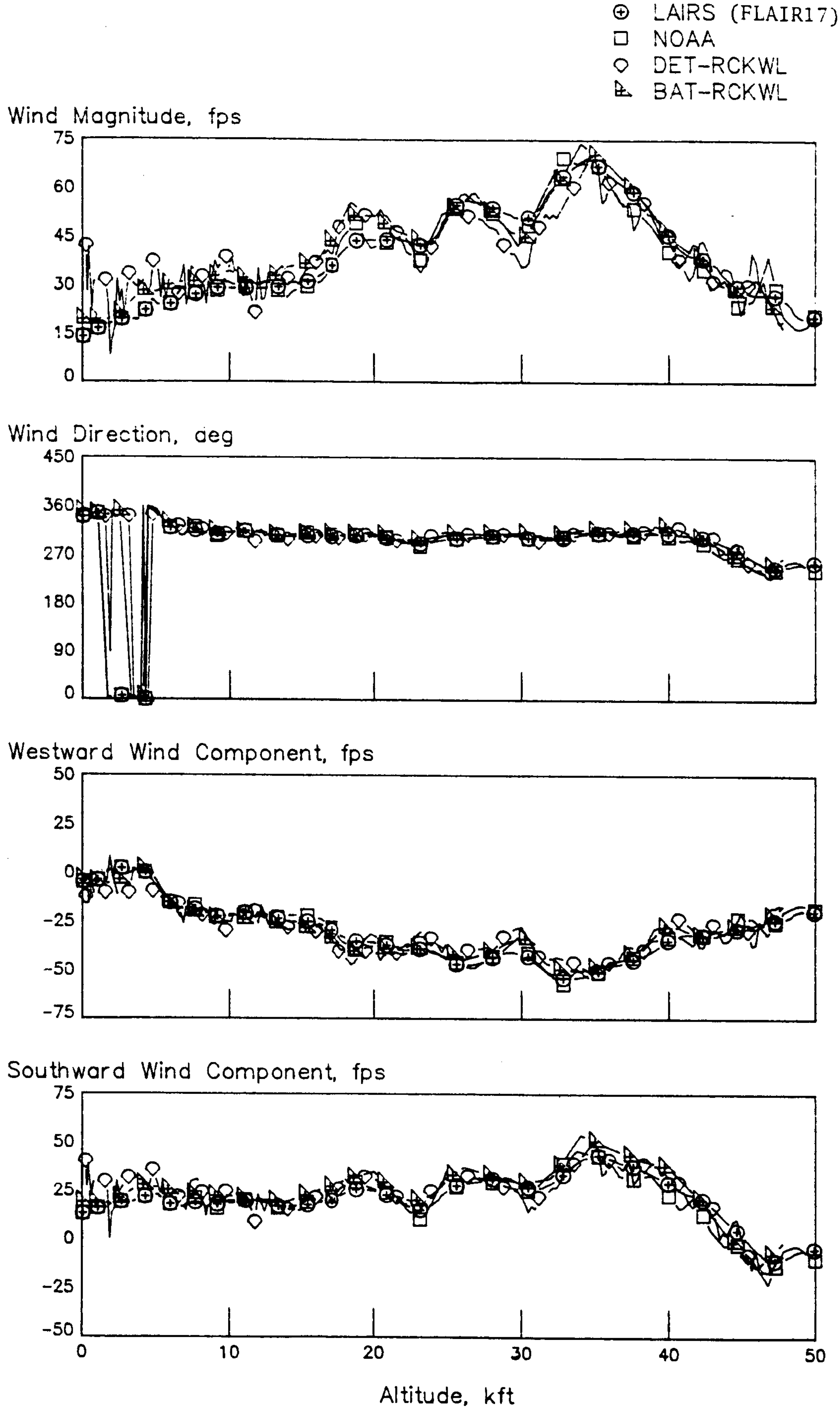


Fig. II-6. STS-17 Measured and Derived Winds

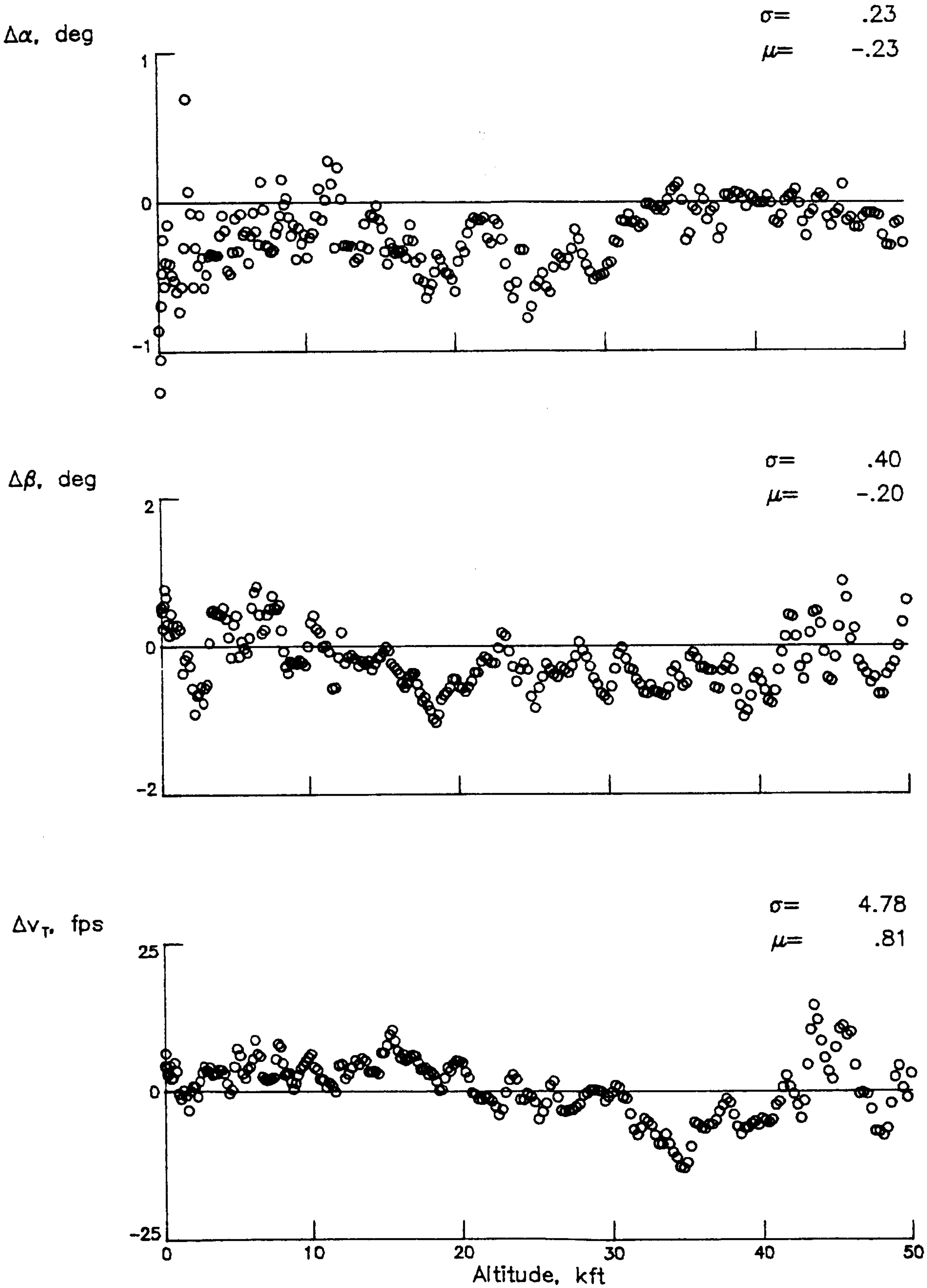


Fig. II-7. STS-17 ADP Differences, ST17ADS-ST17BET

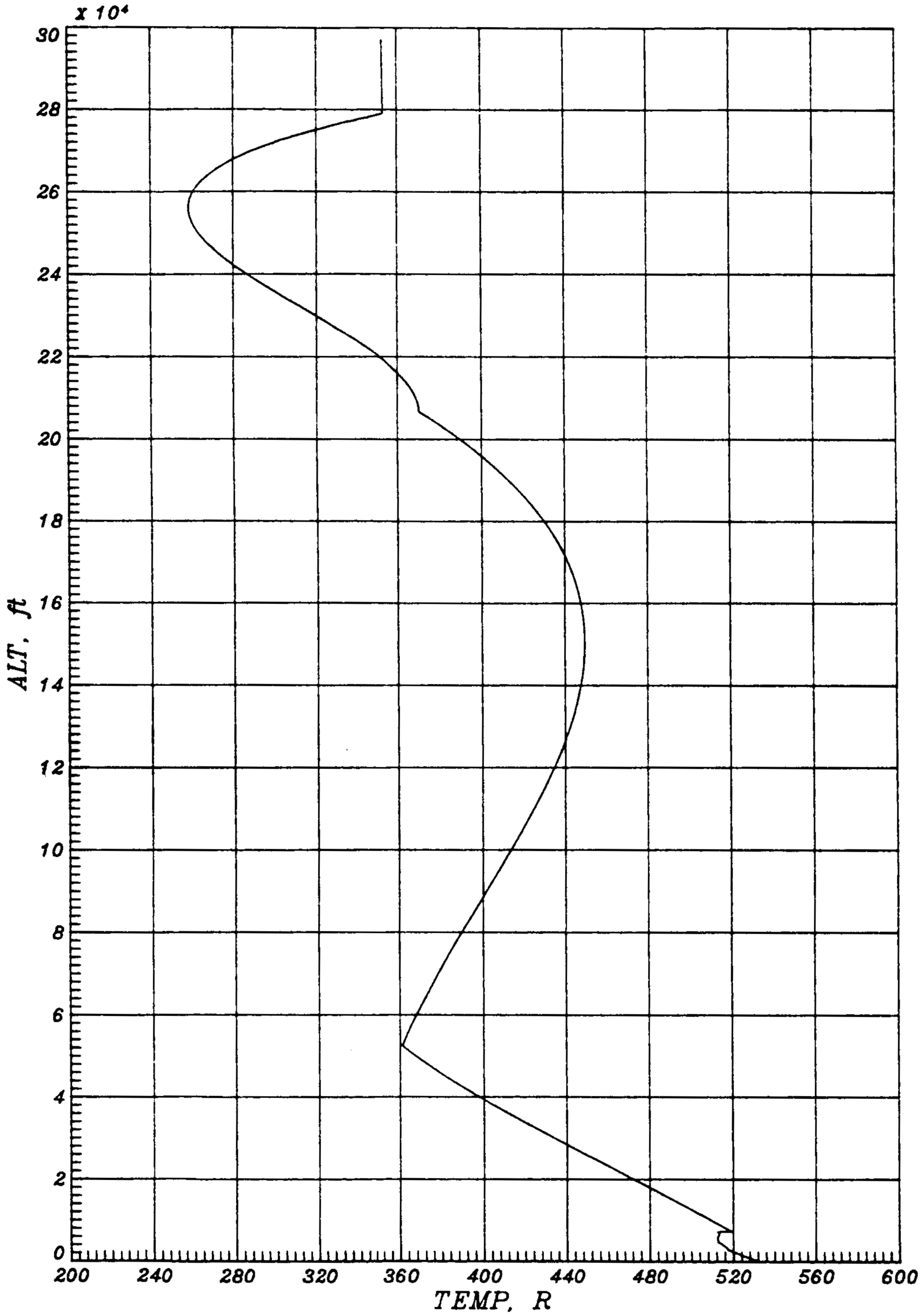


Fig. II-8. Final STS-17 (41-G) temperature profile.

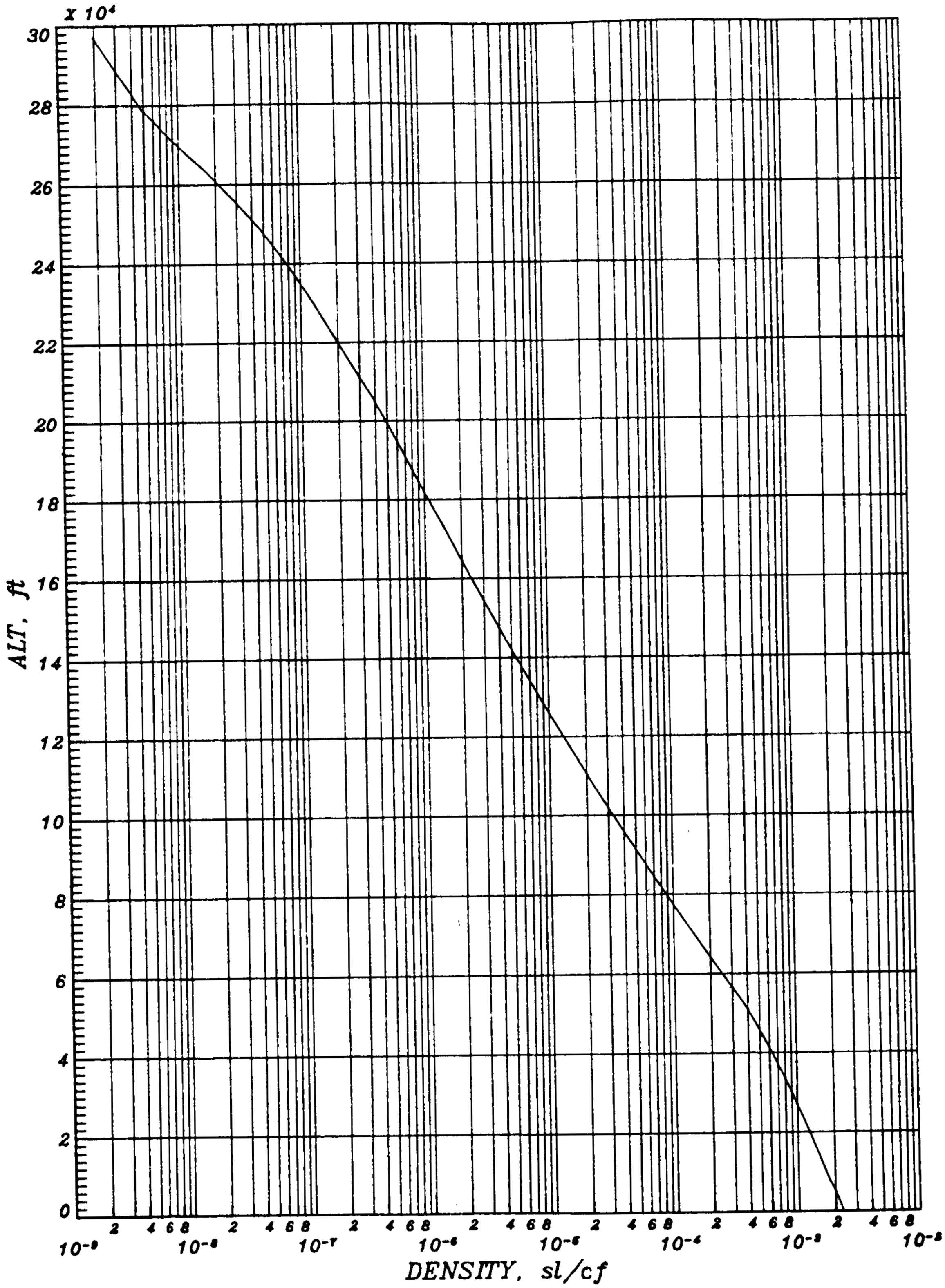


Fig. II-9. Final STS-17 (41-G) density profile.

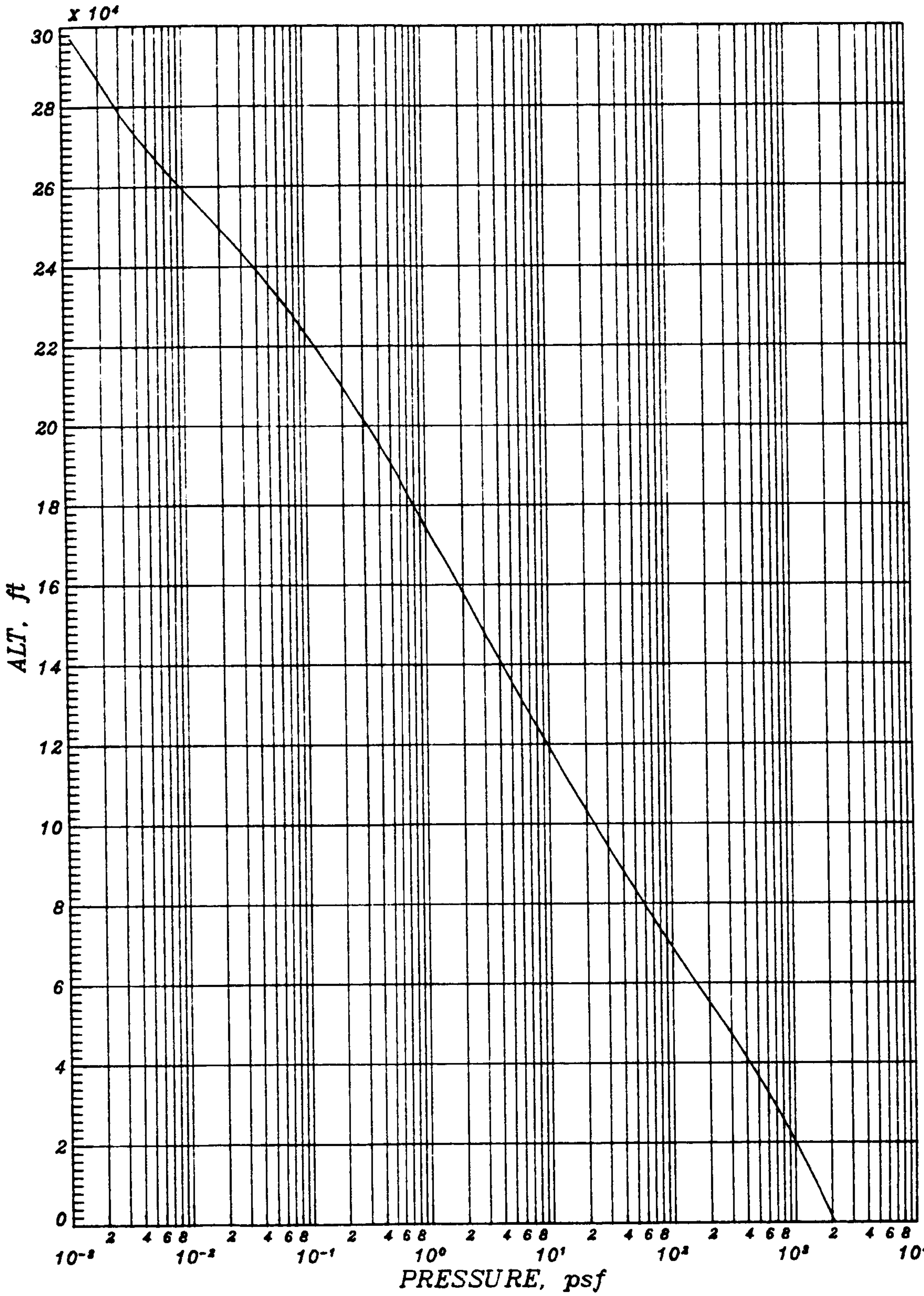


Fig. II-10. Final STS-17 (41-G) pressure profile.

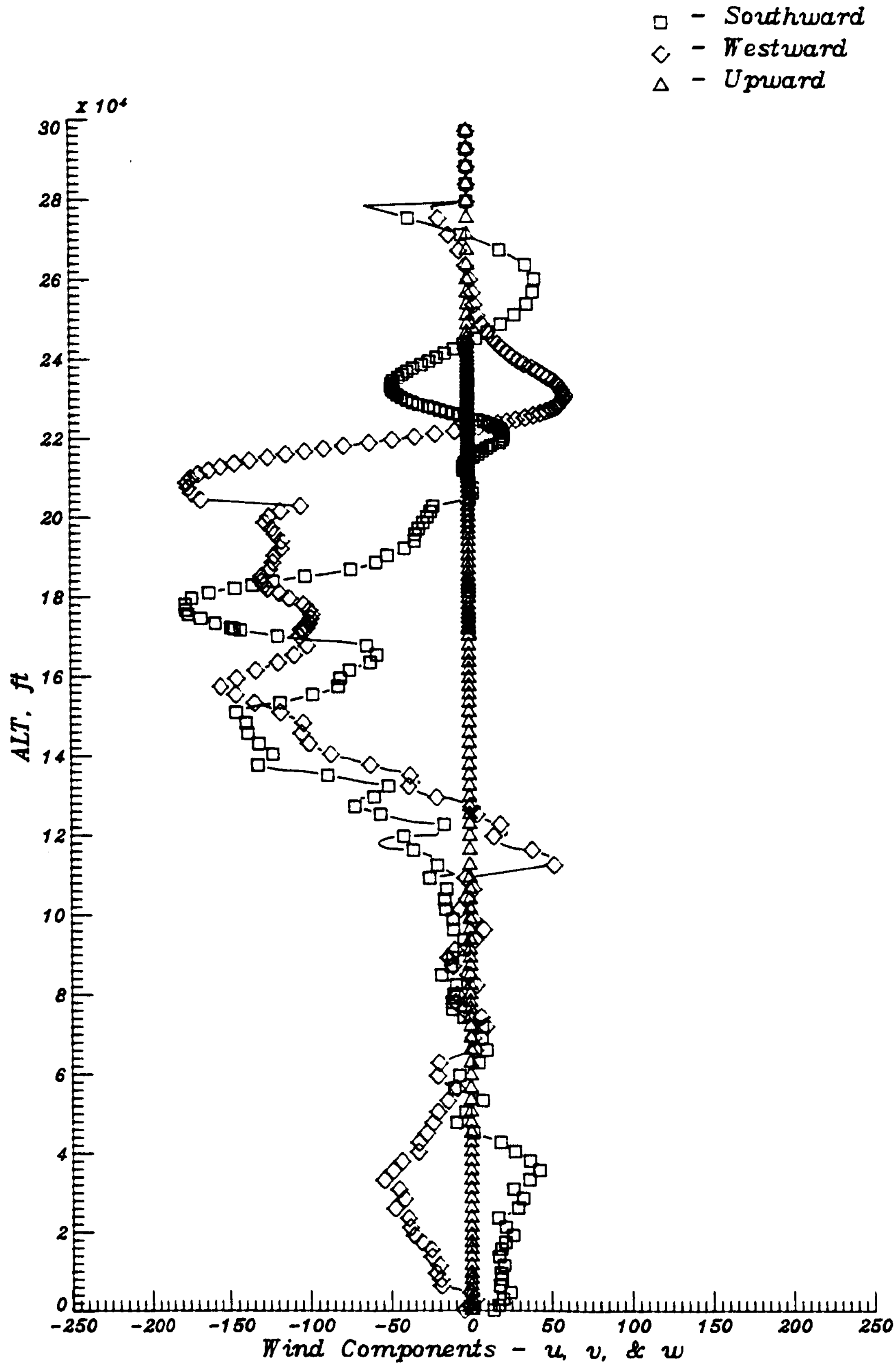


Fig. II-11. Final STS-17 (41-G) wind profiles.

III. Aerodynamic BET Development and Summary Results

The final Extended BET (ST17BET/UN=274885C) was merged with the recorded control surface and RCS firings and the LaRC Orbiter Data Base to develop the AEROBET. The final mass properties utilized are given in Appendix A. The AEROBET was written on nine-track physical reel NJ0333 with a back-up (duplicate) copy on NJ0346. This section presents summary results plotted from the AEROBET.

Figures III-1 and III-2 depict the altitude history and descent rate (versus time and altitude), respectively. Dynamic pressure is plotted versus time and altitude as Figure III-3. Mach number is next presented plotted versus the same two parameters as Figure III-4. The dotted line shown thereon is the resulting Mach number if the Air Force 1978 Reference Model had been adopted. The Mach profile on the AEROBET clearly is a manifestation of the uppermost temperature departure for the LAIRS data discussed in the previous Section. Therein the suggested altitude threshold was h~230 kft. Even at this altitude one can see differences in the two Mach number computations of as much as three, viz ~27 for the LAIRS profile, ~24 using the AF'78 temperature. One must keep these differences in mind when analyzing flight results for this particular mission.

Figure III-5 shows $\tilde{V}_\infty$ versus altitude with the Reynolds number profile presented as Figure III-6. Again, the Reynolds number plot reflects the alternate computation based on the AF'78 model. Air relative attitude angles (angle-of-attack, side-slip angle, and roll about the velocity vector) are given in Figure III-7 versus Mach and III-8 versus altitude, respectively. The shaded region on the plot versus Mach number reflects the range of α's flown on the twelve(12) flights to date, that is for STS-1 through STS-14 excluding STS-10 and 12.

Spacecraft angular rates and linear accelerations in the body axes are plotted versus Mach number as Figure III-9. Control surface deflections versus both Mach and altitude are next presented. The plot versus Mach (Figure III-10) again includes the shading reflecting the range of control effectors based on the first twelve flight experience. More negative elevon opportunities are seen between Mach 9 and 18 thereon. Also, this is the second consecutive flight with the indicated hypersonic speed brake profile, the third unique profile flown to date. To complete the configuration plots, RCS activity is presented as Figure III-12 versus Mach number.

The next three figures show the STS-17 flight/data base comparisons. Figure III-13 shows force coefficient comparison in the stability axes along with L/D performance comparisons. Again, the shading reflects the previous flight results. In this instance, the previous results are the ensemble statistics of width ($\pm 1\sigma$) about the mean prediction error. Body axes force coefficient comparisons, as well as the percentage difference in the pitching moment with respect to the 65 percent reference c.g., are presented as Figure III-14. Actual pitching moment comparisons at the flight c.g. are presented in Figure III-15. Figure III-16 shows the flight c.g. versus Mach number, indicating that this is the furthest forward location flown to date by some two(2) inches. The hypersonic pitching moment discrepancy, due principally to real gas effects, is seen in Figure III-15 to be ~0.036. It is noted that the percentage difference curve (Figure III-14) was plotted with a larger scale than previous flights but still yields regions wherein the differences are off-scale and thus truncated.

Of particular interest herein are the most noticeable force differences which occur in the interval, $5<M<10$ (see Figs. III-13 and III-14). Based on examination of the configuration flown relative to all past flights, eventhough the elevon and speed brake control effectors are on or slightly outside the previous ranges flown, this could likely relate to atmospheric density differences. This Mach interval corresponds to an altitude range between 120 kft and 170 kft. Over most of this interval (see Section II) the LAIRS atmosphere is more dense than that provided by the National Weather Service, by as much as five(5) percent. Thus, less overprediction would be obtained in this interval had the NOAA data been utilized, enough in fact to place the STS-17 results within the ensemble band. However, it must be noted that the additional overprediction indicated in this Mach interval is more consistent with previous "Challenger only" statistics. Readers can refer to NASA CR-172440 wherein separate results are presented showing both Columbia and Challenger ranges of configurations flown as well as ensemble statistics for each based on six(6) and five(5) flights, respectively. Therein, the shift in the mean difference at Mach 7 would be the approximate five(5) percent shown here. Though not simple to isolate, the difference in this Mach interval, if real, would relate to a combination of differing (on average relative to Columbia) speed brake, body flap, and α profiles flown by Challenger. No vehicular aerodynamic differences are expected, nor suggested herein.

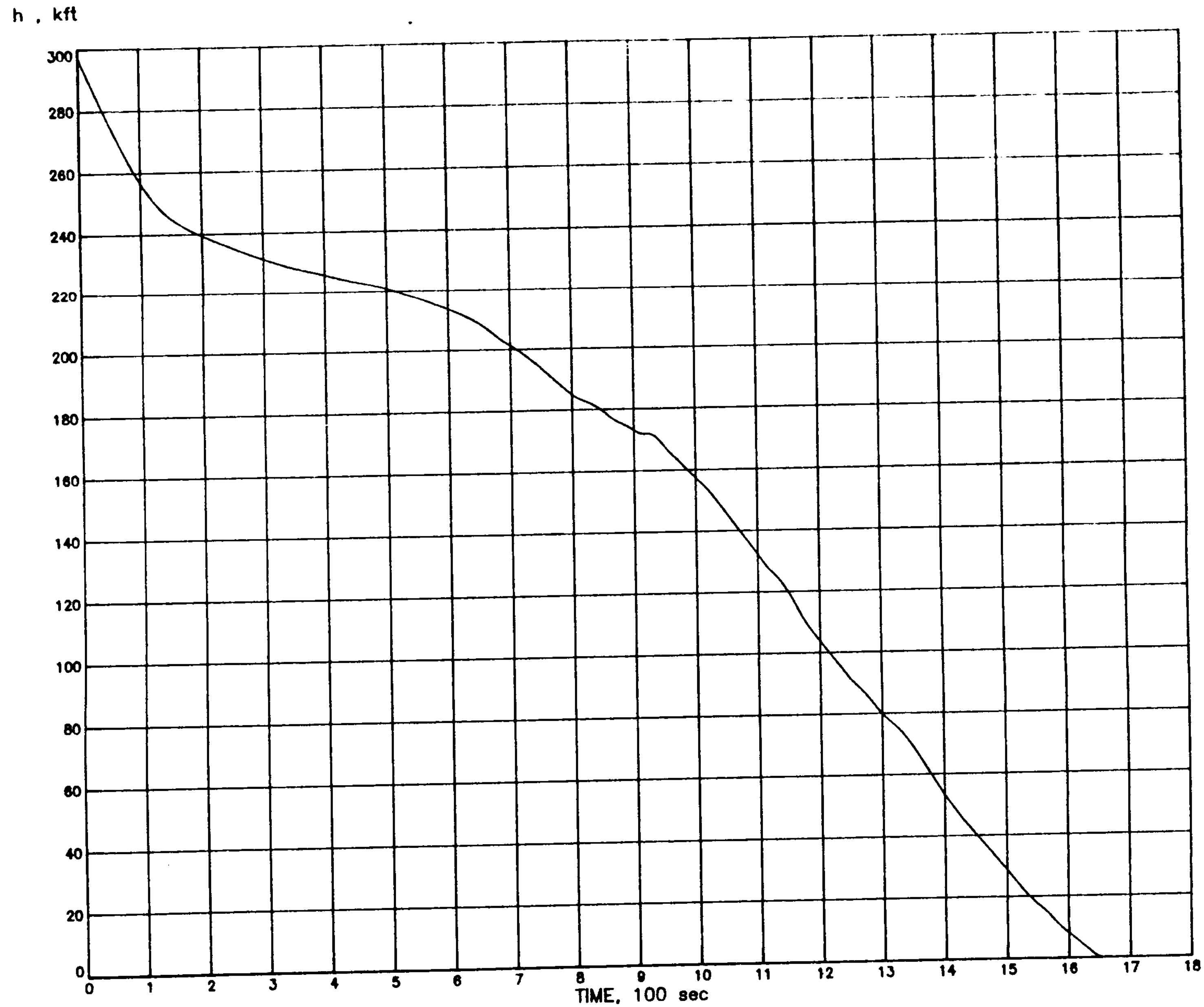
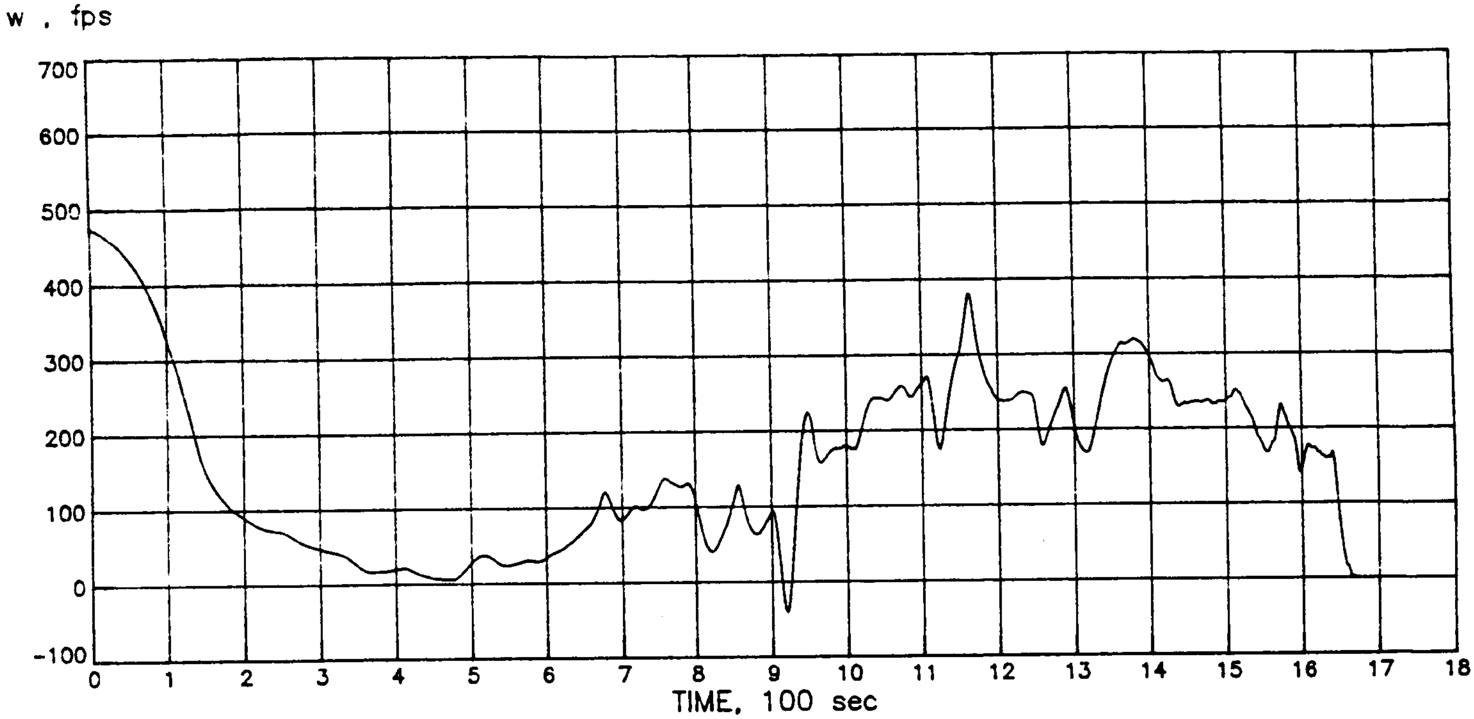


Figure III-1. STS-17 altitude time history



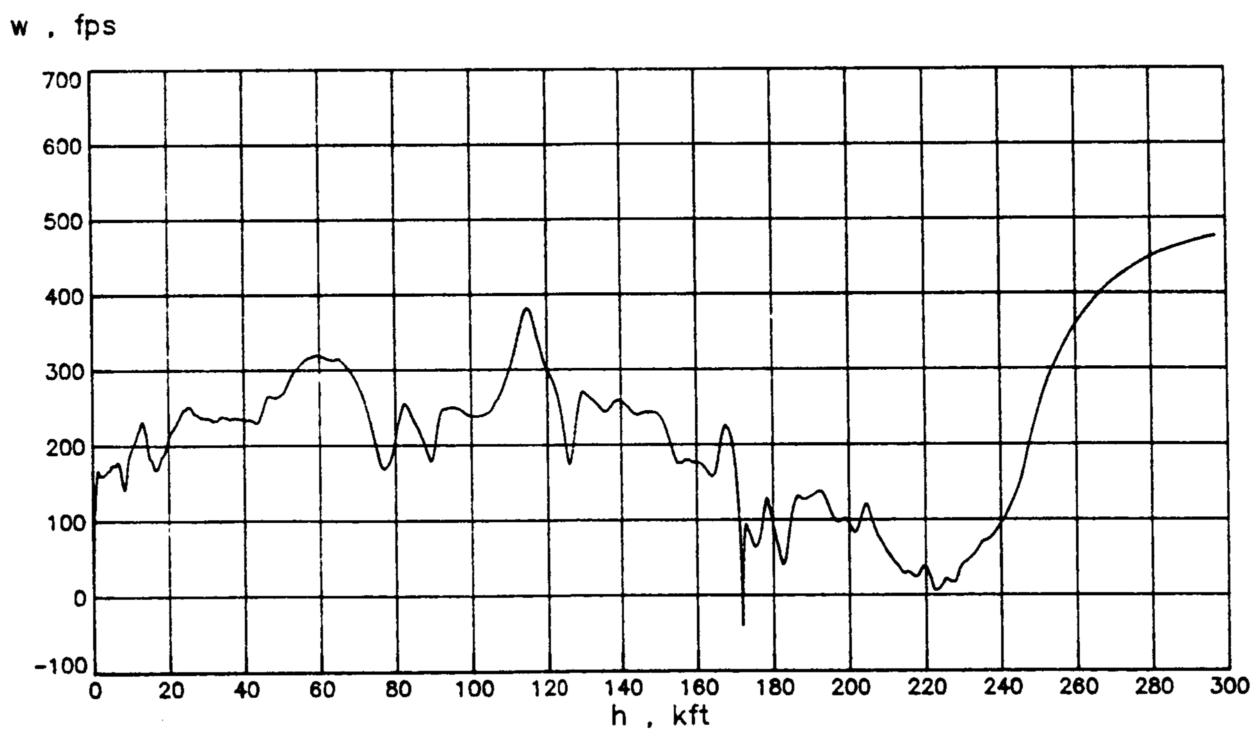
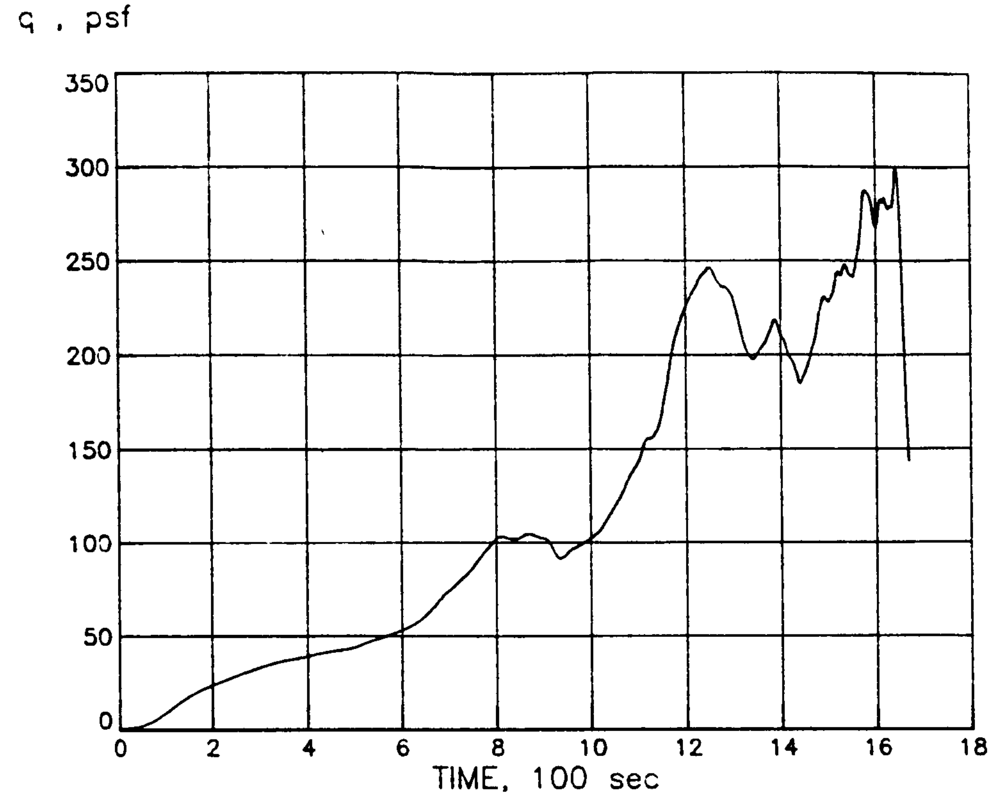


Figure III-2. STS-17 descent rate versus time and altitude



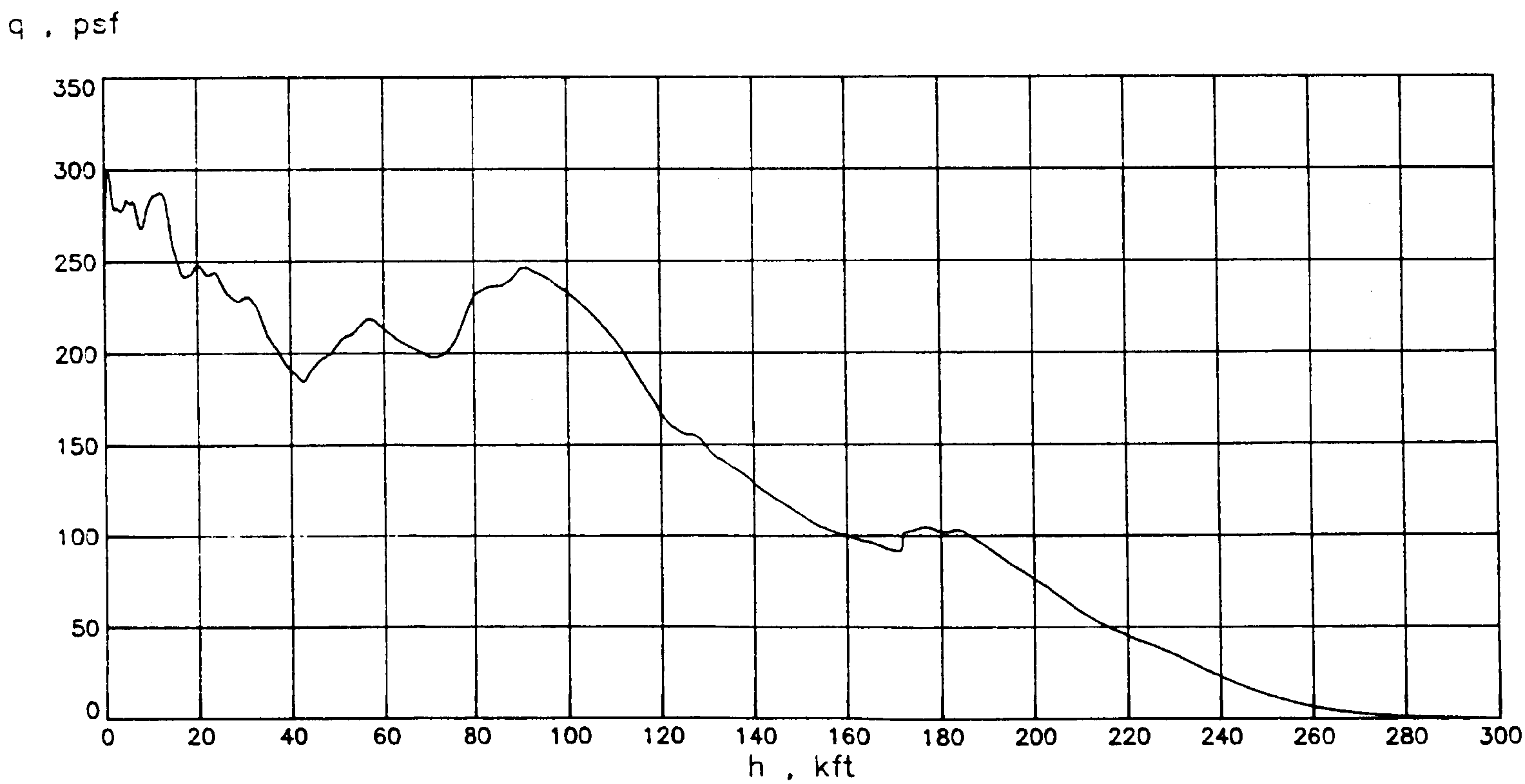


Figure III-3. STS-17 dynamic pressure vs. time and altitude

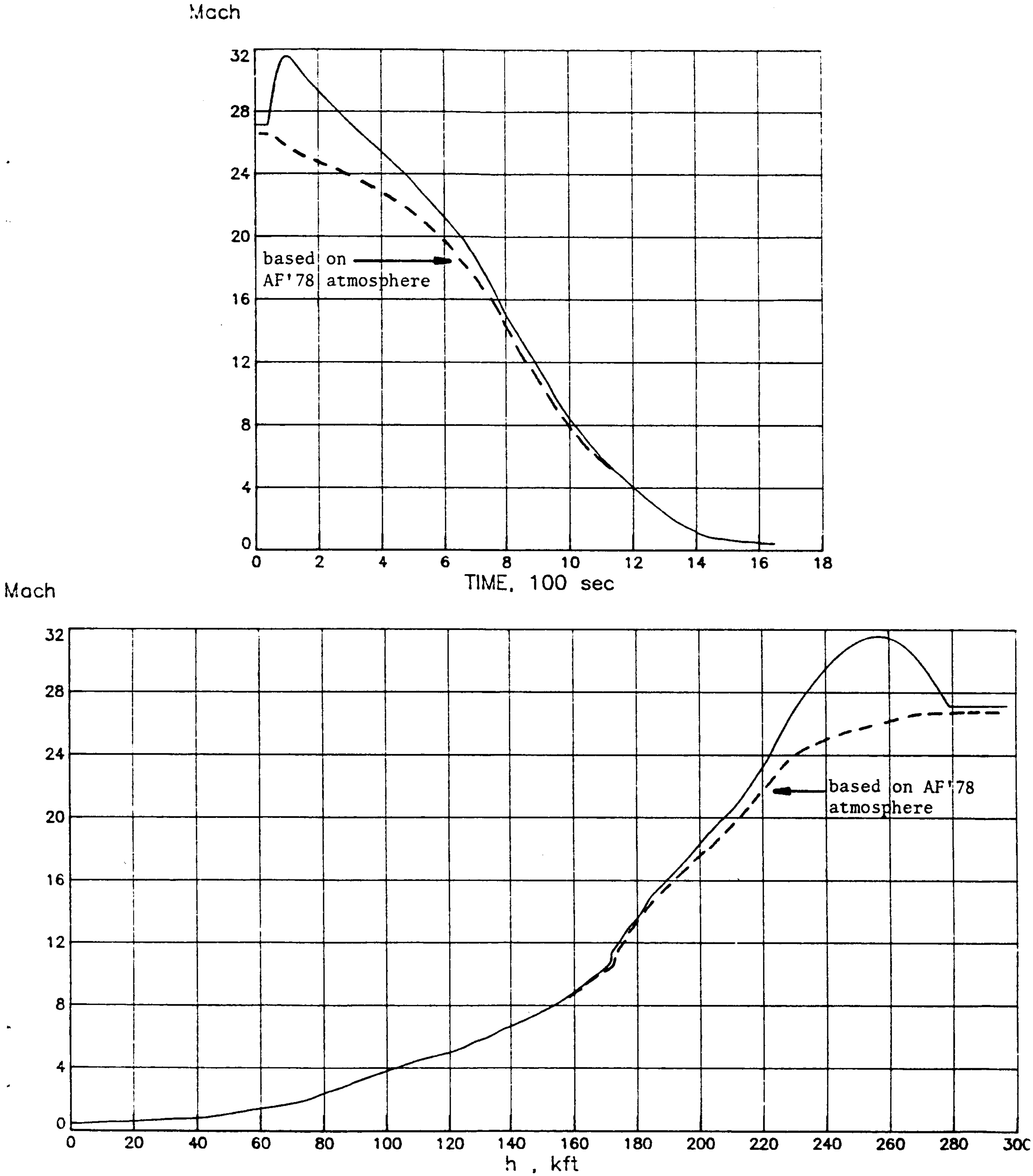


Figure III-4. STS-17 Mach number versus time and altitude

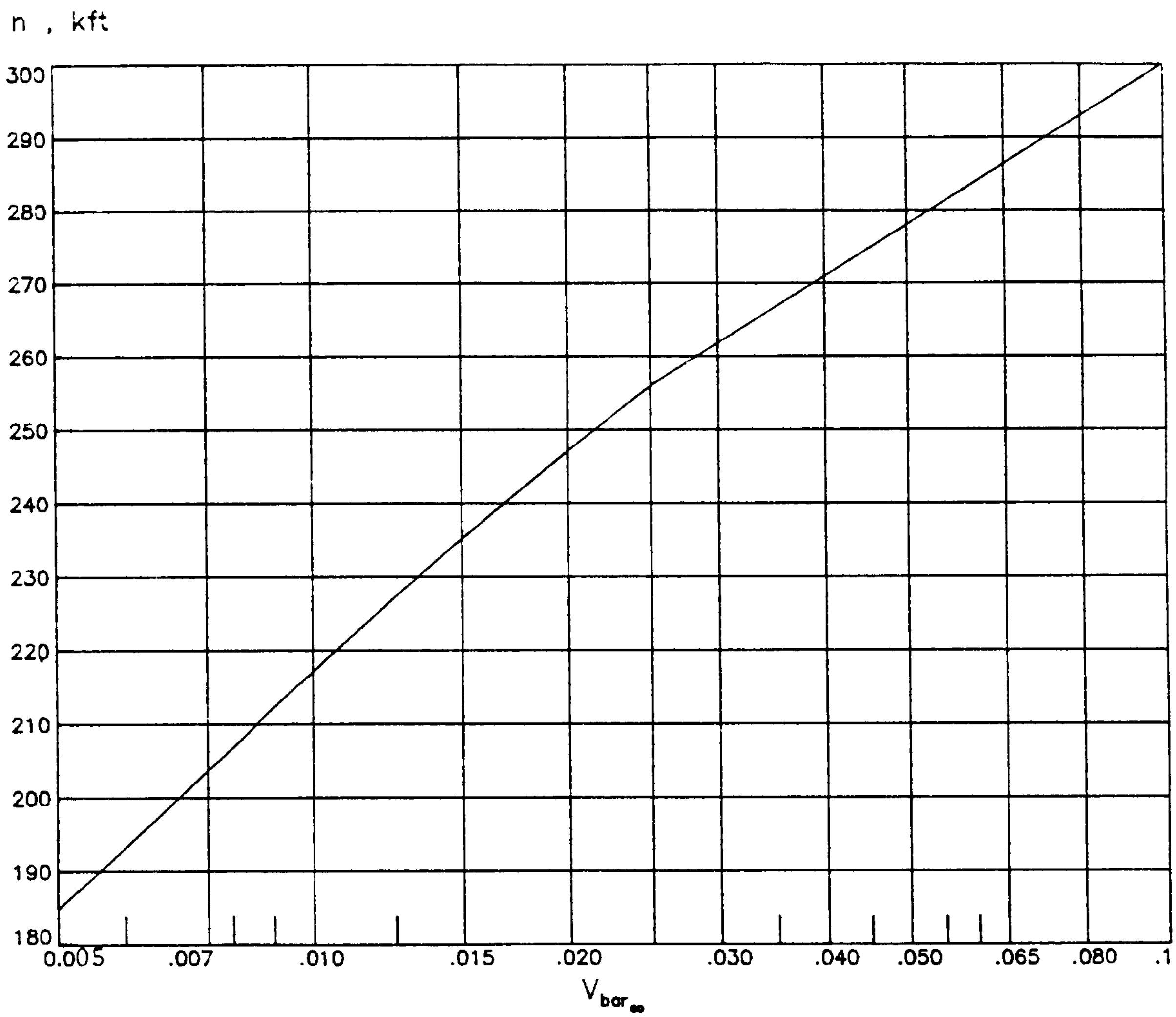


Figure III-5. STS-17 Vbar versus altitude

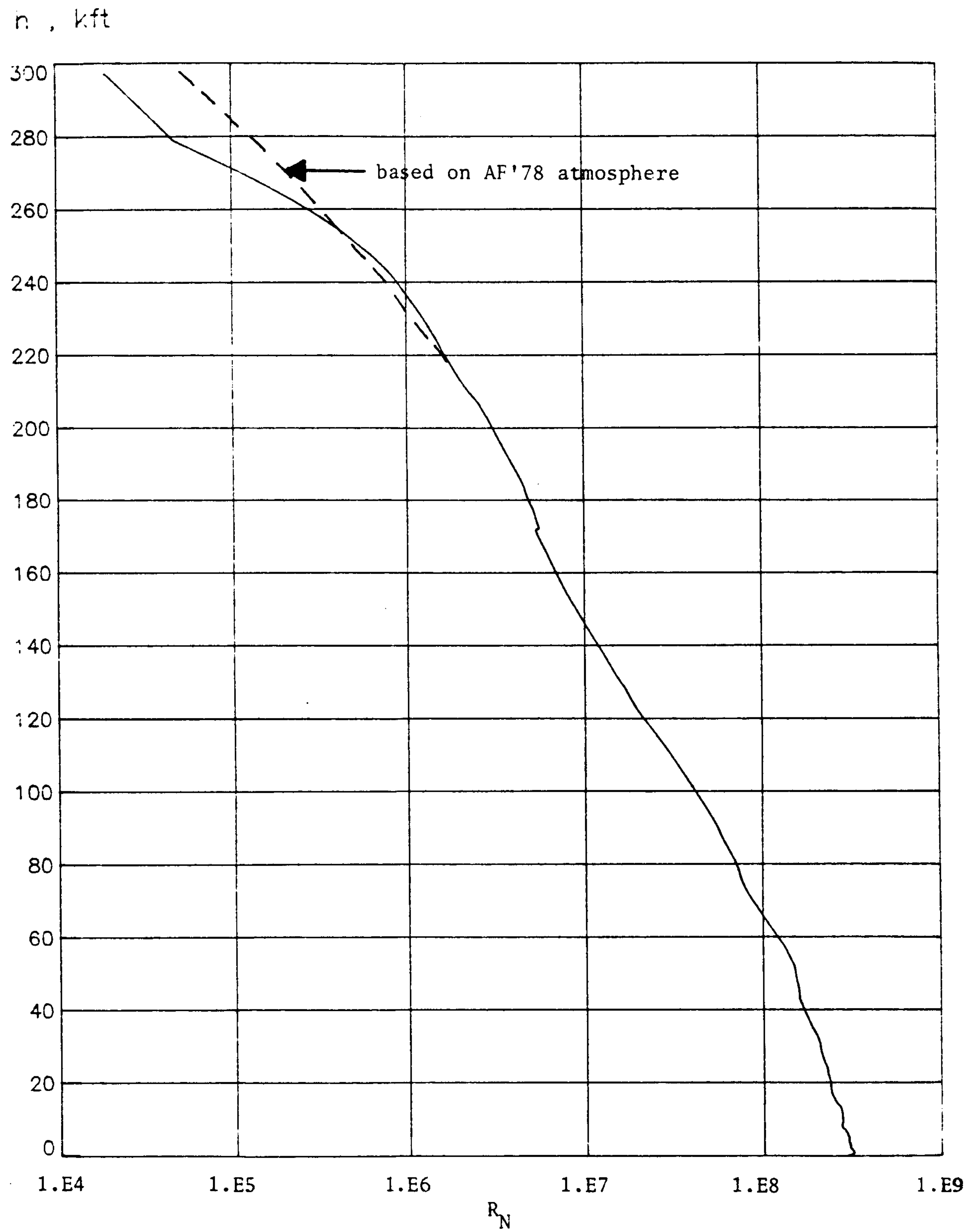


Fig. III-6. STS-17 Rnum versus altitude.

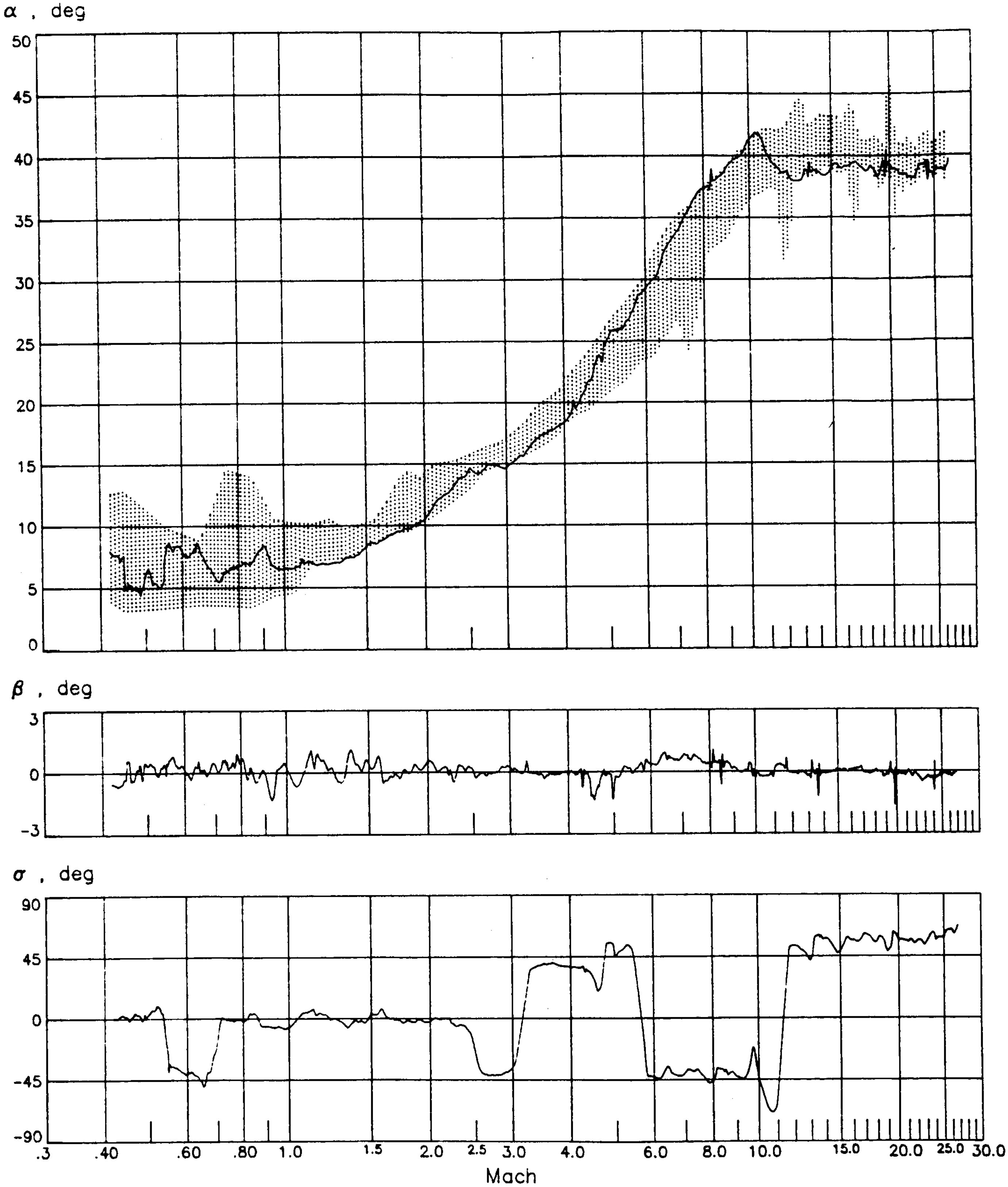


Figure III-7. STS-17 α, β and σ vs. Mach

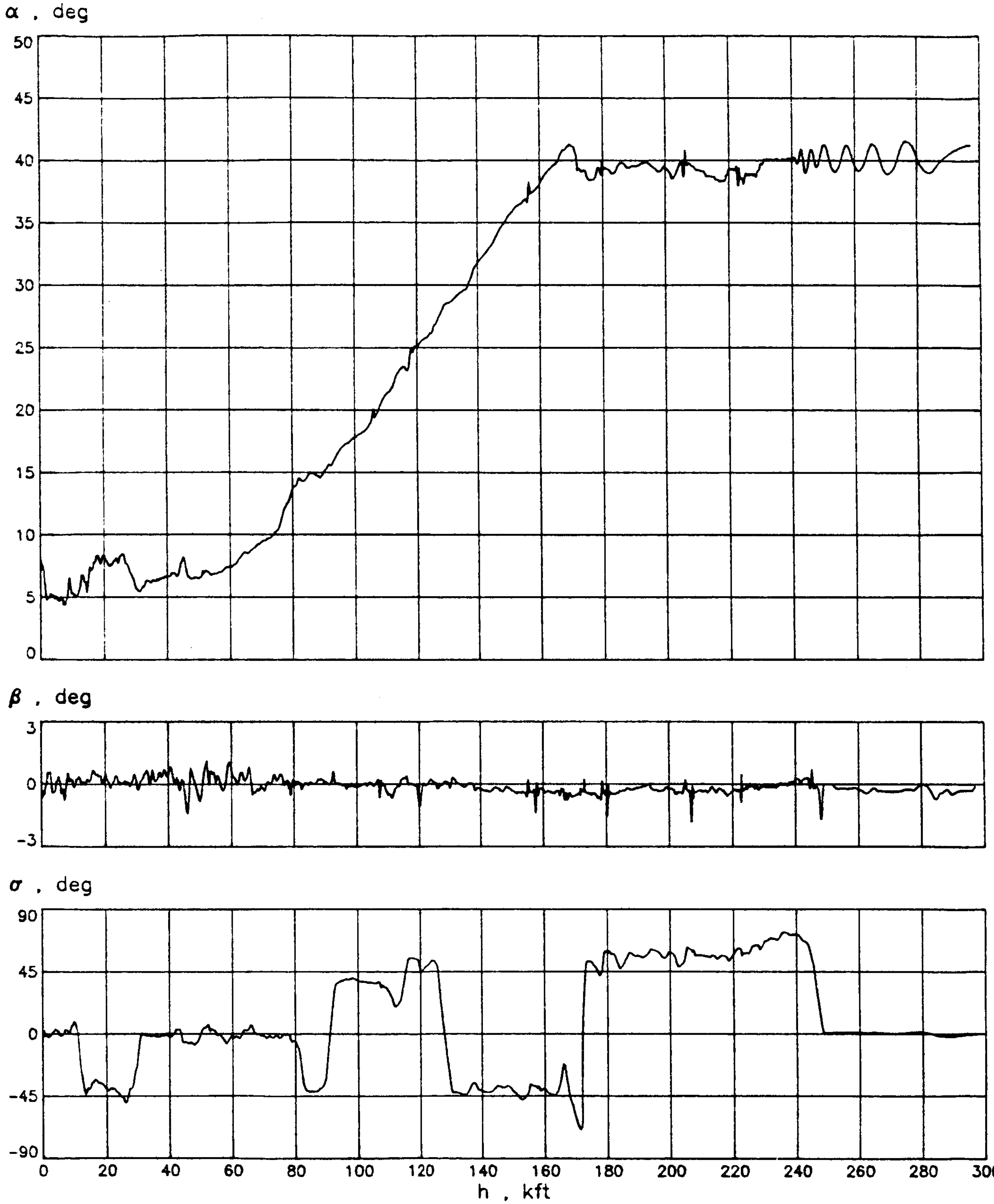


Figure III-8. STS-17 α, β and σ vs. h

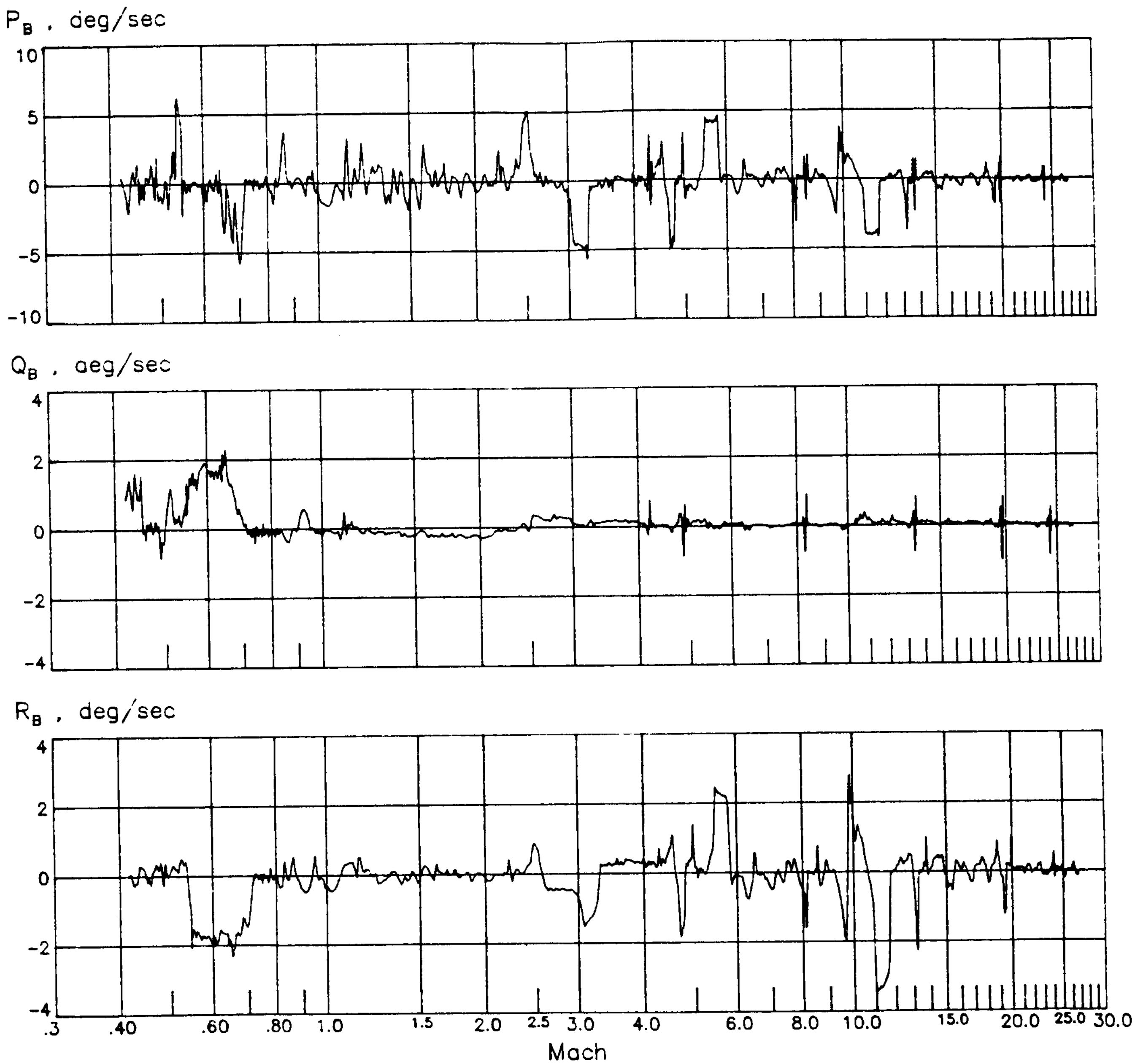


Figure III-9. STS-17 dynamic data vs. Mach

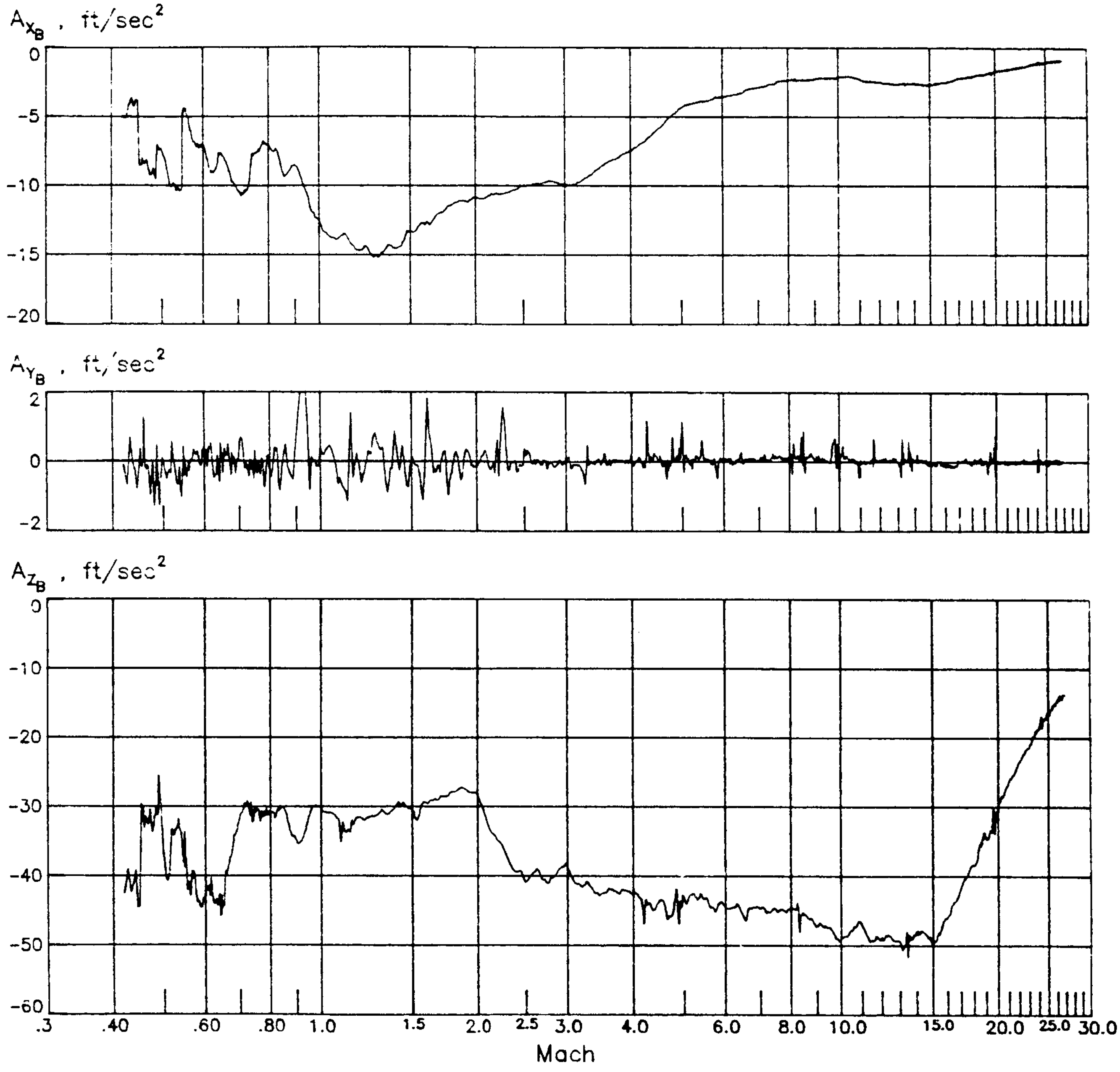


Figure III-9. (concluded)

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OF POOR QUALITY

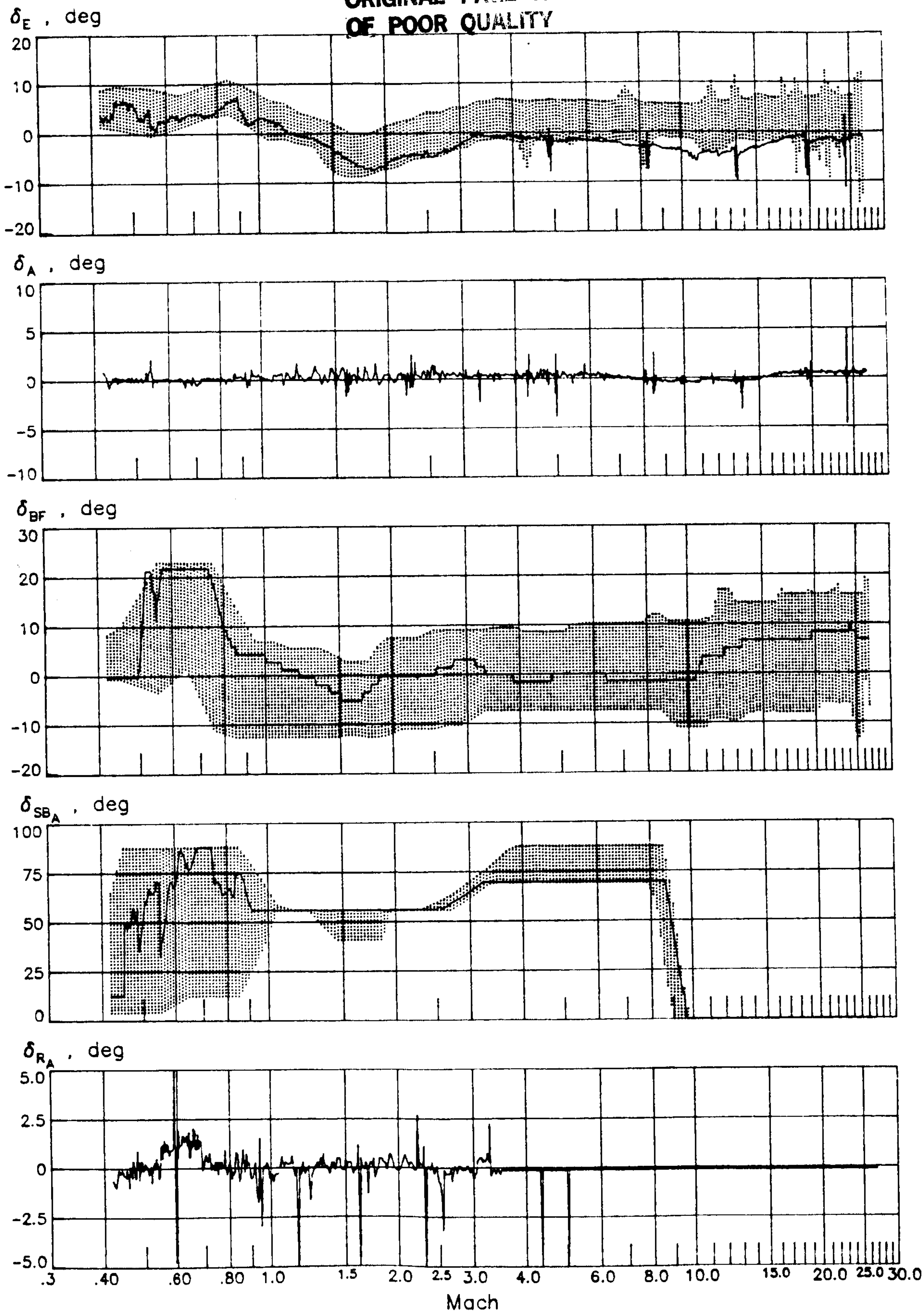


Figure III-10. STS-17 control surfaces vs. Mach

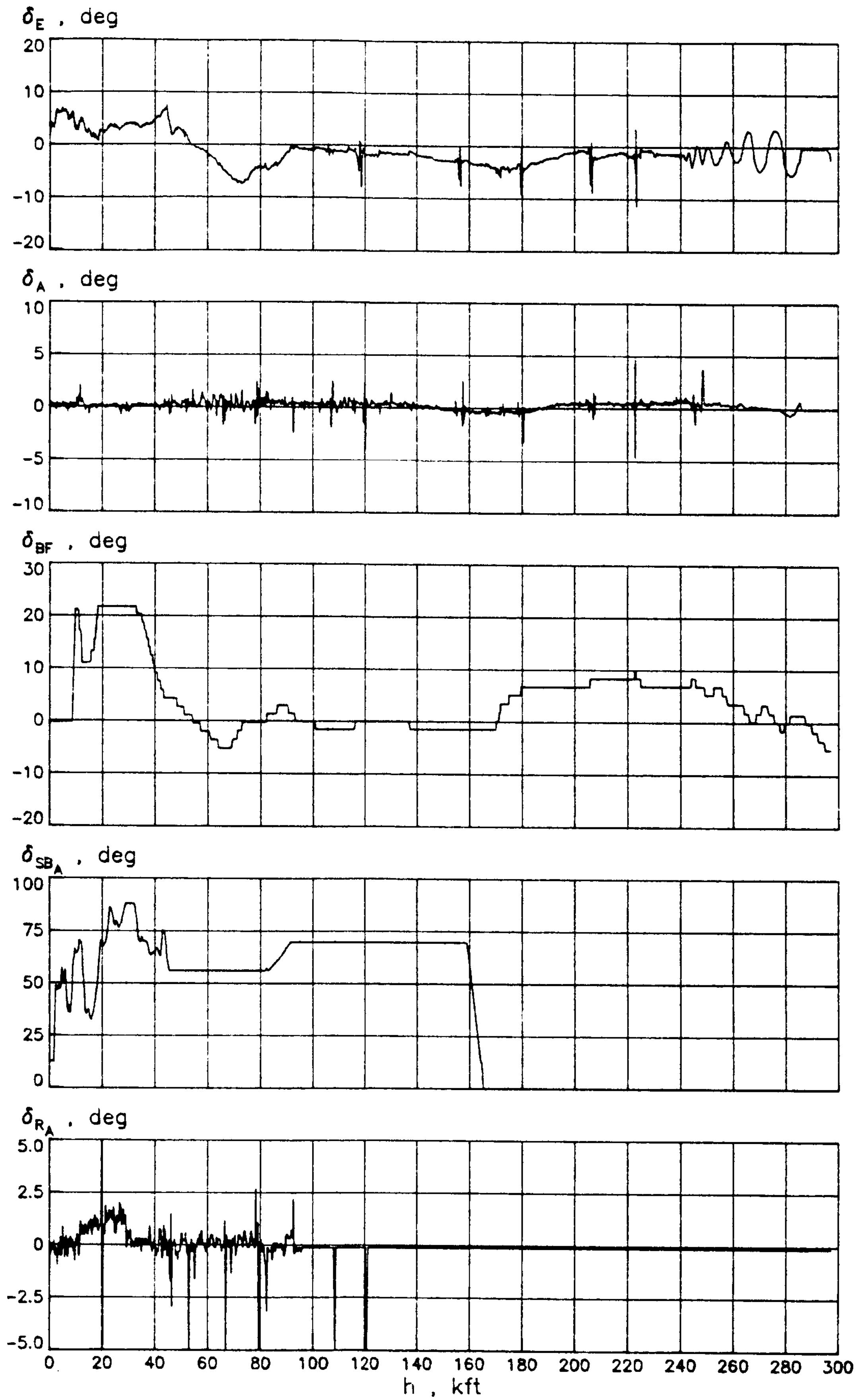


Figure III-11. STS-17 control surfaces vs. altitude

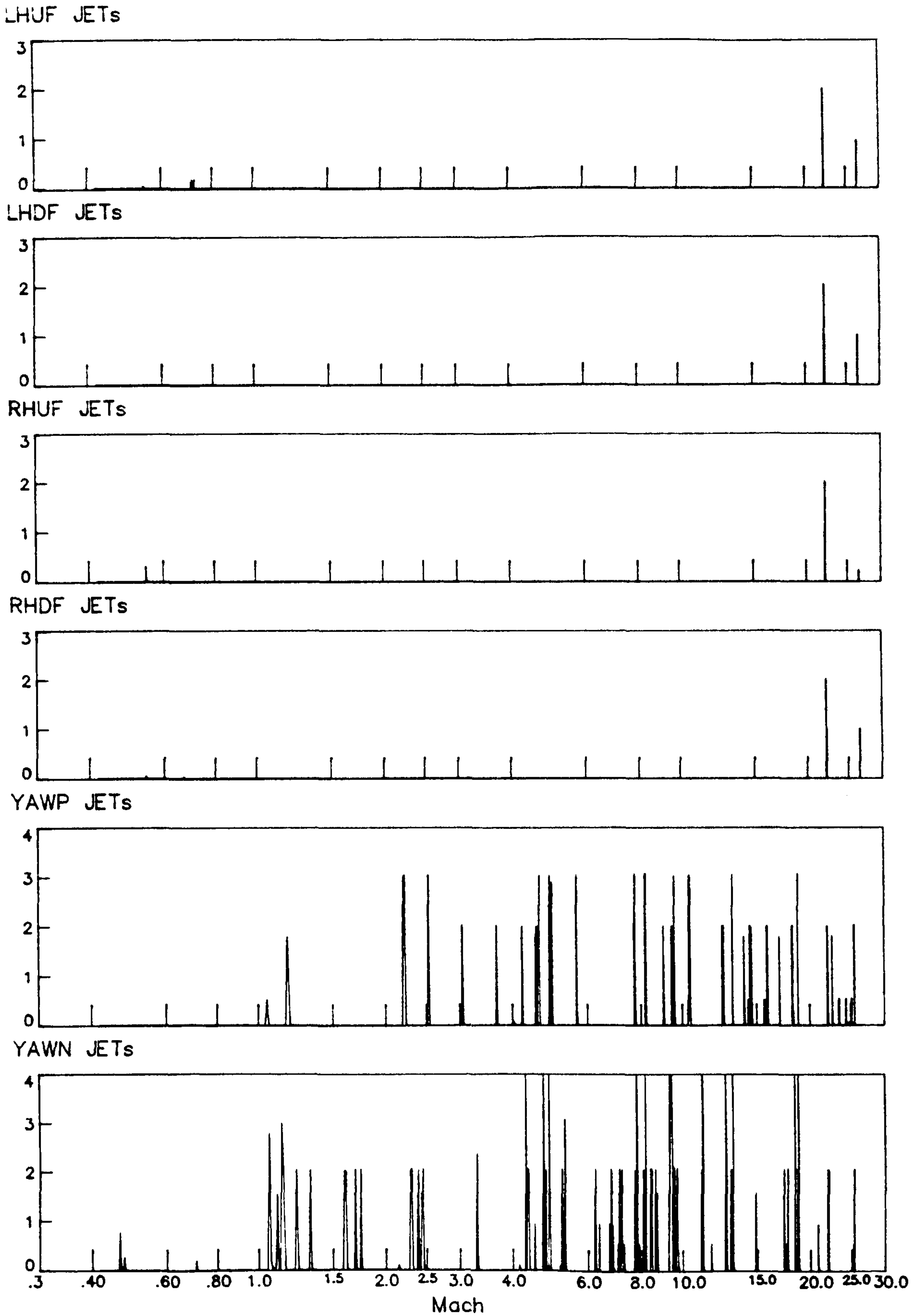


Figure III-12. STS-17 RCS firings vs. Mach

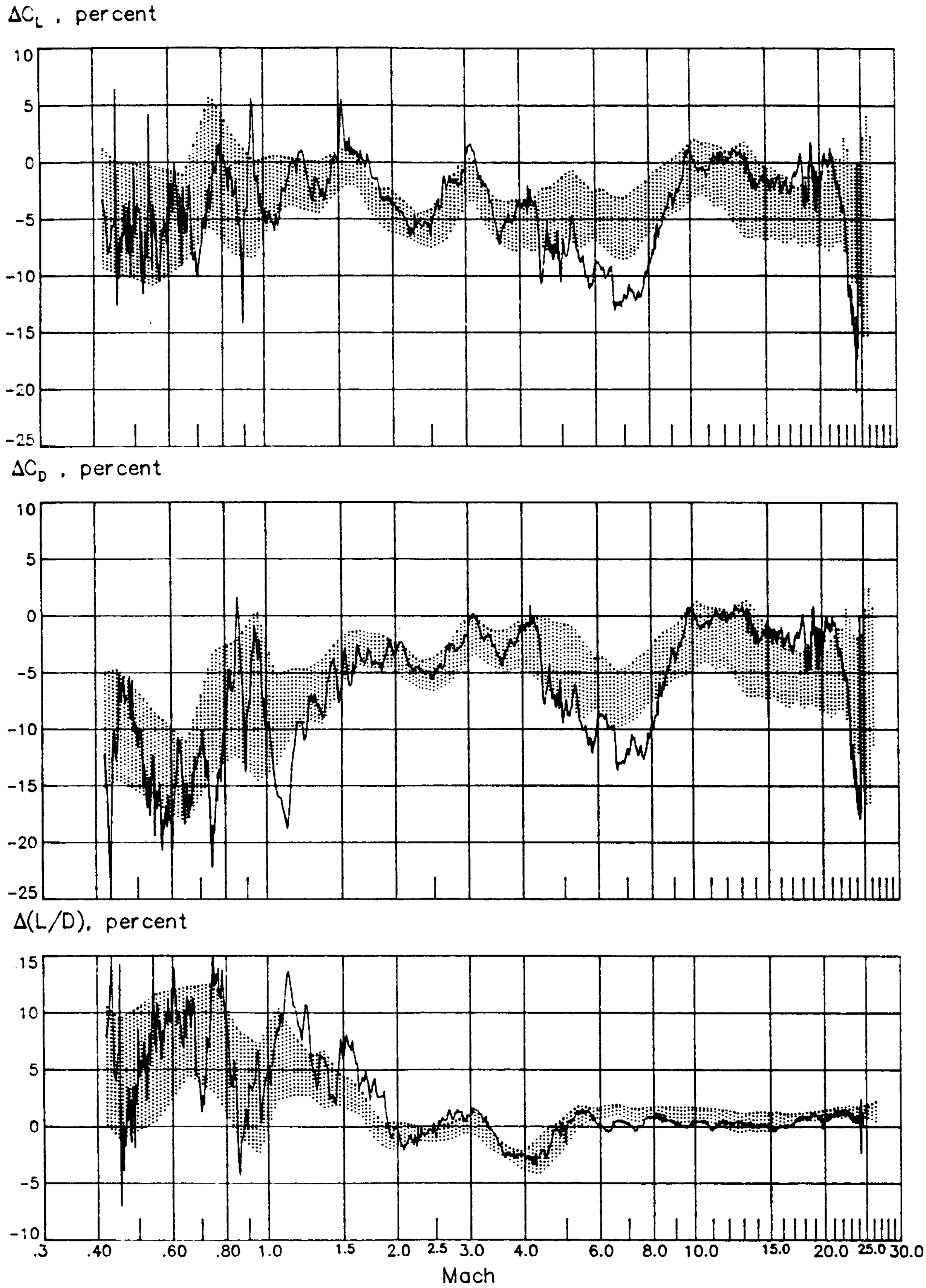


Figure III-13. STS-17 flight/data base differences vs. Mach (lift, drag, and L/D).

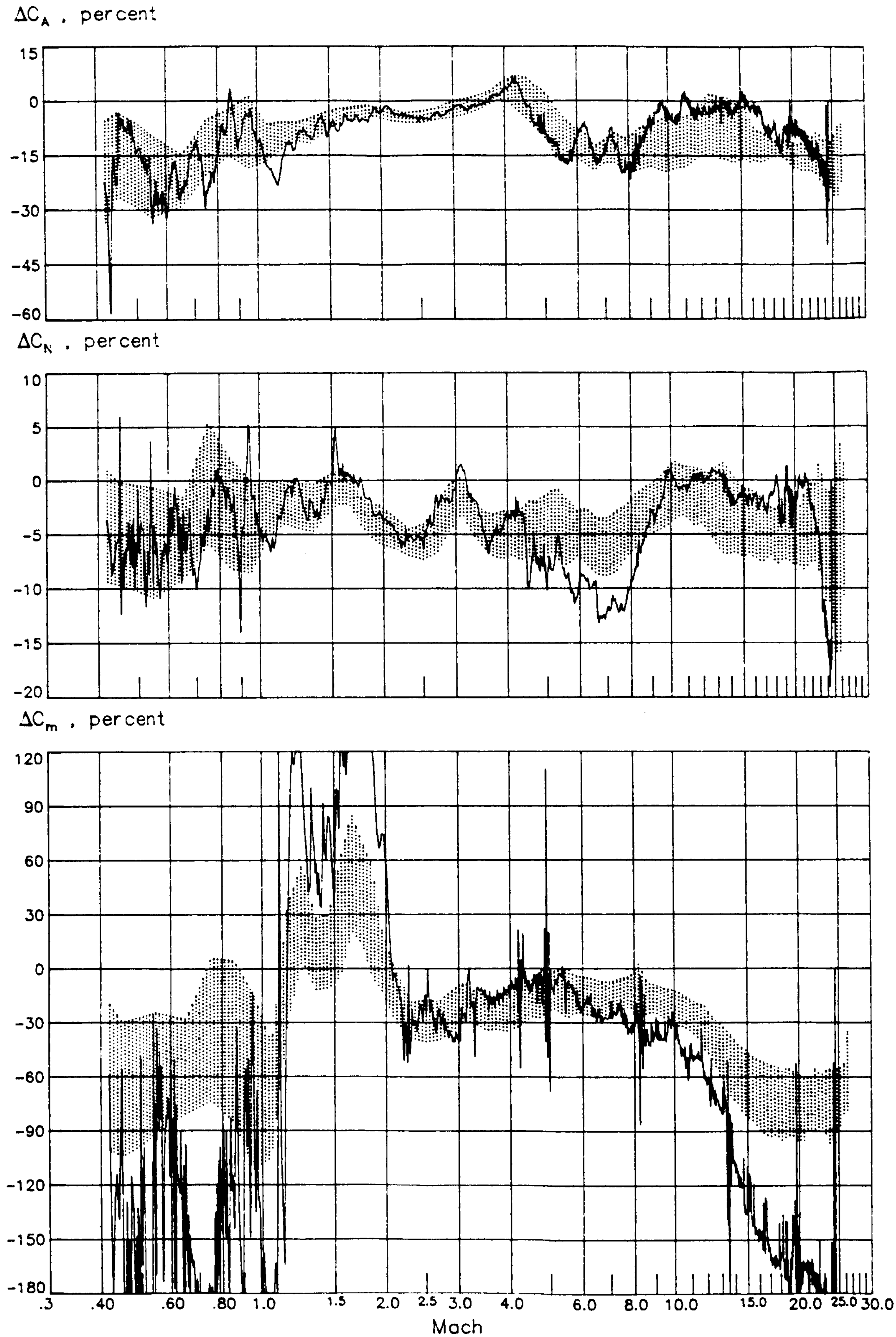


Figure III-14. STS-17 flight/data base differences vs. Mach (axial, normal, and pitching moment).

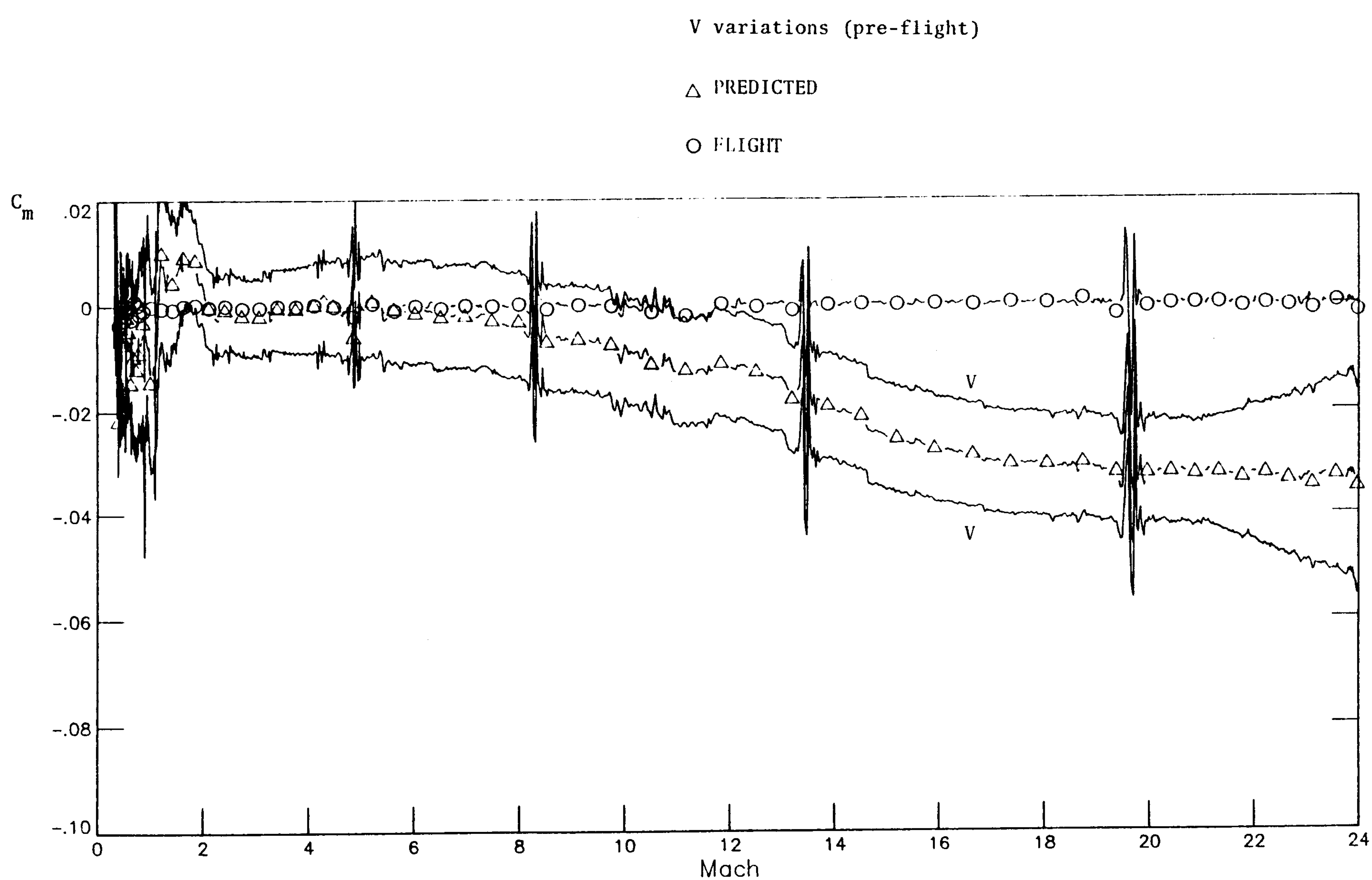


Figure III-15. STS-17 C_m comparisons vs. Mach

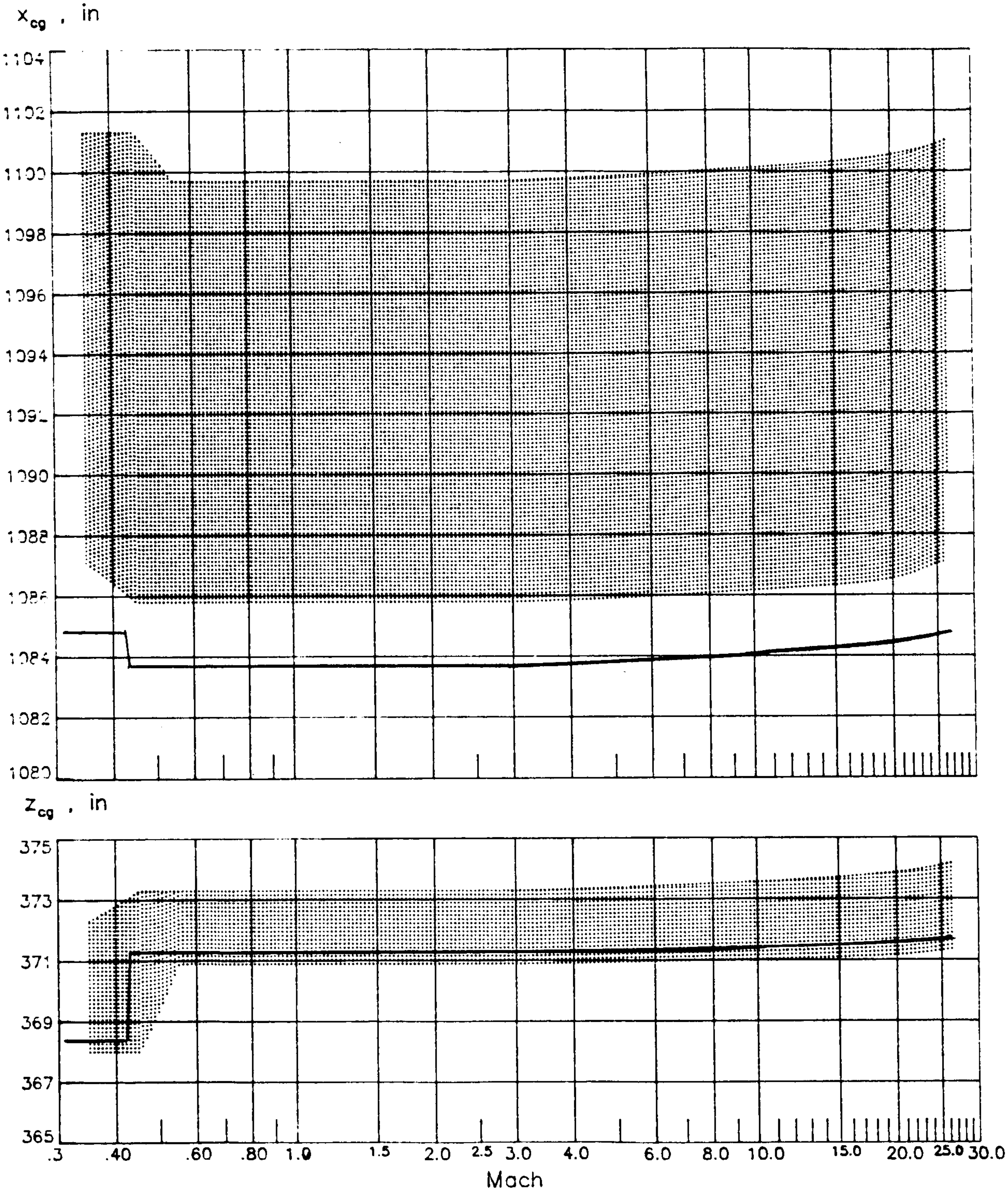


Figure III-16. STS-17(41-G) c.g. profiles vs. Mach

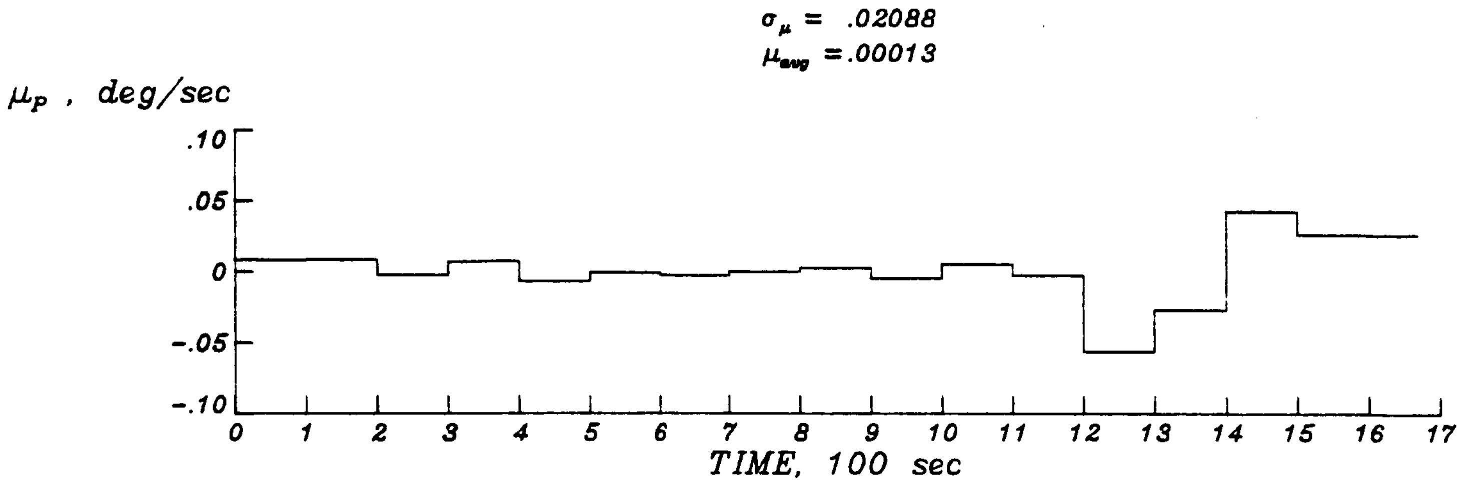
IV. MMLE Input File Generation

In view of the previously mentioned loss of ACIP data, GTFILEs for STS-17 could only be generated based on the IMU and RGA/AA measurements. The 25 Hz IMU2 file was generated and output on tape NJ0523. The RGA/AA file, output on reel number NJ0568, was generated by replacing the dynamic data on the IMU file with the measured RGA body axes angular rates and the two available AA accelerations, A_y and A_z. These data were rectified versus IMU2 as shown in Figures IV-1 and IV-2. The indicated 100 second sample differences shown thereon were removed as extraneous signal by simple sub-interval bias rectification. Investigators can refer to Table IV herein for actual maneuver specification during the STS-17 entry. Final mass properties for maneuver analysis are given in Appendix A.

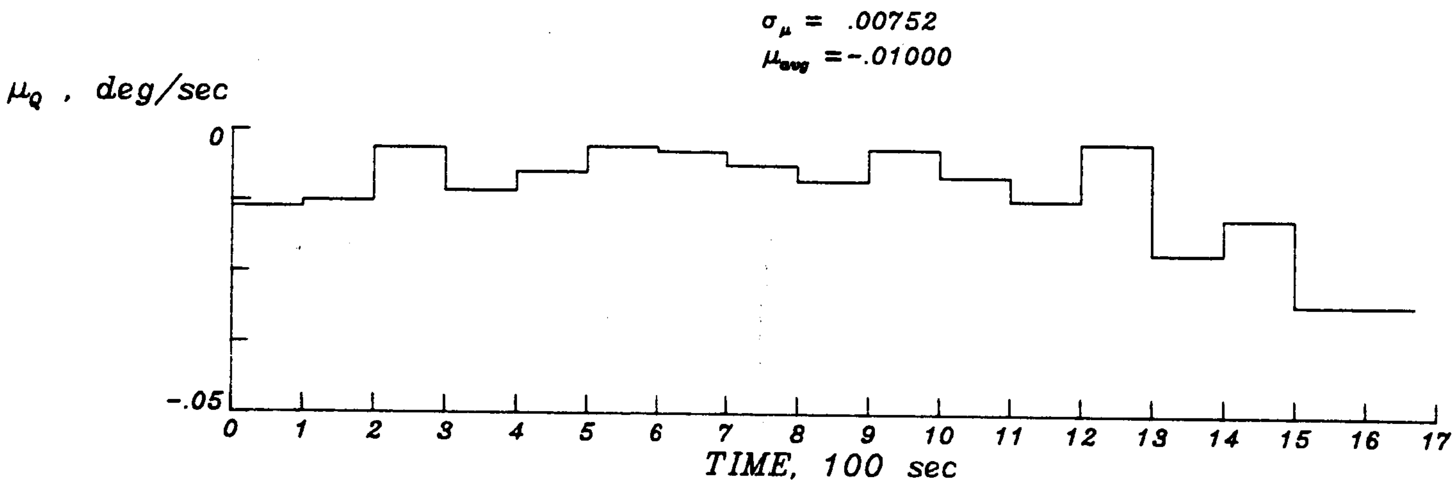
Longitudinal			
Start times		Stop times	
(H: M: S)	(sec from epoch)	(H: M: S)	(sec from epoch)
16:06:20.0	635	16:06:35.0	650
16:09:49.0	664	16:10:01.0	676
16:12:50.0	845	16:12:59.0	854
16:15:26.0	1001	16:15:35.0	1010
16:17:56.0	1151	16:18:02.0	1157
16:18:34.0	1189	16:18:40.0	1195
16:21:27.0	1362	16:21:31.0	1366
16:22:11.0	1406	16:22:14.5	1409.5

Lateral			
Start times		Stop times	
(H: M: S)	(sec from epoch)	(H: M: S)	(sec from epoch)
16:06:30.0	645	16:06:41.0	656
16:09:41.0	656	16:09:52.0	667
16:12:42.0	837	16:12:53.0	848
16:15:18.0	993	16:15:28.0	1003
16:17:46.5	1141.5	16:17:58.0	1153
16:18:29.5	1184.5	16:18:35.0	1190
16:20:27.0	1302	16:20:37.0	1312
16:21:19.5	1354.5	16:21:26.0	1361
16:22:05.0	1400	16:22:10.0	1405
16:22:28.0	1423	16:22:36.0	1431

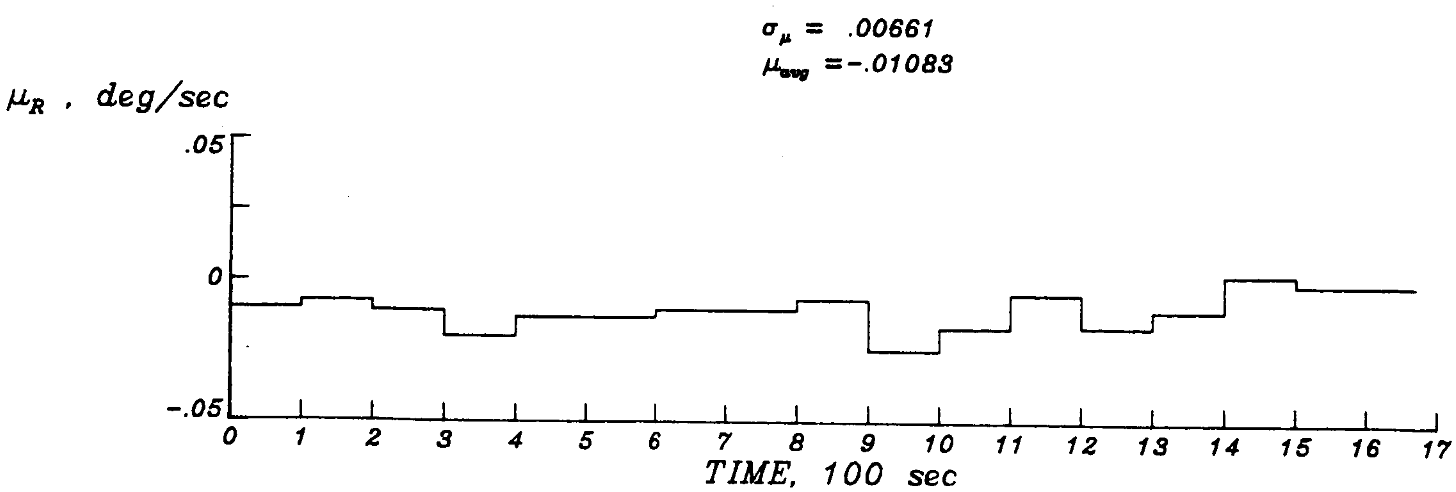
Table IV Maneuvers specified for STS-17 (41-G).



(a) Roll rate statistics versus time

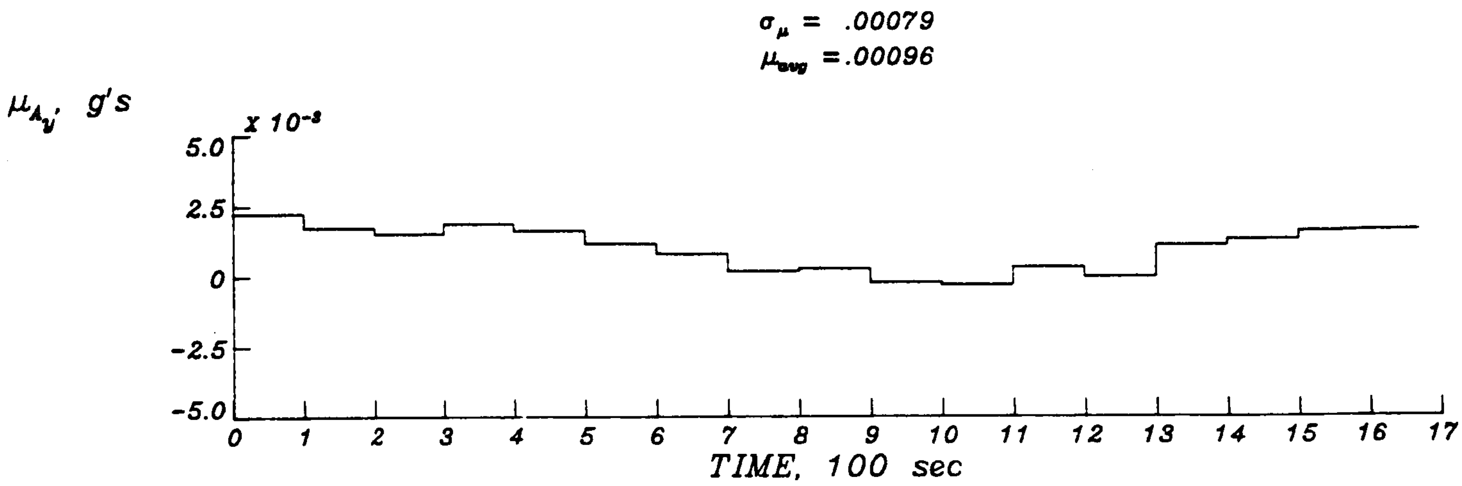


(b) Pitch rate statistics versus time

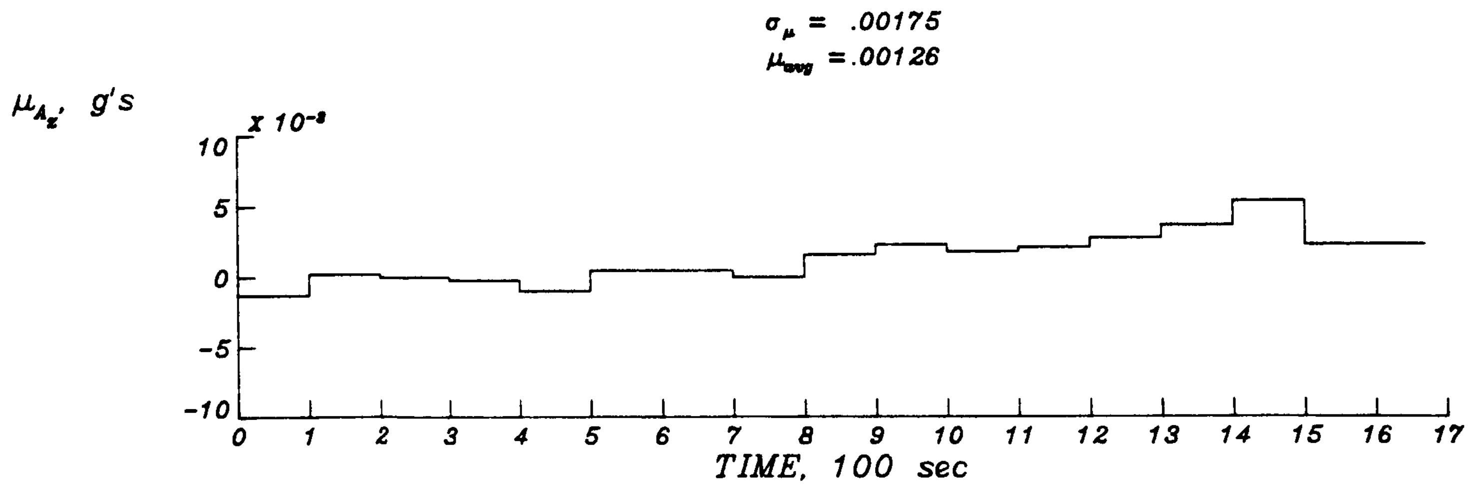


(c) Yaw rate statistics versus time

Figure IV-1. STS-17 angular rate differences between derived values from IMU2 and RGA measurements.



(e) Y-body acceleration statistics versus time



(f) Z-body acceleration statistics versus time

Figure IV-2. STS-17 lateral and normal acceleration differences between IMU2 derived and AA measurements.

APPENDIX A

Spacecraft and Physical Constants

+++++IMU NBR 1 ATTITUDE INFORMATION+++++

...INERTIAL (EE50) TO ROTATING (ETOD)

-.14543044E+00	-.98936835E+00	.49878366E-03
.98936281E+00	-.14543129E+00	-.33118982E-02
.33492267E-02	.11832144E-04	.99999439E+00

...ROTATING (ETOD) TO N-E-D

.72976142E+00	.37039789E+00	.57467701E+00
.45259873E+00	-.89171430E+00	0.
.51244771E+00	.26009808E+00	-.81838031E+00

...NAV BASE TO S/C BODY

.98291057E+00	.36562364E-03	-.18408337E+00
-.37935496E-03	.99999993E+00	-.39375571E-04
.18408334E+00	.10853560E-03	.98291063E+00

...NAV BASE TO OUTER ROLL

.99999950E+00	-.91449388E-03	.40092134E-03
.91449381E-03	.99999958E+00	.36664027E-06
-.40092151E-03	0.	.99999992E+00

...PLATFORM TO OUTER ROLL

.36293020E+00	.60981031E+00	.70456559E+00
-.92777276E+00	.16612024E+00	.33412762E+00
.86712100E-01	-.77494190E+00	.62605578E+00

...INERTIAL (EE50) TO PLATFORM

.21106833E+00	-.73014283E+00	.64987814E+00
-.38499874E+00	.54901433E+00	.74186200E+00
-.89845765E+00	-.40678579E+00	-.16522455E+00

...S/C BODY TO N-E-D

.25402087E+00	-.94505243E+00	.20578854E+00
.72094569E+00	.32684604E+00	.61107175E+00
-.64475594E+00	-.68626949E-02	.76435737E+00

TABLE A-1

STS-17 IMU attitude matrices @ epoch

+++++IMU NBR 2 ATTITUDE INFORMATION+++++

...INERTIAL (EE50) TO ROTATING (ETOD)

-.14543044E+00	-.98936835E+00	.49878866E-03
.98936281E+00	-.14543129E+00	-.33118982E-02
.33492267E-02	.11832144E-04	.99999439E+00

...ROTATING (ETOD) TO N-E-D

.72976142E+00	.37039789E+00	.57467701E+00
.45259873E+00	-.89171430E+00	0.
.51244771E+00	.26009808E+00	-.81838031E+00

...NAV BASE TO S/C BODY

.98291057E+00	.36562364E-03	-.18408337E+00
-.37935496E-03	.99999993E+00	-.39375571E-04
.18408334E+00	.10853560E-03	.98291063E+00

...NAV BASE TO OUTER ROLL

.99999530E+00	-.74577054E-03	-.62278928E-03
.74578641E-03	.99999972E+00	.25249802E-04
.62277028E-03	-.25714258E-04	.99999981E+00

...PLATFORM TO OUTER ROLL

.97982388E+00	-.65858486E-02	-.19975430E+00
.96825932E-01	-.85869512E+00	.50325616E+00
-.17484248E+00	-.51244380E+00	-.84073230E+00

...INERTIAL (EE50) TO PLATFORM

-.78582752E+00	-.19800540E-01	.61812866E+00
.61265671E+00	-.16135889E+00	.77370220E+00
.84420860E-01	.98669714E+00	.13893121E+00

...S/C BODY TO N-E-D

.25399721E+00	-.94515516E+00	.20534315E+00
.72048986E+00	.32653591E+00	.61177016E+00
-.64526863E+00	-.74402805E-02	.76391790E+00

TABLE A-1

(continued)

+++++IMU NBR 3 ATTITUDE INFORMATION+++++

...INERTIAL (EE50) TO ROTATING (ETOD)

-.14543044E+00	-.98936835E+00	.49878866E-03
.98936281E+00	-.14543129E+00	-.33118982E-02
.33492267E-02	.11832144E-04	.99999439E+00

...ROTATING (ETOD) TO N-E-D

.72976142E+00	.37039789E+00	.57467701E+00
.45259873E+00	-.89171430E+00	0.
.51244771E+00	.26009808E+00	-.81838031E+00

...NAV BASE TO S/C BODY

.98291057E+00	.36562364E-03	-.18408337E+00
-.37935496E-03	.99999993E+00	-.39375571E-04
.18408334E+00	.10853560E-03	.98291063E+00

...NAV BASE TO OUTER ROLL

.99999429E+00	.12891322E-02	.31251399E-02
-.12891429E-02	.99999917E+00	.14160325E-05
-.31251355E-02	-.54447762E-05	.99999512E+00

...PLATFORM TO OUTER ROLL

.11215776E+00	.85533072E+00	-.50579636E+00
-.31062602E+00	-.45332064E+00	-.83547101E+00
-.94389198E+00	.25081805E+00	.21484459E+00

...INERTIAL (EE50) TO PLATFORM

.31395340E+00	.47914213E+00	.81966829E+00
-.48728257E+00	-.65962714E+00	.57223046E+00
.81485516E+00	-.57906377E+00	.26385400E-01

...S/C BODY TO N-E-D

.25363640E+00	-.94540721E+00	.20463060E+00
.72165165E+00	.32581066E+00	.61079148E+00
-.64411758E+00	-.72469672E-02	.76489219E+00

TABLE A-1

(concluded)

Planet Parameters

Physical Model

Polar Radius:	20,855,591.48	ft
Equatorial Radius:	20,925,741.47	ft
Rotational Rate:	.7292115147E-4	rad/sec

Gravity Model

Central mass, μ:	.1407646853E17 ft^3/sec^2
J_2:	.10827E-2
C_{30}:	.256E-5
C_{40}:	.158E-5
C_{22}:	.157E-5
S_{22}:	-.897E-6

Runway 33 Location:

Altitude:	-199 ft (above ellipsoid)
Geodetic Latitude:	28.597182 deg
Longitude:	279.317350 deg
Azimuth:	329.999488 deg

Location of IMU relative to center-of-gravity in Body coordinates

(Assumed constant for entry reconstruction)

X_B	56 ft
Y_B	0.0 ft
Z_B	-4 ft

Spacecraft aerodynamic reference parameters

Reference Area	2690 ft^2
Span	78.057 ft
Chord	39.567 ft

Average Attitude Computations @ Epoch (57525 sec)

	IMU1	IMU2	IMU3	μ	σ
ψ(deg)	70.5904	70.5807	70.6351	70.6021	0.0290
θ(deg)	40.1474	40.1859	40.0995	40.1443	0.0433
ϕ(deg)	-0.5144	-0.5580	-0.5428	-0.5384	0.0221

TABLE A-2

Planet and Spacecraft Data Used for

BT17N26, ST17BET, and AEROBET Generation

Weight and Center-of-Gravity (c.g.) Location

Event	Time (sec from epoch)	Weight (lbs)	Xc.g. (inches in Orbiter	Y.c.g. Structural	Zc.g. Reference)
EI	-220	203651.1	1085.4	-0.2	371.9
Mach 3	1262	202829.1	1083.7	-0.2	371.3
Landing	1669	202266.1	1084.8	-0.1	368.4

Moments and Products of Inertia

Event	Time (sec from epoch)	I_{XX}	I_{YY}	I_{ZZ}	I_{XY}	I_{XZ}	I_{YZ}
EI	-220	907968.0	7000453.8	7299405.9	966.6	160902.9	-1678.0
Mach 3	1262	902777.9	6959429.3	7260768.4	888.1	149561.6	-1769.3
Landing	1669	930280.0	6973554.2	7250596.6	2039.5	139903.3	-1372.8

Notes:

- EI time relative to epoch approximated due to gap in OI data
- Mach 3 values held constant until gear deploy (1651 sec), landed values adopted thereafter.

Table A-3 STS-17 (41-G) mass properties.

APPENDIX B

Final residuals for STS-17 trajectory reconstruction

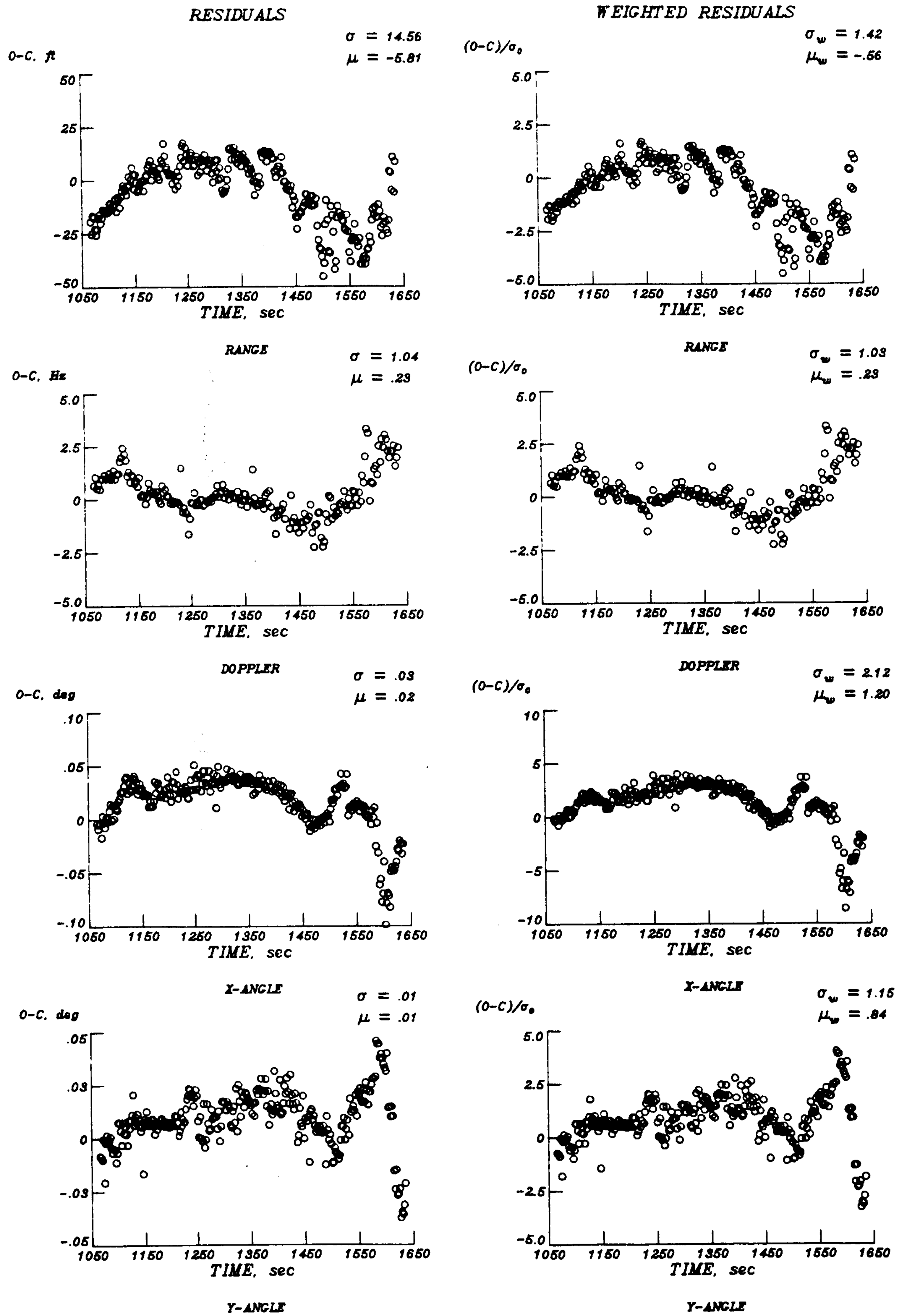


Fig. B-1. *Smoothed residuals versus time for MLXS*

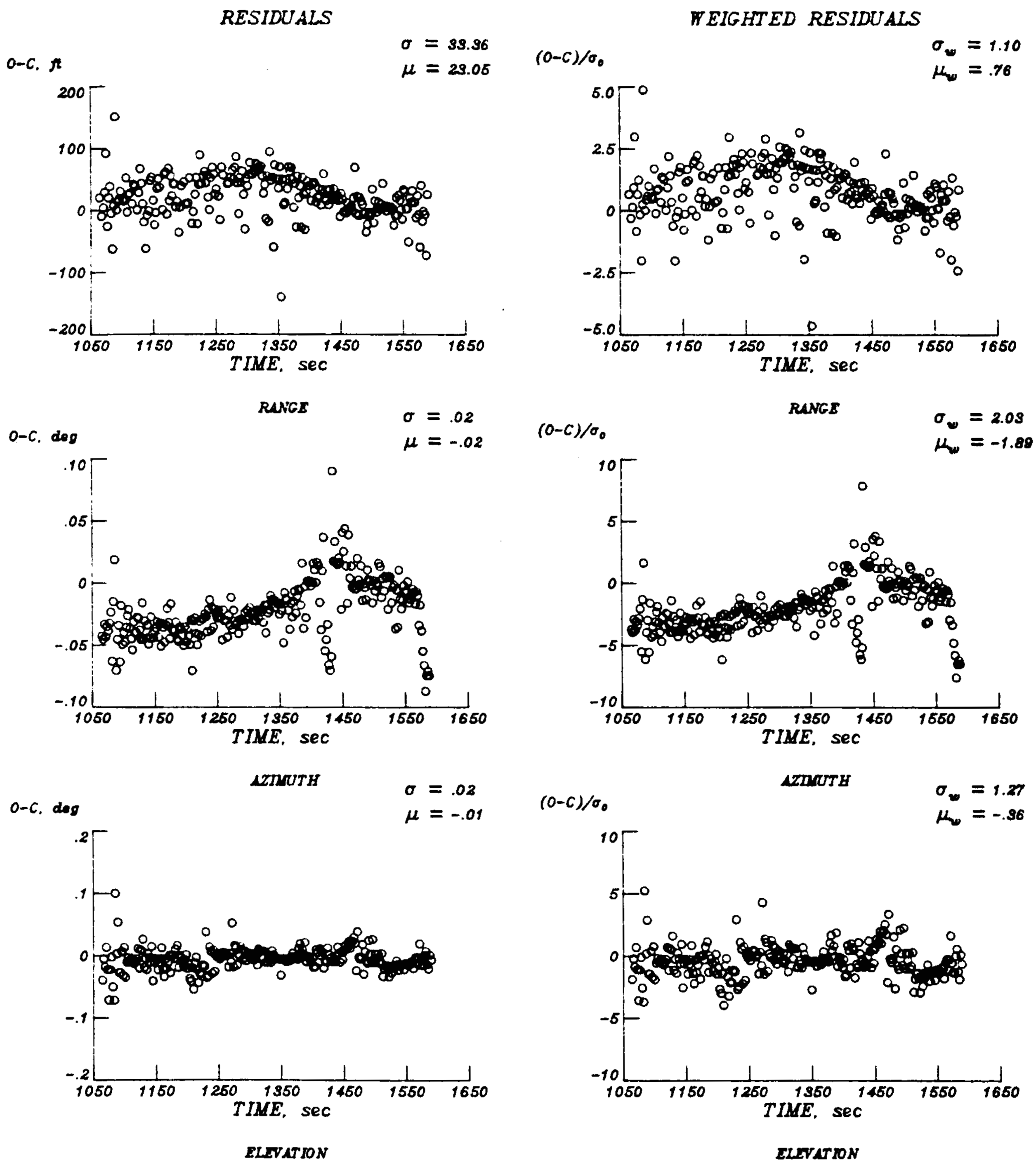


Fig. B-2. *Smoothed residuals versus time for MLMC*

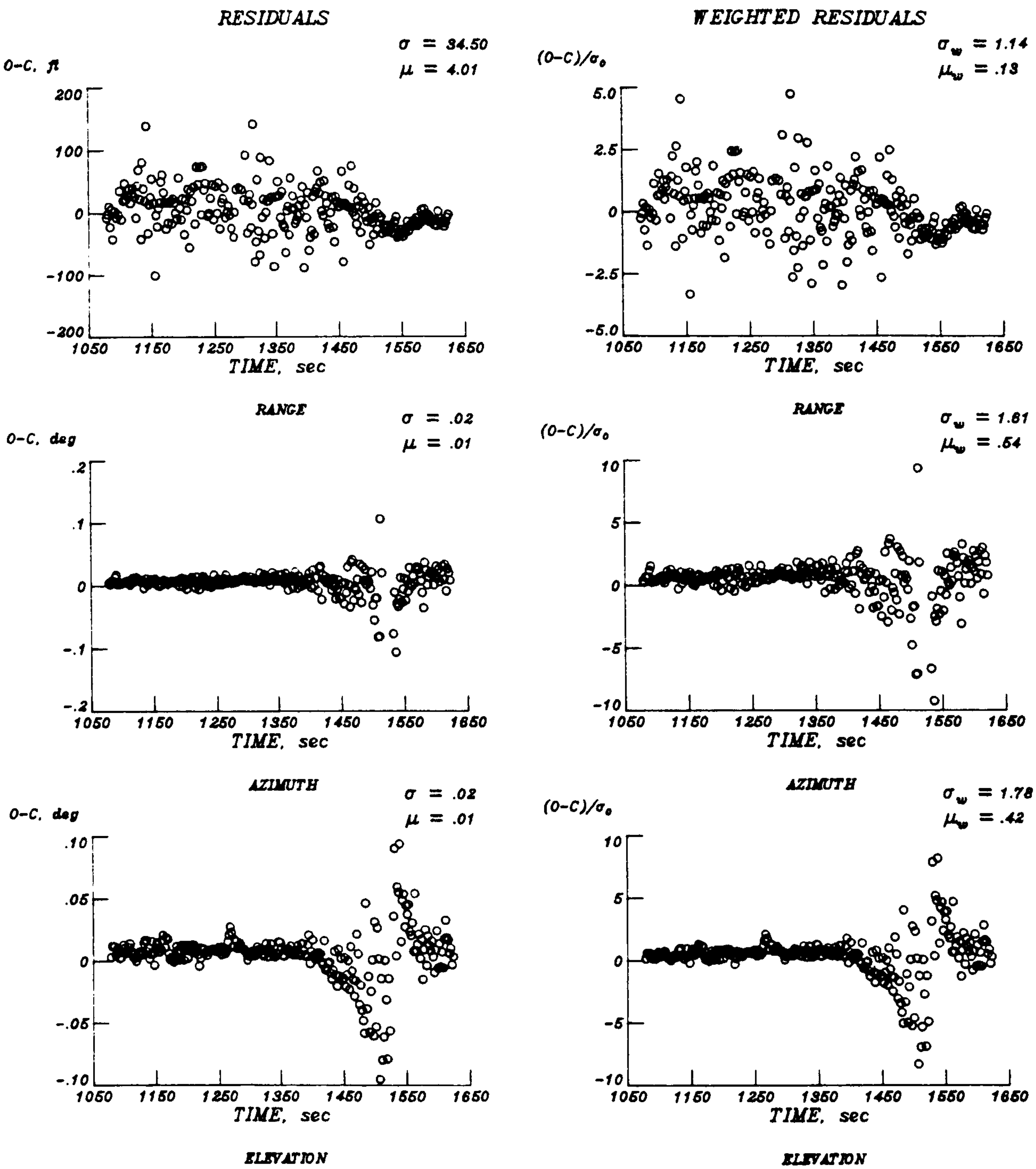


Fig. B-3. *Smoothed residuals versus time for MLAC*

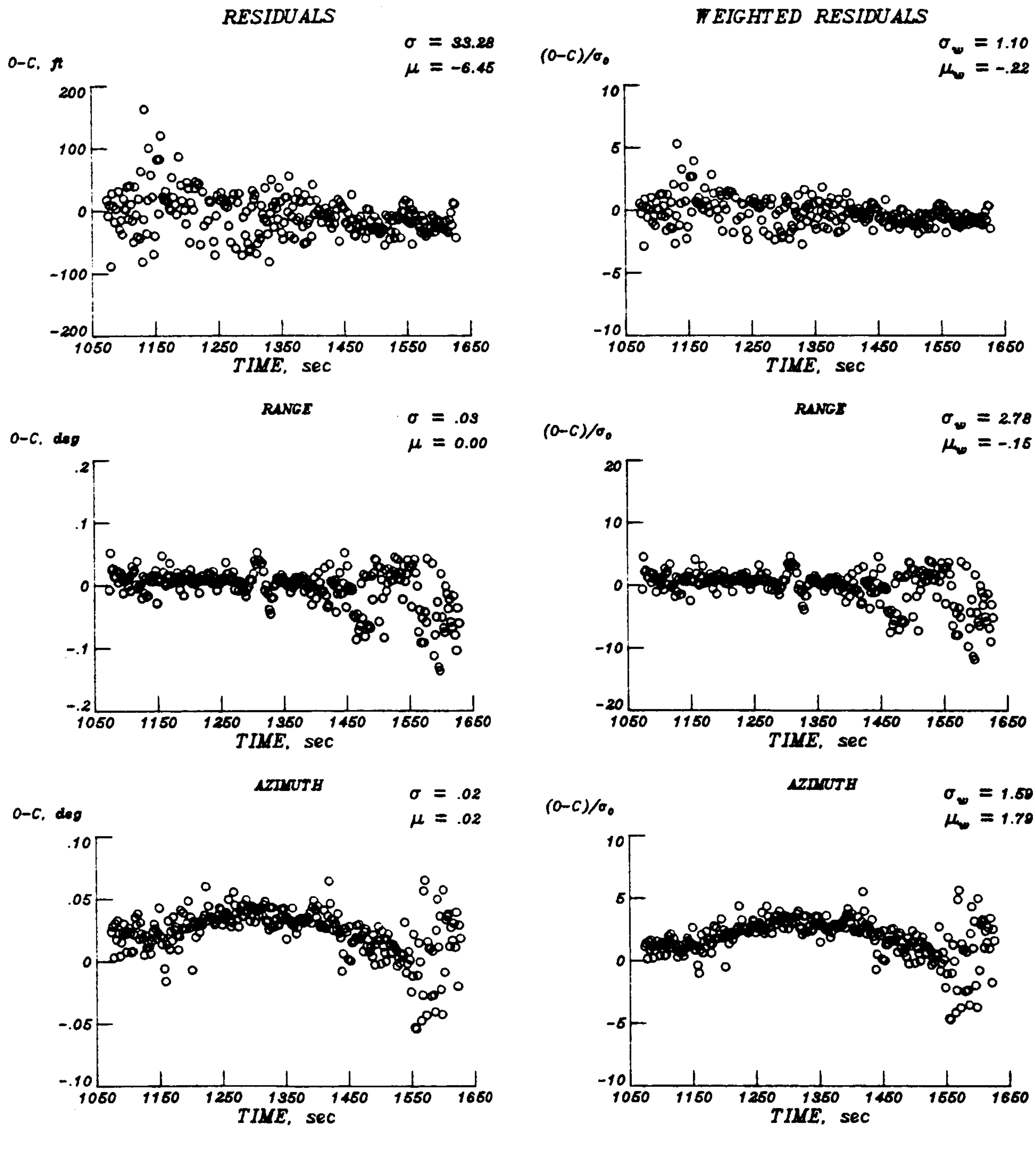


Fig. B-4. *Smoothed residuals versus time for CNMC*

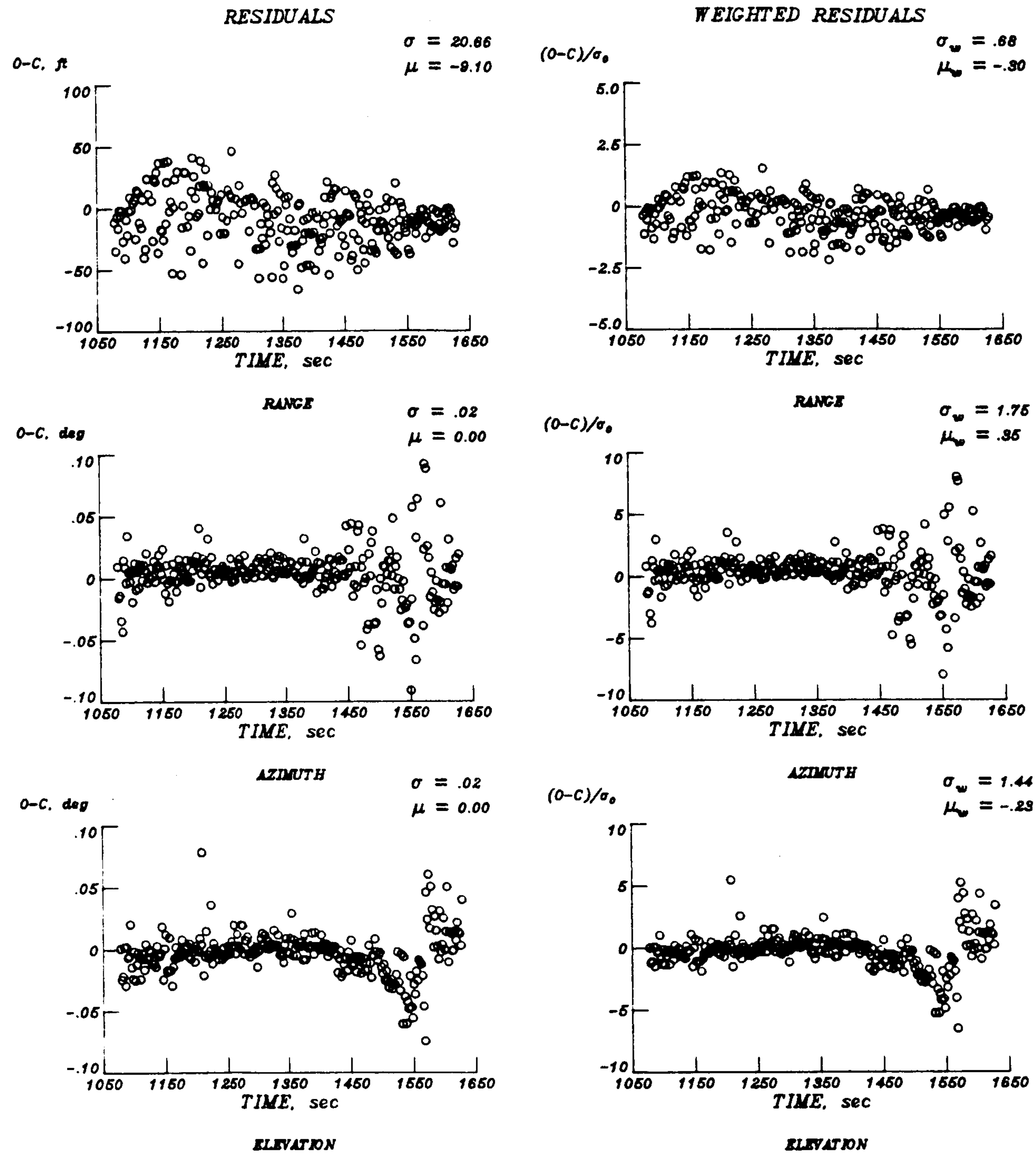


Fig. B-5. *Smoothed residuals versus time for CNVC*

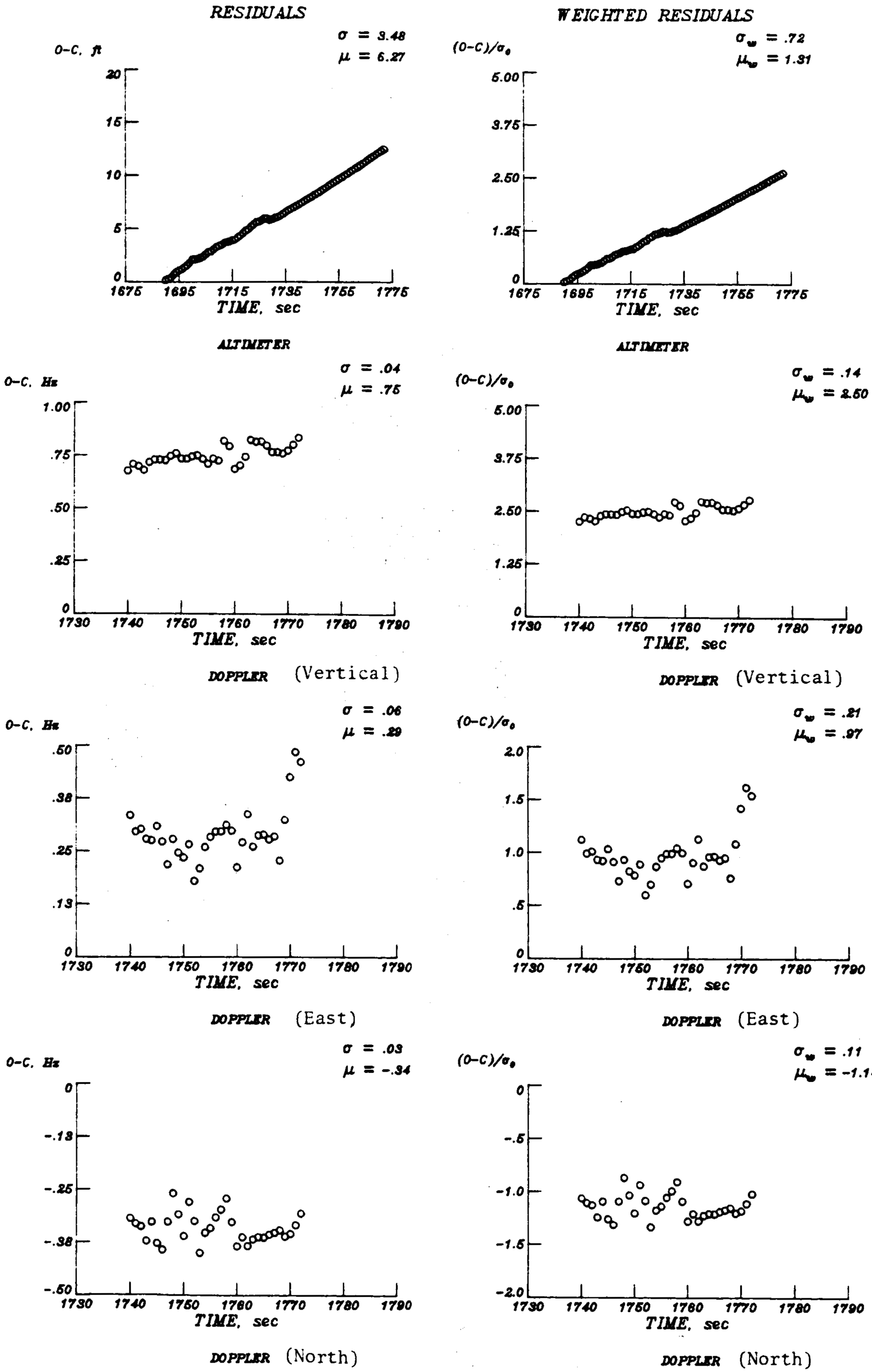


Fig. B-6. Smoothed residuals for altimeter and Doppler (pseudo data).

APPENDIX C

Listing of trajectory and air relative parameters
from final STS-17 (41-G) Extended BET
at two(2) second intervals

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******************************************************************************
*                       LARC "EXTENDED" BET HEADER RECORD                    *
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...DESCRIPTIVE DATA (46-WORDS)
ST17BET USING FLAIR17, INERTIAL-BT17N26, NN0137 DYN. DATA.
841013 1773 STS-17 INERTIAL BET /BT17N26/ (TREF=57525)
INITIAL CONDITIONS FROM EARLIER ITERATIONS (1-4)
IMU NBR 2 EA SEQ 1 (TAPE NC0423)
S,C-BAND, PSEUDO ALTIMETER (POST WONG), PSEUDO DOPPLER (POST STOP)
SOLUTION SET--STATE ONLY, EXTENDED PARTIALS ON

...LABELS AND UNITS FOR DATA ITEMS

(1)	TIME	SEC	(2)	VEL A	FT/SEC	(3)	GAM A	DEG
(4)	HDG A	DEG	(5)	ALTDE	FEET	(6)	LATD	DEG
(7)	LONG	DEG	(8)	SIGMAA	DEG	(9)	BETA A	DEG
(10)	ALPHAA	DEG	(11)	YAW E	DEG	(12)	PTCH E	DEG
(13)	ROLL E	DEG	(14)	U	FT/SEC	(15)	V	FT/SEC
(16)	W	FT/SEC	(17)	VEL R	FT/SEC	(18)	GAM R	DEG
(19)	HDG R	DEG	(20)	SIGMAR	DEG	(21)	BETA R	DEG
(22)	ALPHAR	DEG	(23)	U-WIND	FT/SEC	(24)	V-WIND	FT/SEC
(25)	W-WIND	FT/SEC	(26)	SIG-VA	FT/SEC	(27)	SIG-GA	DEG
(28)	SIG-HA	DEG	(29)	SIG-H	FEET	(30)	SIG-LA	DEG
(31)	SIG-LO	DEG	(32)	SIG-SA	DEG	(33)	SIG-BA	DEG
(34)	SIG-AA	DEG	(35)	SIG-YE	DEG	(36)	SIG-PE	DEG
(37)	SIG-RE	DEG	(38)	SIG-U	FT/SEC	(39)	SIG-V	FT/SEC
(40)	SIG-W	FT/SEC	(41)	MACH A	NONE	(42)	MACH R	NONE
(43)	PINF	PSF	(44)	TEMP	DEG RANKIN	(45)	RHO	SLUGS/FT3
(46)	Q A	PSF	(47)	Q R	PSF	(48)	PSTAG	PSF
(49)	P	DEG/SEC	(50)	Q	DEG/SEC	(51)	R	DEG/SEC
(52)	X ACCEL	FT/SEC/SEC	(53)	Y ACCEL	FT/SEC/SEC	(54)	Z ACCEL	FT/SEC/SEC
(55)	CXB	NONE	(56)	CYB	NONE	(57)	CZB	NONE
(58)	CL	NONE	(59)	CD	NONE	(60)	L/D	NONE
(61)	CL-ROLL	NONE	(62)	CM-PITCH	NONE	(63)	CN-YAW	NONE
(64)	PDOT	DEG/SEC2	(65)	QDOT	DEG/SEC2	(66)	RDOT	DEG/SEC2

...NUMERICAL DATA
ISERNO 1 NWDS 66 IUNITS 2
EPOCH .57525000E+05 RADE .20925741E+08 RADP .20855591E+08 OMEGA .72921151E-04

ST17BET USING FLAIR17, INERTIAL-BT17N26, NN0137 DYN. DATA.

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
0.0	297082.8	24950.7	-1.093	70.807	-.397	-.111	41.262	27.139	.618
2.0	296183.0	24950.8	-1.090	71.003	-.715	-.311	41.238	27.140	.647
4.0	295285.0	24950.9	-1.088	71.199	-.841	-.302	41.162	27.140	.676
6.0	294388.5	24950.9	-1.085	71.396	-.961	-.297	41.081	27.140	.708
8.0	293493.8	24950.9	-1.082	71.594	-1.103	-.304	40.983	27.139	.740
10.0	292600.9	24950.8	-1.080	71.792	-1.250	-.325	40.869	27.139	.774
12.0	291709.9	24950.7	-1.077	71.990	-1.421	-.367	40.744	27.137	.809
14.0	290820.9	24950.5	-1.074	72.189	-1.605	-.442	40.590	27.136	.845
16.0	289933.9	24950.3	-1.071	72.389	-1.799	-.516	40.418	27.135	.883
18.0	289049.0	24950.1	-1.068	72.589	-1.731	-.351	40.253	27.133	.923
20.0	288166.2	24949.9	-1.065	72.789	-1.656	-.257	40.062	27.131	.964
22.0	287285.6	24949.6	-1.062	72.990	-1.631	-.362	39.842	27.129	1.007
24.0	286407.3	24949.3	-1.058	73.191	-1.602	-.448	39.573	27.128	1.052
26.0	285531.4	24949.0	-1.055	73.393	-1.522	-.560	39.285	27.126	1.097
28.0	284657.7	24948.7	-1.052	73.596	-1.174	-.721	39.062	27.124	1.145
30.0	283786.5	24948.3	-1.048	73.799	-.568	-.605	38.998	27.123	1.196
32.0	282917.9	24947.8	-1.045	74.002	.071	-.339	39.096	27.122	1.247
34.0	282052.1	24947.2	-1.041	74.206	.656	-.148	39.290	27.120	1.301
36.0	281189.4	24946.4	-1.036	74.410	1.118	-.038	39.586	27.119	1.356
38.0	280330.0	24945.5	-1.032	74.615	1.458	-.029	40.014	27.119	1.413
40.0	279474.1	24944.4	-1.027	74.821	1.521	-.067	40.597	27.118	1.473
42.0	278622.2	24943.1	-1.022	75.027	1.419	-.169	41.097	27.220	1.545
44.0	277774.4	24905.7	-1.018	75.354	1.249	-.179	41.374	27.474	1.647
46.0	276930.9	24907.5	-1.012	75.544	1.083	-.168	41.517	27.765	1.760
48.0	276091.8	24909.0	-1.006	75.735	.903	-.163	41.488	28.048	1.881
50.0	275257.3	24910.4	-1.000	75.927	.714	-.183	41.238	28.322	2.010
52.0	274427.6	24911.5	-.994	76.119	.522	-.241	40.750	28.588	2.147
54.0	273602.8	24912.4	-.987	76.313	.358	-.299	40.086	28.843	2.293
56.0	272783.3	24913.4	-.981	76.508	.246	-.327	39.467	29.089	2.449
58.0	271968.8	24914.3	-.974	76.704	.189	-.348	39.137	29.325	2.614

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
60.0	271159.7	24915.0	-.967	76.900	.180	-.367	38.943	29.549	2.789
62.0	270356.1	24916.0	-.960	77.098	.219	-.367	38.907	29.763	2.974
64.0	269558.3	24916.3	-.953	77.297	.290	-.380	39.091	29.965	3.170
66.0	268766.4	24916.2	-.945	77.497	.397	-.390	39.524	30.154	3.377
68.0	267980.8	24915.6	-.937	77.699	.550	-.378	40.170	30.331	3.595
70.0	267202.2	24914.4	-.923	77.903	.725	-.377	40.815	30.495	3.824
72.0	266430.9	24912.7	-.918	78.108	.909	-.372	41.193	30.647	4.064
74.0	265667.5	24910.7	-.909	78.313	1.080	-.351	41.309	30.785	4.315
76.0	264912.2	24908.2	-.899	78.519	1.145	-.254	41.096	30.911	4.578
78.0	264165.3	24905.6	-.888	78.726	1.021	-.321	40.599	31.025	4.851
80.0	263427.1	24902.9	-.878	78.932	.815	-.450	39.982	31.127	5.136
82.0	262697.5	24899.9	-.867	79.141	.687	-.536	39.511	31.217	5.432
84.0	261976.8	24896.7	-.856	79.351	.735	-.505	39.224	31.295	5.738
86.0	261265.2	24893.3	-.845	79.563	.878	-.424	39.148	31.363	6.055
88.0	260562.6	24889.5	-.834	79.777	1.035	-.359	39.295	31.419	6.333
90.0	259869.6	24885.5	-.822	79.990	1.148	-.328	39.574	31.465	6.720
92.0	259186.5	24881.1	-.810	80.205	1.211	-.272	40.194	31.501	7.067
94.0	258513.8	24876.2	-.797	80.420	1.172	-.270	40.739	31.528	7.423
96.0	257851.9	24870.9	-.784	80.636	1.095	-.305	41.110	31.545	7.787
98.0	257201.5	24865.0	-.770	80.853	1.049	-.311	41.188	31.553	8.158
100.0	256563.0	24858.9	-.756	81.070	1.016	-.325	40.889	31.554	8.535
102.0	255936.8	24852.9	-.741	81.288	1.015	-.304	40.337	31.548	8.918
104.0	255322.7	24847.1	-.727	81.506	1.027	-.282	39.752	31.535	9.307
106.0	254720.1	24841.5	-.713	81.725	.973	-.303	39.360	31.517	9.702
108.0	254129.4	24835.6	-.699	81.943	.918	-.313	39.081	31.494	10.100
110.0	253550.6	24829.7	-.684	82.163	.874	-.310	39.071	31.465	10.503
112.0	252984.2	24823.6	-.669	82.383	.857	-.292	39.238	31.432	10.908
114.0	252430.7	24817.1	-.654	82.604	.916	-.220	39.557	31.394	11.314
116.0	251890.5	24810.4	-.637	82.825	1.001	-.118	40.062	31.353	11.721
118.0	251364.1	24803.2	-.621	83.047	1.001	-.068	40.645	31.308	12.127

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
120.0	250852.4	24795.3	-.603	83.270	.913	-.078	41.083	31.260	12.531
122.0	250355.8	24787.4	-.585	83.492	.798	-.089	41.264	31.210	12.931
124.0	249874.5	24779.3	-.566	83.715	.695	-.064	41.144	31.159	13.328
126.0	249408.7	24771.3	-.548	83.937	.578	-.043	40.785	31.106	13.719
128.0	248958.1	24763.5	-.530	84.160	.422	-.029	40.290	31.053	14.105
130.0	248522.9	24755.7	-.512	84.381	.817	-1.105	39.764	30.999	14.485
132.0	248103.3	24747.9	-.493	84.604	4.183	-1.751	39.449	30.945	14.858
134.0	247699.7	24740.0	-.474	84.829	10.044	-.786	39.489	30.890	15.222
136.0	247312.0	24731.7	-.455	85.056	16.202	-.254	39.815	30.836	15.577
138.0	246940.2	24723.1	-.436	85.286	22.175	-.144	40.295	30.782	15.921
140.0	246584.1	24714.1	-.417	85.519	27.936	-.128	40.687	30.728	16.255
142.0	246243.0	24704.9	-.400	85.753	33.704	-.230	40.884	30.675	16.578
144.0	245915.8	24695.6	-.384	85.990	39.593	-.199	40.801	30.623	16.892
146.0	245601.3	24686.4	-.370	86.230	45.457	-.041	40.522	30.571	17.196
148.0	245297.5	24677.2	-.358	86.471	50.087	.699	39.988	30.520	17.494
150.0	245003.3	24668.3	-.346	86.712	52.731	.401	39.456	30.470	17.785
152.0	244717.9	24659.6	-.336	86.953	54.993	-.122	39.132	30.422	18.070
154.0	244440.5	24651.0	-.327	87.196	57.773	-.172	38.962	30.373	18.350
156.0	244170.2	24642.1	-.318	87.440	60.569	.213	39.002	30.325	18.625
158.0	243906.3	24633.2	-.311	87.684	62.677	.289	39.241	30.278	18.896
160.0	243648.2	24623.9	-.303	87.929	64.224	.266	39.741	30.230	19.162
162.0	243395.3	24614.2	-.297	88.175	65.330	.290	40.355	30.183	19.424
164.0	243147.7	24604.1	-.290	88.421	66.144	.255	40.765	30.135	19.682
166.0	242905.0	24593.7	-.284	88.667	66.627	.270	40.907	30.087	19.936
168.0	242667.1	24583.2	-.278	88.914	66.931	.240	40.777	30.040	20.187
170.0	242433.8	24572.8	-.272	89.161	67.145	.219	40.468	29.993	20.435
172.0	242205.0	24562.5	-.266	89.407	67.324	.235	40.112	29.947	20.679
174.0	241980.6	24552.3	-.261	89.654	67.498	.134	39.830	29.901	20.921
176.0	241760.4	24542.1	-.255	89.901	67.852	.068	39.702	29.856	21.159
178.0	241544.4	24531.7	-.250	90.148	68.413	.160	39.713	29.811	21.394

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
180.0	241332.3	24521.1	-.245	90.395	69.071	.088	39.864	29.766	21.626
182.0	241123.8	24510.1	-.240	90.642	69.891	.181	40.034	29.722	21.854
184.0	240918.6	24499.3	-.236	90.890	70.627	.264	40.170	29.677	22.080
186.0	240716.2	24488.5	-.232	91.138	71.155	.268	40.215	29.634	22.304
188.0	240516.2	24477.7	-.229	91.385	71.580	.271	40.175	29.590	22.526
190.0	240318.6	24466.7	-.225	91.633	71.861	.254	40.074	29.546	22.747
192.0	240123.0	24455.7	-.222	91.881	72.093	.276	39.957	29.503	22.967
194.0	239929.4	24444.7	-.220	92.129	72.166	.265	39.880	29.460	23.185
196.0	239737.6	24433.6	-.217	92.377	72.045	.183	39.865	29.417	23.402
198.0	239547.8	24422.4	-.214	92.625	71.863	.118	39.918	29.374	23.618
200.0	239360.1	24410.8	-.211	92.874	71.658	.106	40.016	29.331	23.832
202.0	239174.4	24399.3	-.207	93.122	71.553	.055	40.100	29.288	24.044
204.0	238990.9	24387.6	-.204	93.370	71.617	.131	40.140	29.246	24.254
206.0	238809.5	24375.5	-.201	93.619	71.596	.144	40.139	29.203	24.463
208.0	238630.1	24363.5	-.198	93.868	71.494	.129	40.092	29.160	24.669
210.0	238452.8	24351.5	-.195	94.117	71.283	.076	40.040	29.118	24.874
212.0	238277.5	24339.4	-.192	94.365	71.246	-.026	39.999	29.076	25.078
214.0	238104.3	24327.3	-.189	94.613	71.518	.080	39.954	29.035	25.279
216.0	237932.7	24315.3	-.187	94.861	71.667	.120	39.906	28.993	25.480
218.0	237762.7	24304.4	-.184	95.111	71.720	.065	39.890	28.954	25.682
220.0	237594.1	24292.5	-.182	95.358	71.802	.015	39.917	28.913	25.881
222.0	237426.6	24280.6	-.180	95.604	71.980	-.069	39.976	28.873	26.079
224.0	237260.2	24268.4	-.178	95.851	72.386	-.025	40.029	28.832	26.276
226.0	237094.6	24256.0	-.177	96.098	72.733	.017	40.051	28.791	26.473
228.0	236929.6	24243.3	-.176	96.346	72.982	.008	40.046	28.750	26.668
230.0	236765.3	24230.5	-.174	96.593	73.245	.056	39.996	28.709	26.864
232.0	236601.2	24217.7	-.174	96.840	73.395	.061	39.943	28.668	27.060
234.0	236437.3	24204.8	-.173	97.087	73.400	.007	39.894	28.627	27.257
236.0	236273.6	24191.4	-.172	97.335	73.399	-.019	39.863	28.586	27.453
238.0	236110.1	24178.4	-.171	97.581	73.430	.002	39.870	28.545	27.651

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
240.0	235946.4	24165.3	-.171	97.827	73.428	.028	39.918	28.504	27.849
242.0	235782.5	24151.8	-.170	98.074	73.370	.037	39.960	28.462	28.048
244.0	235618.6	24138.1	-.170	98.321	73.188	-.008	39.994	28.420	28.247
246.0	235454.7	24124.1	-.169	98.567	73.031	.023	40.019	28.378	28.446
248.0	235290.8	24109.9	-.168	98.814	72.681	.108	40.048	28.336	28.646
250.0	235127.2	24095.5	-.167	99.061	72.095	.072	40.069	28.293	28.845
252.0	234964.1	24080.9	-.166	99.308	71.457	.049	40.067	28.251	29.044
254.0	234801.9	24066.0	-.164	99.554	70.768	.062	40.028	28.208	29.243
256.0	234640.9	24051.1	-.161	99.800	69.913	.008	39.987	28.166	29.439
258.0	234481.6	24037.0	-.159	100.048	69.109	-.085	39.955	28.124	29.637
260.0	234324.1	24022.1	-.156	100.292	68.673	-.027	39.924	28.082	29.830
262.0	234168.6	24007.1	-.153	100.537	68.223	-.012	39.894	28.041	30.021
264.0	234015.3	23992.2	-.149	100.780	67.954	-.096	39.892	28.000	30.210
265.0	233863.9	23977.3	-.146	101.022	67.732	-.130	39.911	27.959	30.397
268.0	233714.6	23962.2	-.143	101.265	67.364	-.110	39.955	27.919	30.581
270.0	233567.4	23946.8	-.140	101.507	68.104	-.111	39.997	27.878	30.761
272.0	233421.9	23931.2	-.138	101.750	68.386	-.072	40.027	27.838	30.939
274.0	233278.1	23915.4	-.135	101.992	68.629	-.040	40.048	27.797	31.115
276.0	233135.6	23899.6	-.133	102.234	68.789	-.040	40.038	27.757	31.289
278.0	232994.3	23883.6	-.131	102.475	68.849	-.097	39.991	27.717	31.462
280.0	232854.1	23867.5	-.129	102.717	68.916	-.125	39.945	27.677	31.633
282.0	232715.1	23851.1	-.127	102.959	69.001	-.112	39.923	27.637	31.802
284.0	232577.1	23834.7	-.126	103.199	69.043	-.124	39.922	27.597	31.970
286.0	232439.9	23818.2	-.124	103.440	69.076	-.126	39.967	27.557	32.137
288.0	232303.5	23801.3	-.122	103.681	69.108	-.119	40.011	27.517	32.302
290.0	232167.9	23784.3	-.121	103.921	69.115	-.102	40.041	27.477	32.466
292.0	232033.0	23767.2	-.120	104.161	69.108	-.075	40.050	27.437	32.629
294.0	231898.6	23750.1	-.118	104.400	69.016	-.073	40.031	27.398	32.792
296.0	231764.6	23732.8	-.117	104.639	68.811	-.140	39.984	27.358	32.955
298.0	231631.1	23715.5	-.116	104.878	68.672	-.143	39.956	27.318	33.116

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
300.0	231498.2	23698.0	-.115	105.116	68.581	-.089	39.951	27.278	33.277
302.0	231365.7	23680.4	-.114	105.354	68.404	-.091	39.967	27.238	33.437
304.0	231233.9	23663.1	-.112	105.592	68.152	-.111	40.001	27.199	33.598
306.0	231102.9	23644.8	-.110	105.830	67.863	-.123	39.991	27.159	33.755
308.0	230972.8	23626.9	-.109	106.066	67.587	-.116	39.867	27.119	33.912
310.0	230843.1	23609.5	-.108	106.301	67.295	-.108	39.692	27.080	34.070
312.0	230713.6	23592.1	-.107	106.535	66.983	-.115	39.594	27.042	34.228
314.0	230584.7	23574.3	-.106	106.769	66.331	-.118	39.571	27.002	34.384
316.0	230456.3	23556.1	-.104	107.003	66.822	-.114	39.590	26.963	34.540
318.0	230328.4	23537.8	-.103	107.237	66.889	-.106	39.627	26.924	34.694
320.0	230200.7	23519.2	-.102	107.471	66.960	-.095	39.661	26.884	34.847
322.0	230073.4	23500.4	-.101	107.704	66.967	-.086	39.670	26.844	35.000
324.0	229946.4	23481.5	-.100	107.938	66.839	-.079	39.633	26.805	35.152
326.0	229819.9	23462.5	-.099	108.170	66.506	-.077	39.528	26.765	35.303
328.0	229694.0	23443.4	-.098	108.403	66.028	-.051	39.363	26.726	35.454
330.0	229569.1	23424.3	-.096	108.635	65.420	-.082	39.230	26.686	35.603
332.0	229445.3	23405.2	-.093	108.865	64.764	-.081	39.141	26.647	35.750
334.0	229322.9	23386.2	-.091	109.095	64.065	-.118	39.107	26.608	35.896
336.0	229202.2	23367.1	-.088	109.324	63.525	-.171	39.073	26.570	36.039
338.0	229083.6	23347.5	-.085	109.554	63.217	-.131	39.055	26.531	36.178
340.0	228967.6	23327.7	-.081	109.783	62.809	-.129	39.034	26.492	36.311
342.0	228854.3	23307.8	-.077	110.012	62.372	-.128	38.982	26.454	36.440
344.0	228743.9	23288.1	-.073	110.239	61.904	-.131	38.337	26.417	36.565
346.0	228636.1	23268.7	-.069	110.465	61.390	-.167	38.694	26.380	36.687
348.0	228531.1	23249.4	-.065	110.691	61.043	-.238	38.650	26.344	36.804
350.0	228429.1	23230.0	-.061	110.915	61.021	-.266	38.672	26.308	36.916
352.0	228329.7	23210.6	-.057	111.139	61.132	-.229	38.700	26.272	37.024
354.0	228232.8	23191.3	-.054	111.362	61.385	-.222	38.753	26.237	37.128
356.0	228137.9	23171.6	-.050	111.586	61.685	-.230	38.781	26.202	37.228
358.0	228045.1	23151.9	-.048	111.809	62.248	-.253	38.844	26.168	37.324

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TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
360.0	227953.8	23132.0	-.045	112.027	62.912	-.223	38.881	26.133	37.416
362.0	227863.6	23111.8	-.044	112.250	63.318	-.131	38.904	26.098	37.506
364.0	227774.2	23091.5	-.042	112.473	63.496	-.208	38.872	26.063	37.595
366.0	227685.1	23071.6	-.042	112.695	63.842	-.167	38.835	26.029	37.684
368.0	227595.8	23051.4	-.041	112.916	64.138	-.176	38.795	25.994	37.772
370.0	227506.4	23030.9	-.041	113.138	64.421	-.176	38.811	25.959	37.860
372.0	227416.5	23010.4	-.041	113.360	64.530	-.073	38.857	25.925	37.949
374.0	227325.6	22989.9	-.042	113.580	64.255	-.180	38.897	25.890	38.039
376.0	227234.1	22969.2	-.042	113.800	64.094	-.196	38.906	25.854	38.130
378.0	227142.0	22948.3	-.042	114.020	64.006	-.173	38.896	25.819	38.222
380.0	227049.1	22927.4	-.042	114.239	63.909	-.170	38.865	25.783	38.314
382.0	226955.8	22906.1	-.042	114.459	63.739	-.220	38.842	25.747	38.407
384.0	226861.8	22885.1	-.043	114.677	63.750	-.161	38.847	25.712	38.501
386.0	226766.9	22864.0	-.044	114.894	63.752	-.129	38.860	25.676	38.597
388.0	226671.1	22842.5	-.044	115.112	63.652	-.146	38.884	25.640	38.693
390.0	226574.3	22821.1	-.045	115.329	63.665	-.106	38.887	25.603	38.792
392.0	226476.4	22799.6	-.046	115.545	63.640	-.085	38.856	25.567	38.892
394.0	226377.1	22778.1	-.047	115.761	63.570	-.082	38.819	25.530	38.994
396.0	226276.5	22756.4	-.048	115.976	63.383	-.141	38.809	25.493	39.099
398.0	226174.7	22734.7	-.049	116.191	63.280	-.135	38.834	25.456	39.205
400.0	226071.4	22712.8	-.050	116.405	63.213	-.098	38.876	25.419	39.314
402.0	225966.9	22690.4	-.051	116.619	63.017	-.130	38.886	25.381	39.423
404.0	225861.3	22668.0	-.052	116.833	62.892	-.095	38.865	25.343	39.534
406.0	225754.7	22645.3	-.053	117.047	62.725	-.051	38.845	25.305	39.647
408.0	225647.2	22622.6	-.054	117.260	62.403	-.040	38.863	25.266	39.760
410.0	225538.7	22599.7	-.054	117.472	61.792	-.006	38.907	25.227	39.876
412.0	225429.7	22576.8	-.054	117.684	60.950	-.109	38.929	25.189	39.992
414.0	225320.7	22553.6	-.053	117.895	60.479	-.125	38.959	25.149	40.107
416.0	225212.3	22529.8	-.051	118.106	59.984	-.105	38.959	25.110	40.219
418.0	225105.0	22505.9	-.049	118.317	59.335	-.107	38.896	25.071	40.329

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*    ST17BET USING FLAIR17, INERTIAL-BT17N26, NN0137 DYN. DATA.                       PAGE    8   *
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TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
420.0	224999.2	22482.1	-.046	118.526	58.786	-.157	38.732	25.032	40.437
422.0	224895.2	22458.4	-.044	118.735	58.349	-.122	38.575	24.993	40.542
424.0	224792.8	22435.1	-.041	118.942	57.837	-.150	38.439	24.955	40.645
426.0	224691.9	22410.4	-.039	119.142	57.674	-.240	38.206	24.916	40.741
428.0	224592.6	22387.4	-.037	119.348	57.982	-.242	38.152	24.879	40.840
430.0	224494.4	22364.1	-.035	119.554	58.343	-.190	38.333	24.841	40.936
432.0	224397.2	22340.4	-.033	119.760	58.621	-.154	38.508	24.804	41.029
434.0	224301.0	22316.4	-.031	119.966	58.796	-.131	38.567	24.766	41.119
436.0	224205.5	22292.3	-.030	120.172	58.773	-.186	38.556	24.729	41.207
438.0	224110.8	22268.1	-.028	120.378	58.658	-.240	38.539	24.691	41.293
440.0	224016.8	22243.8	-.027	120.583	58.609	-.208	38.555	24.654	41.378
442.0	223923.7	22219.3	-.025	120.788	58.413	-.249	38.594	24.616	41.460
444.0	223831.3	22194.8	-.024	120.992	58.218	-.261	38.636	24.579	41.541
446.0	223739.6	22170.4	-.023	121.195	58.022	-.302	38.629	24.541	41.621
448.0	223648.6	22145.8	-.021	121.398	58.088	-.299	38.585	24.504	41.699
450.0	223558.4	22121.1	-.020	121.601	58.227	-.252	38.557	24.467	41.775
452.0	223468.5	22096.5	-.019	121.803	58.243	-.299	38.602	24.430	41.851
454.0	223378.7	22071.7	-.019	122.005	58.275	-.329	38.634	24.393	41.926
456.0	223289.0	22046.9	-.018	122.206	58.360	-.351	38.540	24.355	42.000
458.0	223198.9	22022.2	-.018	122.407	58.239	-.299	39.288	24.318	42.076
460.0	223109.0	21996.1	-.017	122.608	57.917	-.350	39.115	24.280	42.147
462.0	223019.3	21970.4	-.016	122.809	57.687	-.346	39.394	24.242	42.218
464.0	222930.1	21945.6	-.016	123.008	57.428	-.372	38.055	24.205	42.291
466.0	222840.1	21921.5	-.016	123.205	57.224	-.389	38.093	24.169	42.369
468.0	222749.6	21896.7	-.017	123.402	58.146	.438	38.494	24.132	42.445
470.0	222658.7	21871.5	-.017	123.600	56.571	-.922	38.687	24.095	42.521
472.0	222567.5	21846.1	-.016	123.796	56.517	-.363	38.915	24.057	42.596
474.0	222477.0	21820.3	-.014	123.992	56.759	-.687	39.119	24.020	42.668
476.0	222386.8	21794.1	-.015	124.189	58.640	-.391	39.447	23.982	42.738
478.0	222295.4	21767.3	-.017	124.388	59.911	-.282	39.579	23.943	42.808

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
480.0	222201.6	21740.3	-.020	124.587	60.711	-.306	39.461	23.904	42.882
482.0	222104.8	21713.4	-.024	124.786	61.236	-.317	39.316	23.864	42.962
484.0	222004.3	21686.4	-.028	124.985	61.516	-.337	39.237	23.824	43.048
486.0	221899.9	21659.3	-.033	125.184	61.814	-.336	39.257	23.784	43.142
488.0	221791.1	21632.1	-.039	125.383	62.029	-.290	39.286	23.743	43.244
490.0	221677.6	21604.8	-.045	125.582	61.960	-.343	39.282	23.702	43.355
492.0	221559.4	21577.1	-.051	125.780	61.917	-.360	39.235	23.660	43.473
494.0	221436.5	21548.2	-.057	125.982	61.954	-.297	39.200	23.617	43.596
496.0	221308.5	21520.5	-.063	126.180	61.648	-.303	39.226	23.574	43.734
498.0	221175.7	21492.5	-.069	126.377	61.302	-.336	39.268	23.531	43.880
500.0	221038.6	21464.0	-.074	126.576	61.009	-.310	39.289	23.487	44.033
502.0	220897.4	21435.4	-.079	126.773	60.700	-.282	39.287	23.442	44.194
504.0	220752.3	21406.6	-.084	126.971	60.314	-.259	39.256	23.397	44.362
506.0	220603.4	21377.9	-.089	127.168	59.854	-.247	39.239	23.352	44.539
508.0	220450.9	21349.1	-.093	127.364	59.301	-.251	39.254	23.306	44.723
510.0	220295.2	21320.2	-.097	127.560	58.681	-.275	39.276	23.261	44.914
512.0	220136.7	21290.8	-.100	127.755	58.082	-.311	39.267	23.215	45.110
514.0	219976.7	21260.8	-.101	127.952	57.472	-.346	39.257	23.168	45.306
516.0	219815.8	21230.6	-.101	128.149	57.033	-.374	39.210	23.121	45.504
518.0	219654.6	21200.4	-.102	128.344	56.590	-.363	39.013	23.074	45.703
520.0	219493.3	21170.2	-.101	128.540	56.054	-.372	38.845	23.027	45.903
522.0	219332.3	21140.1	-.100	128.735	55.456	-.400	38.763	22.981	46.104
524.0	219172.3	21109.6	-.098	128.929	54.856	-.423	38.727	22.934	46.302
526.0	219014.0	21078.9	-.095	129.124	54.275	-.447	38.652	22.888	46.496
528.0	218858.1	21048.3	-.091	129.318	53.788	-.448	38.464	22.842	46.686
530.0	218704.7	21017.9	-.088	129.510	53.349	-.456	38.314	22.797	46.872
532.0	218554.0	20987.6	-.083	129.703	53.015	-.483	38.237	22.752	47.054
534.0	218406.3	20957.2	-.079	129.894	52.877	-.545	38.267	22.707	47.230
536.0	218261.7	20926.7	-.075	130.086	53.269	-.511	38.282	22.663	47.399
538.0	218119.7	20895.9	-.071	130.288	53.822	-.488	38.239	22.619	47.562

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
540.0	217979.4	20865.5	-.069	130.479	54.287	-.418	38.206	22.575	47.723
542.0	217840.5	20835.0	-.067	130.671	54.693	-.417	38.205	22.532	47.882
544.0	217702.3	20804.4	-.067	130.863	55.174	-.355	38.231	22.488	48.039
546.0	217564.4	20773.6	-.066	131.055	55.460	-.347	38.233	22.445	48.194
548.0	217426.7	20742.6	-.066	131.247	55.790	-.333	38.194	22.401	48.349
550.0	217288.7	20711.6	-.066	131.439	56.219	-.289	38.141	22.358	48.505
552.0	217149.8	20680.6	-.068	131.632	56.538	-.201	38.161	22.315	48.664
554.0	217009.6	20649.4	-.069	131.824	56.500	-.242	38.195	22.271	48.824
556.0	216868.0	20618.1	-.071	132.016	56.480	-.245	38.232	22.228	48.988
558.0	216725.1	20586.5	-.073	132.208	56.491	-.222	38.269	22.184	49.154
560.0	216581.0	20554.6	-.074	132.401	56.502	-.200	38.292	22.140	49.321
562.0	216435.5	20522.6	-.076	132.593	56.496	-.160	38.289	22.096	49.492
564.0	216288.7	20490.6	-.078	132.785	56.485	-.119	38.266	22.052	49.666
566.0	216140.4	20458.4	-.080	132.977	56.368	-.102	38.279	22.007	49.843
568.0	215990.5	20426.1	-.082	133.169	56.163	-.095	38.291	21.963	50.024
570.0	215839.3	20393.7	-.083	133.360	55.937	-.074	38.275	21.919	50.208
572.0	215686.7	20361.4	-.085	133.550	55.594	-.105	38.304	21.875	50.397
574.0	215532.9	20328.8	-.086	133.740	55.216	-.112	38.402	21.831	50.587
576.0	215378.4	20295.9	-.087	133.929	54.785	-.116	38.491	21.786	50.778
578.0	215223.7	20262.7	-.087	134.118	54.326	-.193	38.497	21.741	50.970
580.0	215069.3	20229.4	-.086	134.307	54.090	-.219	38.473	21.697	51.160
582.0	214915.5	20195.9	-.085	134.495	53.952	-.286	38.468	21.652	51.349
584.0	214762.6	20162.6	-.083	134.689	54.229	-.244	38.483	21.608	51.538
586.0	214610.1	20128.8	-.083	134.877	54.570	-.237	38.488	21.563	51.723
588.0	214457.8	20094.6	-.083	135.067	55.020	-.182	38.479	21.519	51.908
590.0	214305.2	20060.3	-.084	135.256	55.409	-.145	38.471	21.474	52.093
592.0	214151.9	20025.9	-.085	135.446	55.798	-.125	38.478	21.429	52.279
594.0	213997.2	19991.3	-.087	135.636	56.232	-.061	38.468	21.385	52.470
596.0	213840.7	19956.7	-.090	135.826	56.577	-.029	38.466	21.340	52.664
598.0	213681.6	19921.9	-.094	136.017	56.344	.015	38.464	21.295	52.866

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
600.0	213519.7	19887.0	-.098	136.207	56.967	.058	38.469	21.250	53.074
602.0	213354.8	19851.9	-.103	136.397	56.830	.010	38.468	21.205	53.290
604.0	213187.0	19816.6	-.107	136.588	56.591	-.006	38.450	21.160	53.513
606.0	213016.4	19781.2	-.110	136.777	56.214	-.024	38.440	21.114	53.743
608.0	212843.4	19745.9	-.114	136.965	55.751	-.020	38.448	21.069	53.981
610.0	212668.2	19710.4	-.116	137.153	55.366	-.143	38.512	21.024	54.225
612.0	212491.2	19674.7	-.119	137.340	55.447	-.156	38.605	20.979	54.474
614.0	212312.3	19638.7	-.122	137.527	55.526	-.169	38.683	20.934	54.727
616.0	212131.4	19602.4	-.125	137.714	55.605	-.200	38.766	20.888	54.986
618.0	211948.4	19565.8	-.128	137.901	55.728	-.211	38.813	20.842	55.249
620.0	211763.2	19529.0	-.132	138.088	55.939	-.169	38.817	20.797	55.519
622.0	211575.5	19490.7	-.136	138.273	56.161	-.113	38.823	20.749	55.789
624.0	211385.0	19453.5	-.140	138.460	56.263	-.111	38.829	20.704	56.074
626.0	211191.4	19416.3	-.145	138.648	56.299	-.135	38.828	20.658	56.369
628.0	210994.8	19378.8	-.150	138.836	56.358	-.142	38.858	20.612	56.673
630.0	210795.0	19340.9	-.154	139.024	56.423	-.153	38.885	20.566	56.986
632.0	210592.1	19302.8	-.159	139.213	56.522	-.144	38.909	20.520	57.308
634.0	210386.3	19264.4	-.164	139.402	56.598	-.162	38.914	20.474	57.639
636.0	210177.2	19225.9	-.169	139.591	56.719	-.157	38.924	20.428	57.981
638.0	209964.7	19187.3	-.175	139.780	56.913	-.099	38.925	20.382	58.334
640.0	209748.5	19148.7	-.181	139.969	56.984	-.089	38.923	20.336	58.701
642.0	209527.9	19110.2	-.188	140.157	56.959	-.112	38.931	20.291	59.085
644.0	209302.8	19071.7	-.195	140.345	56.920	-.115	38.980	20.246	59.485
646.0	209073.2	19032.9	-.202	140.533	56.961	-.112	39.081	20.200	59.900
648.0	208839.3	18993.4	-.208	140.722	56.695	-.166	39.159	20.155	60.328
650.0	208601.6	18954.0	-.214	140.909	56.599	-.182	39.192	20.110	60.772
652.0	208359.8	18914.4	-.221	141.097	56.603	-.163	39.190	20.065	61.232
654.0	208113.8	18875.1	-.228	141.279	56.624	-.164	39.273	20.021	61.712
656.0	207863.7	18834.8	-.234	141.468	56.676	-.172	39.351	19.976	62.204
658.0	207610.1	18794.1	-.239	141.657	57.302	-.462	39.422	19.931	62.709

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
660.0	207352.1	18752.8	-.251	141.851	60.245	.115	39.435	19.886	63.231
662.0	207085.6	18711.9	-.264	142.045	59.251	-1.100	39.275	19.842	63.788
664.0	206811.7	18670.8	-.275	142.233	59.943	-.837	39.276	19.798	64.376
666.0	206530.4	18629.2	-.288	142.434	60.893	-.272	39.395	19.740	64.902
668.0	206240.3	18585.6	-.302	142.634	61.381	-.130	40.441	19.670	65.372
670.0	205941.7	18542.5	-.317	142.834	61.802	-.109	38.695	19.600	65.872
672.0	205631.8	18503.3	-.337	143.029	62.275	-.082	38.658	19.533	66.432
674.0	205309.6	18461.7	-.353	143.229	62.592	.213	39.416	19.464	67.012
676.0	204975.7	18418.4	-.372	143.430	59.280	.241	39.588	19.392	67.616
678.0	204636.3	18374.4	-.377	143.628	55.129	.060	39.434	19.319	68.233
680.0	204297.4	18330.7	-.372	143.818	51.418	-.207	39.203	19.247	68.855
682.0	203964.9	18286.4	-.361	144.007	50.288	-.201	39.014	19.176	69.458
684.0	203640.9	18241.7	-.347	144.196	49.630	-.132	38.804	19.105	70.037
686.0	203326.6	18197.1	-.332	144.385	48.998	-.113	38.587	19.035	70.593
688.0	203022.6	18204.9	-.315	144.455	48.518	-.200	38.501	19.021	71.532
690.0	202729.3	18158.3	-.300	144.651	48.350	-.241	38.396	18.952	72.019
692.0	202446.4	18111.8	-.284	144.847	48.930	-.298	38.301	18.883	72.478
694.0	202172.5	18066.2	-.273	145.042	50.327	-.193	38.273	18.817	72.919
696.0	201904.5	18020.8	-.266	145.238	51.896	-.271	38.309	18.751	73.346
698.0	201640.0	17974.1	-.264	145.440	54.568	-.142	38.551	18.684	73.752
700.0	201375.5	17927.3	-.267	145.646	56.285	-.038	38.716	18.618	74.159
702.0	201108.9	17880.2	-.273	145.855	57.178	-.084	38.794	18.551	74.569
704.0	200838.6	17832.6	-.280	146.066	57.987	-.036	38.895	18.484	74.987
706.0	200563.6	17785.1	-.290	146.276	58.364	-.035	38.952	18.417	75.422
708.0	200282.9	17737.2	-.300	146.488	58.716	-.003	39.035	18.350	75.871
710.0	199996.6	17688.3	-.310	146.703	58.952	-.025	39.130	18.281	76.330
712.0	199705.3	17638.2	-.318	146.922	59.051	-.051	39.189	18.211	76.795
714.0	199409.4	17587.6	-.326	147.141	58.472	.070	39.149	18.141	77.270
716.0	199110.2	17536.9	-.331	147.360	57.244	.044	39.004	18.070	77.756
718.0	198809.9	17486.1	-.332	147.576	55.966	.029	38.897	18.000	78.247

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*   ST17BET USING FLAIR17, INERTIAL-BT17N26, NN0137 DYN. DATA.   PAGE   13   *
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TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
720.0	198510.5	17435.7	-.330	147.790	55.052	-.049	38.844	17.931	78.738
722.0	198213.1	17387.4	-.328	147.993	54.699	-.062	38.768	17.864	79.244
724.0	197918.3	17337.1	-.325	148.205	54.739	-.112	38.756	17.795	79.725
726.0	197625.4	17286.7	-.323	148.417	55.158	-.096	38.777	17.727	80.199
728.0	197333.9	17236.0	-.323	148.630	55.730	-.129	38.834	17.659	80.657
730.0	197042.7	17184.9	-.324	148.846	56.647	-.126	38.893	17.590	81.131
732.0	196750.4	17133.2	-.328	149.065	57.594	-.144	38.965	17.521	81.593
734.0	196455.5	17080.9	-.335	149.286	58.532	-.093	39.047	17.452	82.060
736.0	196156.5	17028.4	-.345	149.510	59.155	-.095	39.078	17.383	82.537
738.0	195852.2	16975.4	-.356	149.736	59.562	-.085	39.131	17.313	83.029
740.0	195541.8	16922.2	-.368	149.963	59.921	-.080	39.194	17.243	83.540
742.0	195224.4	16868.9	-.382	150.190	60.242	-.088	39.258	17.172	84.074
744.0	194899.4	16814.2	-.397	150.410	60.548	-.072	39.342	17.100	84.622
746.0	194566.1	16760.0	-.413	150.641	60.813	-.063	39.425	17.029	85.203
748.0	194224.1	16705.3	-.430	150.874	61.041	.001	39.494	16.957	85.811
750.0	193873.2	16650.1	-.447	151.110	60.972	.105	39.522	16.884	86.446
752.0	193513.5	16594.4	-.462	151.348	60.013	.205	39.462	16.811	87.109
754.0	193147.3	16538.3	-.473	151.586	58.714	.164	39.439	16.737	87.792
756.0	192777.5	16481.8	-.479	151.824	57.552	.162	39.420	16.663	88.486
758.0	192406.3	16425.0	-.481	152.061	56.545	.138	39.366	16.590	89.185
760.0	192036.0	15368.0	-.480	152.299	55.873	.119	39.291	16.516	89.882
762.0	191667.6	16311.5	-.479	152.544	55.428	.149	39.214	16.443	90.580
764.0	191301.7	16254.4	-.475	152.783	55.139	.076	39.196	16.370	91.264
766.0	190939.0	16197.1	-.472	153.022	55.319	.094	39.162	16.297	91.938
768.0	190579.0	16139.7	-.470	153.263	55.658	.096	39.145	16.225	92.602
770.0	190221.3	16081.2	-.467	153.509	56.134	.045	39.148	16.152	93.247
772.0	189866.1	16022.2	-.466	153.758	56.506	.074	39.138	16.079	93.878
774.0	189512.5	15963.0	-.465	154.007	56.281	.034	39.111	16.006	94.503
776.0	189160.9	15903.6	-.463	154.258	56.200	-.015	39.062	15.933	95.118
778.0	188811.6	15844.1	-.461	154.510	56.446	.064	38.991	15.860	95.725

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
780.0	188463.7	15782.0	-.462	154.756	56.759	-.026	38.980	15.785	96.294
782.0	188116.5	15722.5	-.464	155.012	57.444	-.011	38.993	15.713	96.894
784.0	187768.6	15663.0	-.469	155.272	58.100	-.047	39.009	15.642	97.498
786.0	187418.6	15603.2	-.475	155.536	58.625	.034	39.077	15.570	98.105
788.0	187066.0	15542.6	-.482	155.805	58.279	.056	39.253	15.497	98.714
790.0	186711.6	15481.8	-.486	156.075	57.185	.091	39.315	15.425	99.327
792.0	186358.0	15421.0	-.484	156.342	55.245	.041	39.314	15.353	99.938
794.0	186008.7	15360.2	-.474	156.605	53.616	-.021	39.336	15.281	100.532
796.0	185667.6	15298.9	-.453	156.868	52.238	.013	39.311	15.209	101.087
798.0	185337.8	15237.9	-.437	157.139	50.704	.049	39.235	15.138	101.600
800.0	185022.1	15179.6	-.409	157.402	49.172	.045	39.115	15.070	102.091
802.0	184723.5	15117.7	-.377	157.655	48.207	.062	39.001	15.000	102.465
804.0	184444.0	15055.5	-.342	157.906	47.614	.080	38.848	14.930	102.753
806.0	184184.2	14993.6	-.306	158.154	47.100	.053	38.675	14.861	102.963
808.0	183944.0	14932.1	-.271	158.399	47.148	-.047	38.567	14.793	103.094
810.0	183722.4	14870.6	-.239	158.645	48.282	-.020	38.516	14.726	103.147
812.0	183516.9	14808.9	-.212	158.896	49.470	-.003	38.470	14.659	103.128
814.0	183324.5	14747.4	-.191	159.149	50.518	-.043	38.415	14.593	103.054
816.0	183142.2	14686.0	-.175	159.404	51.546	-.052	38.384	14.527	102.938
818.0	182967.4	14624.8	-.164	159.662	52.535	-.116	38.385	14.462	102.789
820.0	182797.4	14563.6	-.159	159.923	53.802	-.076	38.419	14.397	102.618
822.0	182629.0	14502.5	-.160	160.187	54.914	-.086	38.449	14.332	102.440
824.0	182459.2	14441.6	-.167	160.454	55.858	-.122	38.487	14.267	102.266
826.0	182285.7	14380.8	-.178	160.723	56.789	-.102	38.549	14.203	102.104
828.0	182106.4	14319.4	-.192	160.996	57.481	-.152	38.551	14.138	101.955
830.0	181919.7	14256.9	-.210	161.273	57.746	-.108	38.689	14.071	101.815
832.0	181724.4	14200.8	-.230	161.541	57.833	-.084	38.689	14.011	101.799
834.0	181520.1	14139.5	-.250	161.817	57.716	-.094	38.731	13.946	101.741
836.0	181306.6	14078.4	-.270	162.091	57.459	-.117	38.782	13.880	101.718
838.0	181084.4	14016.6	-.289	162.368	57.149	.003	38.800	13.814	101.718

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
840.0	180854.6	13954.8	-.306	162.644	58.220	-.250	38.369	13.748	101.743
842.0	180614.3	13892.1	-.336	162.931	59.973	.316	38.328	13.680	101.794
844.0	180360.6	13829.8	-.363	163.216	58.383	-1.202	38.680	13.613	101.901
846.0	180095.0	13767.8	-.394	163.501	60.143	.060	38.655	13.546	102.055
848.0	179814.5	13705.2	-.428	163.790	59.911	.007	39.326	13.478	102.258
850.0	179520.4	13639.4	-.456	164.085	59.308	-.200	38.659	13.407	102.463
852.0	179213.0	13578.1	-.490	164.370	59.290	-.005	38.424	13.340	102.786
854.0	178891.9	13514.5	-.520	164.660	58.744	-.082	38.809	13.271	103.128
856.0	178558.2	13449.1	-.547	164.942	55.198	.491	38.857	13.200	103.489
858.0	178220.8	13383.6	-.538	165.209	47.329	-.370	38.819	13.129	103.861
860.0	177895.8	13318.1	-.506	165.457	43.847	-.177	38.480	13.059	104.179
862.0	177589.1	13253.6	-.467	165.695	42.127	-.222	38.185	12.989	104.432
864.0	177302.3	13189.5	-.426	165.930	42.087	-.222	38.062	12.921	104.604
866.0	177034.9	13125.3	-.389	166.169	43.328	-.168	37.999	12.853	104.691
868.0	176784.2	13060.9	-.359	166.416	44.762	-.116	37.986	12.786	104.701
870.0	176547.3	12996.4	-.334	166.670	46.159	-.098	37.973	12.718	104.646
872.0	176321.2	12931.9	-.316	166.930	47.311	-.023	37.958	12.651	104.541
874.0	176103.2	12867.2	-.302	167.194	48.035	-.053	37.946	12.584	104.396
876.0	175891.4	12802.7	-.293	167.462	48.713	-.047	37.950	12.517	104.223
878.0	175683.7	12738.4	-.289	167.732	49.279	-.043	37.964	12.451	104.031
880.0	175478.2	12675.8	-.288	168.005	49.651	-.079	37.998	12.386	103.853
882.0	175273.5	12609.5	-.290	168.279	50.329	-.164	38.062	12.318	103.606
884.0	175067.7	12545.1	-.293	168.557	51.356	-.110	38.140	12.252	103.390
886.0	174858.3	12480.4	-.310	168.839	52.101	-.070	38.234	12.186	103.180
888.0	174643.7	12415.3	-.327	169.124	52.409	-.090	38.558	12.119	102.978
890.0	174423.1	12349.2	-.343	169.413	52.650	-.091	38.731	12.051	102.779
892.0	174196.2	12283.0	-.362	169.703	52.617	-.085	38.710	11.983	102.600
894.0	173962.1	12216.8	-.381	169.993	52.453	-.066	38.675	11.915	102.443
896.0	173721.4	12150.3	-.399	170.285	52.208	-.064	38.666	11.846	102.302
898.0	173474.2	12083.9	-.418	170.576	51.906	-.015	38.624	11.778	102.184

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
900.0	173220.4	12017.6	-.438	170.868	51.408	.114	38.597	11.710	102.089
902.0	172959.6	11951.2	-.453	171.155	46.350	.640	38.746	11.642	102.015
904.0	172702.0	11683.8	-.427	171.407	36.450	.090	38.965	11.573	101.903
906.0	172464.3	11816.2	-.366	171.612	26.854	.217	39.010	11.504	101.702
908.0	172258.9	11748.7	-.278	171.763	16.920	.267	39.092	11.435	101.368
910.0	172094.8	11681.9	-.171	171.854	6.738	.293	39.211	11.368	100.874
912.0	171976.8	11615.1	-.058	171.896	-3.615	.335	39.266	11.302	100.192
914.0	171903.9	11548.9	.047	171.858	-14.122	.324	39.380	11.236	99.340
916.0	171870.3	11483.3	.133	171.758	-24.494	.299	39.475	11.172	98.347
918.0	171865.9	11418.5	.189	171.599	-34.960	.274	39.603	11.109	97.259
920.0	171876.0	11354.1	.204	171.388	-45.474	.217	39.784	11.046	96.165
922.0	171882.6	11290.0	.169	171.132	-55.975	.104	39.979	10.984	95.082
924.0	171864.5	11226.3	.079	170.842	-63.632	-.281	40.164	10.922	94.009
926.0	171804.7	11162.4	-.039	170.540	-66.334	-.174	40.238	10.859	93.169
928.0	171697.4	11097.8	-.163	170.234	-67.871	-.105	40.502	10.795	92.488
930.0	171539.4	11032.0	-.304	169.922	-68.718	-.171	40.977	10.729	91.969
932.0	171329.2	10964.5	-.445	169.605	-68.970	-.239	41.271	10.661	91.609
934.0	171066.2	10896.1	-.587	169.286	-68.345	-.233	41.391	10.592	91.421
936.0	170751.9	10826.3	-.725	168.966	-67.152	-.245	41.598	10.520	91.388
938.0	170389.3	10755.0	-.855	168.644	-65.171	-.256	41.765	10.447	91.498
940.0	169982.9	10682.7	-.971	168.325	-62.191	-.259	41.747	10.373	91.743
942.0	169539.5	10608.6	-1.068	168.009	-58.767	-.233	41.848	10.296	92.087
944.0	169067.0	10533.1	-1.146	167.697	-54.786	-.228	41.704	10.218	92.505
946.0	168574.0	10445.9	-1.200	167.363	-50.567	-.079	41.534	10.129	92.783
948.0	168069.2	10371.0	-1.234	167.078	-47.482	-.053	41.333	10.052	93.317
950.0	167558.2	10297.6	-1.253	166.807	-42.245	-.320	41.229	9.977	93.896
952.0	167050.8	10225.2	-1.234	166.576	-35.299	.070	41.098	9.902	94.474
954.0	166558.0	10155.0	-1.190	166.384	-27.466	-.098	40.802	9.830	95.034
956.0	166089.5	10086.7	-1.117	166.250	-21.991	.385	40.490	9.761	95.532
958.0	165651.2	10022.5	-1.041	166.145	-23.233	.403	40.209	9.695	95.988

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
960.0	165240.4	9961.9	-.979	166.002	-29.112	.088	40.098	9.634	96.400
962.0	164849.4	9898.0	-.942	165.816	-34.568	.018	39.983	9.570	96.671
964.0	164469.9	9835.0	-.926	165.603	-38.461	.039	39.866	9.506	96.905
966.0	164095.7	9772.3	-.925	165.371	-41.223	-.003	39.842	9.443	97.119
968.0	163722.4	9709.9	-.935	165.126	-43.167	-.057	39.782	9.381	97.329
970.0	163346.2	9646.1	-.955	164.874	-44.187	-.051	39.696	9.319	97.554
972.0	162965.3	9586.4	-.978	164.616	-44.583	-.027	39.649	9.257	97.793
974.0	162579.2	9525.1	-1.002	164.358	-44.372	.023	39.559	9.196	98.056
976.0	162187.7	9467.6	-1.025	164.119	-43.823	.083	39.461	9.138	98.413
978.0	161791.5	9407.3	-1.047	163.867	-43.486	.128	39.347	9.078	98.723
980.0	161391.2	9346.5	-1.065	163.612	-43.118	.186	39.231	9.017	99.033
982.0	160988.0	9285.4	-1.082	163.355	-42.750	.158	39.114	8.957	99.342
984.0	160582.6	9224.4	-1.095	163.099	-41.745	.135	38.901	8.896	99.654
986.0	160176.4	9164.0	-1.104	162.850	-40.279	.285	38.591	8.836	99.979
988.0	159770.8	9104.2	-1.110	162.609	-39.747	.368	38.507	8.777	100.306
990.0	159366.1	9044.7	-1.116	162.366	-39.965	.475	38.395	8.718	100.630
992.0	158961.7	8982.0	-1.126	162.112	-40.842	.452	38.323	8.656	100.874
994.0	158556.0	8920.6	-1.144	161.872	-41.621	.397	38.239	8.596	101.145
996.0	158146.8	8862.7	-1.162	161.613	-39.311	.394	38.141	8.539	101.502
998.0	157737.5	8805.3	-1.165	161.369	-38.185	.599	38.026	8.482	101.867
1000.0	157329.1	8749.0	-1.175	161.116	-38.794	-.225	37.966	8.427	102.245
1002.0	156921.1	8692.9	-1.179	160.863	-37.733	.532	37.393	8.372	102.621
1004.0	156515.0	8636.0	-1.178	160.605	-37.580	.412	38.871	8.316	102.965
1006.0	156113.5	8579.3	-1.175	160.344	-37.272	.445	37.555	8.261	103.287
1008.0	155712.9	8527.5	-1.185	160.081	-36.945	.443	37.412	8.210	103.719
1010.0	155313.1	8477.3	-1.187	159.817	-36.581	.601	37.484	8.161	104.181
1012.0	154915.3	8424.7	-1.194	159.555	-40.494	.764	37.464	8.110	104.573
1014.0	154513.1	8372.4	-1.233	159.254	-43.872	.173	37.389	8.059	104.984
1016.0	154100.8	8320.7	-1.281	158.944	-45.270	.374	37.284	8.008	105.449
1018.0	153676.1	8269.3	-1.337	158.622	-46.483	.358	37.263	7.958	105.970

C-2

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1020.0	153237.1	8218.3	-1.399	158.292	-47.279	.380	37.230	7.909	106.559
1022.0	152782.7	8167.6	-1.465	157.954	-47.662	.348	37.163	7.860	107.222
1024.0	152312.6	8123.6	-1.528	157.621	-47.322	.408	37.100	7.817	108.130
1026.0	151827.9	8072.6	-1.589	157.279	-46.434	.416	36.973	7.768	108.918
1028.0	151329.8	8021.3	-1.645	156.940	-44.931	.419	36.774	7.718	109.756
1030.0	150821.0	7969.5	-1.690	156.608	-43.293	.528	36.595	7.668	110.629
1032.0	150304.3	7916.8	-1.727	156.279	-42.323	.601	36.438	7.617	111.514
1034.0	149781.5	7863.1	-1.760	155.949	-41.391	.628	36.254	7.566	112.395
1036.0	149254.9	7799.1	-1.786	155.583	-39.839	.688	35.975	7.504	112.997
1038.0	148726.5	7749.1	-1.802	155.278	-38.322	.732	35.719	7.456	114.011
1040.0	148198.3	7695.2	-1.812	154.972	-37.712	.783	35.498	7.405	114.908
1042.0	147671.4	7641.1	-1.822	154.664	-38.261	.685	35.351	7.353	115.792
1044.0	147145.5	7586.7	-1.834	154.348	-39.010	.521	35.172	7.301	116.660
1046.0	146620.2	7532.2	-1.846	154.028	-39.029	.592	34.933	7.250	117.519
1048.0	146095.5	7477.8	-1.853	153.710	-38.526	.618	34.674	7.198	118.379
1050.0	145572.6	7423.2	-1.863	153.429	-37.917	.780	34.437	7.146	119.216
1052.0	145052.3	7369.6	-1.870	153.115	-37.607	.806	34.142	7.095	120.071
1054.0	144533.8	7316.6	-1.879	152.795	-38.368	.791	33.927	7.045	120.934
1056.0	144016.0	7263.5	-1.895	152.457	-39.767	.711	33.790	6.995	121.787
1058.0	143497.0	7210.6	-1.920	152.102	-41.148	.602	33.649	6.945	122.648
1060.0	142974.4	7158.0	-1.955	151.731	-42.092	.528	33.471	6.895	123.534
1062.0	142446.4	7101.8	-1.995	151.333	-42.409	.520	33.293	6.842	124.317
1064.0	141913.0	7050.1	-2.033	150.945	-42.450	.587	33.128	6.794	125.284
1066.0	141374.0	6999.4	-2.072	150.552	-42.399	.529	32.960	6.746	126.314
1068.0	140830.0	6949.6	-2.107	150.156	-41.944	.564	32.781	6.700	127.403
1070.0	140282.2	6900.9	-2.138	149.760	-41.464	.652	32.603	6.654	128.552
1072.0	139731.3	6853.2	-2.165	149.363	-41.121	.629	32.397	6.609	129.759
1074.0	139179.2	6815.7	-2.177	148.992	-40.622	.727	32.223	6.575	131.369
1076.0	138629.1	6766.1	-2.180	148.573	-40.090	.629	31.940	6.529	132.511
1078.0	138063.0	6715.9	-2.178	148.157	-37.708	.580	31.449	6.482	133.606

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1080.0	137543.8	6665.5	-2.158	147.761	-35.457	.901	31.028	6.435	134.647
1082.0	137013.6	6614.5	-2.140	147.361	-36.002	.867	30.687	6.388	135.617
1084.0	136490.5	6563.4	-2.135	146.945	-37.545	.789	30.259	6.340	136.529
1086.0	135970.8	6505.6	-2.149	146.426	-39.958	.627	30.095	6.286	137.140
1088.0	135450.7	6453.4	-2.177	145.953	-42.368	.471	30.019	6.237	137.971
1090.0	134927.0	6401.2	-2.220	145.464	-43.826	.322	29.898	6.189	138.819
1092.0	134397.2	6349.0	-2.269	144.968	-44.118	.295	29.738	6.140	139.692
1094.0	133861.4	6296.8	-2.316	144.475	-43.767	.324	29.575	6.092	140.593
1096.0	133320.2	6244.6	-2.360	143.985	-43.397	.339	29.413	6.043	141.522
1098.0	132774.4	6187.2	-2.403	143.523	-42.979	.374	29.242	5.990	142.226
1100.0	132224.4	6133.1	-2.447	143.052	-42.500	.386	29.075	5.940	143.097
1102.0	131670.0	6085.2	-2.489	142.584	-42.252	.505	28.919	5.896	144.278
1104.0	131111.1	6039.6	-2.531	142.116	-42.519	.569	28.792	5.854	145.594
1106.0	130547.0	5996.1	-2.580	141.637	-42.331	.156	28.744	5.814	147.047
1108.0	129978.8	5954.3	-2.600	141.179	-36.074	.140	28.553	5.776	148.615
1110.0	129418.3	5920.6	-2.540	140.849	-26.246	.379	28.496	5.746	150.557
1112.0	128879.8	5887.8	-2.423	140.589	-16.533	.410	28.183	5.716	152.414
1114.0	128371.9	5846.1	-2.279	140.445	-7.030	.332	27.819	5.678	153.621
1116.0	127898.6	5803.3	-2.122	140.419	2.335	.219	27.528	5.638	154.538
1118.0	127460.4	5759.5	-1.968	140.514	11.844	.145	27.305	5.598	155.151
1120.0	127053.7	5715.3	-1.846	140.730	21.367	.089	27.020	5.557	155.520
1122.0	126669.1	5671.3	-1.779	141.057	30.814	-.051	26.740	5.516	155.730
1124.0	126294.2	5626.3	-1.778	141.502	40.669	-.099	26.637	5.474	155.808
1126.0	125914.2	5576.7	-1.863	142.036	48.309	.114	26.557	5.427	155.644
1128.0	125515.6	5532.0	-1.993	142.610	50.975	.145	26.158	5.386	155.866
1130.0	125092.4	5487.9	-2.146	143.196	52.411	.148	25.987	5.345	156.270
1132.0	124642.4	5443.1	-2.308	143.799	53.132	.207	26.018	5.303	156.803
1134.0	124164.9	5398.0	-2.473	144.403	52.858	.229	25.928	5.262	157.497
1136.0	123660.4	5353.2	-2.635	144.991	51.636	.131	25.793	5.220	158.379
1138.0	123130.8	5308.3	-2.785	145.559	50.254	-.024	25.816	5.179	159.421

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1140.0	122579.1	5254.4	-2.926	146.011	49.226	-.269	25.908	5.129	160.069
1142.0	122007.7	5210.7	-3.054	146.598	48.659	-.309	25.859	5.089	161.455
1144.0	121418.9	5168.2	-3.167	147.215	47.541	-.240	25.783	5.051	163.046
1146.0	120816.4	5127.8	-3.262	147.846	46.327	-.501	25.596	5.014	164.872
1148.0	120201.2	5090.5	-3.357	148.492	44.290	-1.327	25.236	4.981	167.000
1150.0	119574.0	5066.1	-3.443	149.328	48.464	-.841	25.159	4.960	170.111
1152.0	118930.8	5033.9	-3.586	150.085	53.936	-.149	25.004	4.932	172.859
1154.0	118262.9	4997.2	-3.767	150.815	54.601	-.134	24.617	4.900	175.532
1156.0	117569.2	4956.4	-3.934	151.558	55.059	-.074	24.412	4.863	178.156
1158.0	116849.1	4918.0	-4.144	152.214	54.799	-.134	23.226	4.829	181.191
1160.0	116098.7	4869.6	-4.355	152.699	54.702	-.200	23.644	4.786	183.774
1162.0	115322.2	4826.5	-4.516	153.358	48.660	-.091	23.795	4.748	186.994
1164.0	114535.8	4783.0	-4.557	153.961	39.383	-.194	23.589	4.709	190.315
1166.0	113758.5	4740.0	-4.491	154.461	28.906	-.430	23.237	4.671	193.648
1168.0	113007.1	4698.5	-4.335	154.931	22.771	-.649	22.788	4.634	196.908
1170.0	112289.1	4658.6	-4.170	155.236	20.441	-.855	22.181	4.599	200.045
1172.0	111602.5	4617.6	-4.021	155.546	19.822	-1.174	21.799	4.562	202.826
1174.0	110944.5	4576.5	-3.890	155.862	23.793	-1.323	21.690	4.525	205.350
1176.0	110310.4	4534.7	-3.793	156.299	28.148	-1.155	21.619	4.487	207.592
1178.0	109695.5	4487.1	-3.721	157.588	30.895	-.372	21.045	4.443	209.105
1180.0	109097.3	4447.3	-3.654	158.065	33.095	-.187	20.847	4.407	211.173
1182.0	108514.1	4406.4	-3.593	158.600	34.170	-.019	20.577	4.370	212.983
1184.0	107945.4	4364.9	-3.537	159.172	35.312	.050	20.318	4.332	214.581
1186.0	107388.8	4324.4	-3.498	159.760	33.344	-.728	19.908	4.295	216.141
1188.0	106842.9	4284.5	-3.470	160.371	37.735	.124	19.715	4.258	217.640
1190.0	106304.2	4244.7	-3.463	161.036	37.158	.052	19.438	4.222	219.058
1192.0	105772.2	4204.9	-3.428	161.705	36.515	-.131	20.142	4.185	220.380
1194.0	105252.4	4166.2	-3.388	162.383	36.669	-.187	19.358	4.149	221.674
1196.0	104739.9	4128.4	-3.385	163.051	37.040	-.059	18.939	4.115	222.963
1198.0	104231.9	4090.3	-3.390	163.725	37.502	-.005	18.730	4.079	224.156

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1200.0	103726.7	4052.6	-3.408	164.406	37.228	.010	18.533	4.045	225.339
1202.0	103223.8	4014.7	-3.423	165.080	36.736	-.129	18.370	4.009	226.447
1204.0	102723.4	3977.4	-3.440	165.770	37.654	-.020	18.280	3.975	227.575
1206.0	102224.7	3940.9	-3.464	166.476	37.774	-.001	18.166	3.941	228.760
1208.0	101726.9	3903.9	-3.493	167.171	37.851	-.039	18.075	3.907	229.842
1210.0	101229.5	3866.2	-3.528	167.860	38.077	-.061	18.001	3.872	230.807
1212.0	100732.0	3829.1	-3.566	168.548	38.019	-.124	17.906	3.837	231.822
1214.0	100233.9	3792.8	-3.607	169.230	38.347	-.135	17.772	3.804	232.905
1216.0	99734.8	3755.4	-3.651	169.927	38.829	-.145	17.763	3.769	233.835
1218.0	99235.1	3716.9	-3.696	170.636	39.465	-.150	17.705	3.733	234.596
1220.0	98733.9	3678.9	-3.755	171.365	40.118	-.142	17.592	3.697	235.397
1222.0	98229.3	3640.6	-3.827	172.115	40.605	-.017	17.475	3.661	236.169
1224.0	97720.6	3604.1	-3.899	172.864	39.756	-.204	17.405	3.627	237.173
1226.0	97208.3	3569.3	-3.967	173.610	39.742	-.196	17.363	3.595	238.423
1228.0	96692.8	3533.3	-4.029	174.372	39.199	-.348	17.280	3.561	239.516
1230.0	96175.3	3496.5	-4.088	175.173	39.671	-.166	17.145	3.527	240.478
1232.0	95656.2	3458.9	-4.145	175.990	39.338	-.117	17.018	3.492	241.321
1234.0	95136.4	3420.4	-4.191	176.820	38.518	-.152	16.869	3.455	241.983
1236.0	94617.6	3382.1	-4.230	177.650	38.386	-.080	16.672	3.419	242.628
1238.0	94100.0	3344.1	-4.268	178.475	37.694	-.071	16.448	3.383	243.243
1240.0	93584.2	3305.7	-4.302	179.308	36.965	-.066	16.194	3.347	243.738
1242.0	93070.2	3267.2	-4.341	-179.862	36.123	-.060	15.958	3.311	244.135
1244.0	92557.7	3230.9	-4.380	-179.037	34.826	.341	15.669	3.276	244.790
1246.0	92048.2	3196.4	-4.367	-178.298	26.685	.245	15.611	3.244	245.621
1248.0	91552.1	3161.3	-4.241	-177.766	16.483	-.017	15.616	3.210	246.173
1250.0	91079.7	3126.1	-4.042	-177.461	6.314	-.078	15.473	3.177	246.370
1252.0	90635.6	3091.6	-3.823	-177.398	-3.403	-.024	15.253	3.144	246.264
1254.0	90219.3	3057.7	-3.619	-177.570	-12.896	.074	15.152	3.111	245.883
1256.0	89826.7	3022.7	-3.473	-177.978	-22.538	.153	15.003	3.078	244.975
1258.0	89448.5	2987.6	-3.435	-178.602	-31.434	.065	14.844	3.044	243.829

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1260.0	89073.2	2952.9	-3.496	-179.354	-34.995	.223	14.675	3.010	242.642
1262.0	88692.6	2918.6	-3.623	179.844	-37.276	.276	14.559	2.977	241.545
1264.0	88301.7	2883.7	-3.780	178.983	-38.832	.229	14.639	2.943	240.412
1266.0	87899.1	2849.5	-3.949	178.091	-39.531	.215	14.714	2.910	239.470
1268.0	87484.6	2815.6	-4.120	177.173	-40.076	.214	14.784	2.877	238.674
1270.0	87058.3	2782.1	-4.291	176.213	-41.144	.070	14.853	2.845	238.012
1272.0	86620.6	2748.2	-4.464	175.195	-41.653	-.026	14.907	2.812	237.354
1274.0	86172.0	2713.8	-4.635	174.139	-41.585	-.041	14.842	2.778	236.689
1276.0	85713.5	2680.8	-4.792	173.054	-41.867	-.092	14.929	2.747	236.298
1278.0	85246.3	2649.8	-4.945	171.958	-41.441	-.037	14.746	2.717	236.332
1280.0	84770.1	2617.7	-5.111	170.853	-41.880	-.142	14.522	2.686	236.184
1282.0	84234.0	2585.0	-5.299	169.719	-41.683	-.161	14.323	2.654	236.002
1284.0	83786.4	2552.2	-5.503	168.626	-41.119	-.060	14.201	2.622	235.875
1286.0	83277.0	2518.4	-5.707	167.527	-40.394	-.067	14.177	2.590	235.630
1288.0	82758.1	2483.7	-5.876	166.461	-38.010	-.190	14.277	2.556	235.239
1290.0	82235.5	2446.8	-5.961	165.489	-32.290	-.251	14.489	2.520	234.399
1292.0	81720.0	2411.3	-5.882	164.749	-22.002	.173	14.489	2.486	233.650
1294.0	81222.6	2377.8	-5.725	164.303	-13.480	.241	14.000	2.453	232.989
1296.0	80745.7	2345.2	-5.549	164.033	-9.601	.162	13.883	2.421	232.183
1298.0	80290.7	2313.3	-5.345	163.852	-7.186	.135	13.849	2.390	231.182
1300.0	79858.6	2280.8	-5.141	163.721	-5.392	.294	13.663	2.358	229.718
1302.0	79447.8	2248.4	-4.963	163.596	-4.725	.314	13.335	2.326	227.937
1304.0	79055.0	2216.4	-4.828	163.480	-5.592	-.226	13.002	2.294	225.964
1306.0	78676.4	2185.0	-4.738	163.387	-5.630	-.469	12.713	2.263	223.882
1308.0	78308.2	2154.1	-4.696	163.281	-3.928	.097	12.529	2.232	221.727
1310.0	77947.5	2123.7	-4.671	163.219	-.299	.197	12.414	2.202	219.509
1312.0	77592.8	2093.5	-4.675	163.211	.051	.221	12.210	2.172	217.220
1314.0	77241.9	2063.6	-4.702	163.191	-.365	.148	12.079	2.142	214.887
1316.0	76893.4	2034.2	-4.753	163.147	-.759	.051	11.855	2.112	212.562
1318.0	76544.7	2005.5	-4.853	163.107	-.398	.095	11.491	2.084	210.321

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1320.0	76191.8	1978.1	-5.015	163.097	.231	.368	11.131	2.056	208.352
1322.0	75830.4	1950.9	-5.243	163.063	-.717	.528	10.797	2.029	206.454
1324.0	75456.4	1924.4	-5.535	162.970	-2.164	.518	10.505	2.003	204.795
1326.0	75066.2	1898.5	-5.880	162.820	-2.927	.347	10.297	1.977	203.359
1328.0	74658.1	1872.7	-6.238	162.665	-2.877	.159	10.218	1.951	202.073
1330.0	74232.4	1846.3	-6.601	162.520	-1.387	.100	10.125	1.925	200.877
1332.0	73789.0	1821.1	-6.980	162.443	-.888	.255	9.970	1.900	199.863
1334.0	73327.4	1795.7	-7.384	162.370	-1.786	.377	9.816	1.875	199.002
1336.0	72846.6	1770.9	-7.802	162.234	-2.987	.050	9.700	1.850	198.421
1338.0	72347.3	1746.1	-8.209	162.132	-2.515	-.065	9.688	1.826	197.968
1340.0	71831.2	1721.9	-8.597	162.094	-1.720	.052	9.651	1.802	197.731
1342.0	71299.6	1698.1	-8.983	162.098	-2.289	.100	9.505	1.778	197.706
1344.0	70752.9	1675.2	-9.353	162.015	-3.681	-.238	9.503	1.756	197.957
1346.0	70193.2	1652.9	-9.701	161.989	-1.971	-.227	9.415	1.734	198.427
1348.0	69621.4	1631.2	-10.044	161.999	-1.190	-.108	9.284	1.712	199.098
1350.0	69038.0	1610.4	-10.382	161.984	-1.550	-.221	9.204	1.692	200.048
1352.0	68444.3	1589.0	-10.695	161.945	-.250	-.190	9.109	1.671	200.929
1354.0	67841.5	1567.5	-11.015	161.899	-.559	-.343	8.943	1.650	201.780
1356.0	67230.1	1545.3	-11.332	161.852	.399	-.410	8.808	1.628	202.509
1358.0	66610.8	1523.2	-11.643	161.949	2.096	-.539	8.731	1.606	203.261
1360.0	65984.8	1500.8	-11.947	162.176	6.477	.587	8.525	1.584	203.933
1362.0	65352.2	1478.2	-12.261	162.547	4.777	.697	8.522	1.561	204.552
1364.0	64715.1	1456.1	-12.482	162.859	2.330	.266	8.593	1.539	205.268
1366.0	64080.0	1434.6	-12.589	163.156	2.648	.151	8.477	1.518	206.031
1368.0	63447.6	1413.6	-12.776	163.473	2.408	.431	8.238	1.497	206.855
1370.0	62814.1	1393.6	-12.997	163.677	-.896	.578	8.045	1.477	207.896
1372.0	62179.0	1374.7	-13.223	163.635	-3.420	.218	7.812	1.458	209.235
1374.0	61541.5	1355.6	-13.483	163.567	-2.627	.092	7.593	1.439	210.476
1376.0	60900.6	1336.7	-13.740	163.523	-2.155	.357	7.538	1.420	211.731
1378.0	60257.2	1318.0	-14.010	163.433	-2.811	.402	7.398	1.402	213.018

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1380.0	59611.5	1299.6	-14.235	163.461	-1.330	.946	7.407	1.383	214.390
1382.0	58966.1	1281.8	-14.410	163.425	-3.715	1.017	7.392	1.366	215.866
1384.0	58322.6	1264.7	-14.552	163.249	-5.902	.589	7.307	1.348	217.485
1386.0	57682.1	1245.8	-14.709	162.782	-6.855	-.225	7.118	1.329	218.398
1388.0	57044.4	1225.7	-14.901	162.257	-4.232	-.511	6.966	1.309	218.748
1390.0	56409.2	1203.0	-15.105	161.881	-2.360	-.442	6.981	1.286	218.014
1392.0	55778.8	1179.2	-15.276	161.680	-.469	-.018	6.929	1.261	216.652
1394.0	55154.4	1154.7	-15.451	161.549	-.767	.164	6.847	1.236	214.854
1396.0	54536.6	1131.5	-15.594	161.532	1.106	.384	6.906	1.212	213.269
1398.0	53926.4	1108.1	-15.732	161.790	2.502	.544	6.821	1.188	211.369
1400.0	53323.0	1086.8	-15.870	162.226	3.688	.896	6.803	1.166	210.034
1402.0	52727.4	1068.0	-15.902	162.637	2.042	.177	6.888	1.146	209.445
1404.0	52142.1	1051.9	-15.812	163.133	6.689	1.055	6.993	1.128	209.001
1406.0	51570.1	1036.4	-15.666	163.548	5.338	.614	6.973	1.109	208.135
1408.0	51010.4	1021.2	-15.540	163.813	4.380	.053	7.291	1.091	207.141
1410.0	50463.7	1004.8	-15.524	164.001	3.797	-.410	6.695	1.071	205.416
1412.0	49923.1	988.7	-15.646	164.096	1.106	-.688	6.551	1.052	203.633
1414.0	49386.5	972.4	-15.809	164.060	-2.202	-.504	6.511	1.033	201.634
1416.0	48853.3	957.2	-15.973	163.914	-5.145	-.073	6.562	1.015	199.895
1418.0	48322.5	943.8	-16.158	163.757	-6.950	.271	6.482	.998	198.824
1420.0	47791.6	931.3	-16.429	163.431	-8.037	.396	6.459	.983	197.993
1422.0	47258.9	919.9	-16.714	163.018	-6.961	.222	6.522	.969	197.561
1424.0	46724.3	907.6	-16.996	162.619	-5.901	.113	6.722	.954	196.685
1426.0	46190.4	895.0	-17.113	162.253	-6.823	-1.195	6.864	.939	195.576
1428.0	45664.4	882.5	-16.967	162.019	-6.621	-1.186	7.624	.924	194.322
1430.0	45152.8	869.4	-16.663	161.754	-5.897	-.418	8.320	.908	192.597
1432.0	44658.1	857.0	-16.345	161.383	-5.999	.097	8.177	.894	190.967
1434.0	44177.7	845.1	-16.139	160.849	-5.985	-.007	7.908	.880	189.360
1436.0	43708.9	832.6	-16.043	160.361	-3.414	-.446	7.439	.865	187.307
1438.0	43245.7	820.4	-16.241	160.415	2.620	-.263	6.967	.851	185.250

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1440.0	42781.2	811.6	-16.535	160.603	3.333	.229	6.846	.840	184.695
1442.0	42313.6	805.4	-16.761	160.626	3.275	-.039	6.955	.832	185.320
1444.0	41843.6	800.4	-16.968	160.828	3.113	-.355	6.911	.825	186.448
1446.0	41371.3	796.3	-17.100	160.971	.266	-.021	7.029	.819	187.959
1448.0	40900.0	791.1	-17.144	160.987	-1.176	.496	6.824	.812	188.958
1450.0	40428.9	786.0	-17.301	160.872	-2.115	.686	6.780	.805	189.964
1452.0	39956.9	781.4	-17.436	160.729	-2.116	.506	6.747	.799	191.191
1454.0	39483.8	777.0	-17.599	160.692	-1.464	.485	6.670	.793	192.544
1456.0	39009.7	772.7	-17.699	160.790	-.911	.839	6.655	.787	193.876
1458.0	38534.7	769.4	-17.859	160.801	-.874	.867	6.614	.782	195.732
1460.0	38058.9	766.5	-17.920	160.722	-1.261	.382	6.550	.778	197.768
1462.0	37582.3	763.6	-18.029	160.700	-1.285	.260	6.651	.773	199.823
1464.0	37106.5	760.6	-18.051	160.661	-1.702	.506	6.447	.768	201.795
1466.0	36631.3	757.2	-18.061	160.498	-2.247	.353	6.551	.763	203.521
1468.0	36158.6	753.4	-18.147	160.337	-1.772	.271	6.273	.758	205.047
1470.0	35684.1	750.4	-18.322	160.217	-1.801	.161	6.319	.753	206.969
1472.0	35207.2	747.2	-18.474	160.211	-1.309	.183	6.298	.749	208.843
1474.0	34729.0	745.5	-18.601	160.229	-1.303	.528	6.075	.745	211.494
1476.0	34248.3	744.9	-18.683	160.185	-1.747	.383	6.180	.743	214.848
1478.0	33768.2	744.3	-18.587	160.175	-1.384	.480	6.251	.741	218.258
1480.0	33292.3	744.0	-18.379	160.199	-1.407	.659	6.189	.739	221.810
1482.0	32822.2	742.0	-18.231	160.132	-1.242	.559	5.796	.736	224.322
1484.0	32352.5	739.5	-18.379	160.070	-.778	.597	5.770	.732	226.547
1486.0	31883.6	735.6	-18.418	159.904	-.621	.477	5.580	.727	227.924
1488.0	31413.4	732.5	-18.648	159.649	-.103	.219	5.405	.722	229.762
1490.0	30939.5	728.1	-18.873	159.461	-.063	.119	5.526	.716	230.766
1492.0	30463.8	722.2	-19.110	159.168	-4.073	.027	5.670	.709	230.822
1494.0	29988.0	714.9	-19.257	158.354	-14.040	.274	5.943	.700	229.908
1496.0	29512.5	708.0	-19.479	156.587	-23.642	.451	6.293	.692	229.210
1498.0	29036.4	700.8	-19.702	154.142	-26.653	.371	6.592	.684	228.277

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TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1500.0	28560.0	695.0	-19.931	151.354	-33.545	.016	6.741	.677	228.152
1502.0	28081.1	690.5	-20.233	147.861	-38.594	-.083	6.952	.671	228.860
1504.0	27597.9	686.2	-20.568	143.943	-39.719	-.113	7.322	.665	229.750
1506.0	27112.1	682.0	-20.741	139.879	-40.191	.140	7.571	.660	230.702
1508.0	26624.9	678.5	-21.036	135.305	-45.903	.123	7.677	.655	232.033
1510.0	26129.7	674.7	-21.630	129.971	-50.111	.125	8.366	.650	233.307
1512.0	25627.6	671.9	-21.946	124.043	-49.476	.015	8.393	.646	235.205
1514.0	25123.1	670.3	-21.989	118.373	-46.479	.354	8.473	.643	238.019
1516.0	24621.1	668.3	-21.830	112.772	-45.848	.464	8.462	.640	240.534
1518.0	24124.8	666.7	-21.751	107.443	-45.086	.223	7.866	.637	243.300
1520.0	23631.9	662.5	-21.616	102.276	-42.610	.295	8.040	.632	244.122
1522.0	23147.3	656.5	-21.383	97.094	-41.806	.034	7.727	.625	243.457
1524.0	22674.5	650.3	-21.064	91.847	-40.603	-.336	7.502	.617	242.580
1526.0	22210.7	645.0	-20.870	86.876	-39.228	-.161	7.650	.611	242.236
1528.0	21755.9	641.4	-20.616	81.830	-40.027	-.055	7.597	.607	243.004
1530.0	21308.6	639.4	-20.299	76.766	-39.302	-.045	7.669	.604	245.004
1532.0	20869.3	637.2	-20.036	71.744	-40.525	.120	7.850	.600	246.723
1534.0	20436.9	634.2	-19.799	66.578	-41.215	.218	8.038	.597	247.772
1536.0	20013.6	630.2	-19.440	61.313	-40.342	.355	8.303	.592	247.949
1538.0	19602.5	624.7	-18.920	55.987	-39.342	.249	8.365	.586	246.761
1540.0	19206.8	618.4	-18.380	50.841	-38.204	.292	8.320	.579	244.818
1542.0	18826.1	612.7	-17.930	46.045	-36.952	.412	7.917	.573	243.237
1544.0	18453.4	608.5	-17.812	41.712	-36.062	.756	8.189	.568	242.709
1546.0	18086.3	604.4	-17.675	37.410	-35.990	.750	8.451	.563	242.187
1548.0	17727.7	600.5	-17.164	32.829	-35.298	.624	8.515	.559	241.736
1550.0	17380.6	596.9	-16.822	28.379	-35.680	.600	8.450	.555	241.448
1552.0	17043.0	594.2	-16.462	23.879	-34.495	.393	7.825	.551	241.775
1554.0	16709.2	592.9	-16.518	19.861	-33.527	.298	7.669	.549	243.172
1556.0	16376.0	592.4	-16.498	15.995	-32.892	.414	7.281	.548	245.310
1558.0	16037.9	592.7	-16.988	12.325	-33.802	.433	7.023	.548	248.066

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1560.0	15689.4	593.3	-17.489	8.451	-35.246	.221	6.932	.548	251.244
1562.0	15331.1	593.5	-17.845	4.298	-35.550	.021	7.295	.547	254.184
1564.0	14969.6	593.5	-18.033	-.041	-37.589	-.152	6.590	.546	257.013
1566.0	14597.2	594.6	-18.981	-4.178	-39.986	-.066	5.596	.547	260.881
1568.0	14195.9	598.3	-20.629	-7.830	-39.231	.042	5.659	.549	267.378
1570.0	13767.0	602.3	-21.526	-11.996	-40.802	-.007	5.928	.552	274.544
1572.0	13317.3	605.5	-22.388	-16.501	-43.559	.066	6.540	.554	281.273
1574.0	12857.3	605.8	-22.361	-22.044	-40.959	.077	6.914	.553	285.437
1576.0	12406.0	603.5	-21.710	-27.357	-35.298	.078	6.259	.550	287.152
1578.0	11968.2	599.9	-21.311	-31.414	-27.689	.210	5.581	.546	287.465
1580.0	11541.1	595.3	-20.737	-34.336	-17.938	.389	5.151	.541	286.751
1582.0	11127.5	591.0	-20.345	-35.931	-6.112	.232	5.078	.536	286.068
1584.0	10724.0	586.8	-20.029	-36.101	3.739	.181	4.954	.532	285.452
1586.0	10328.0	582.4	-19.757	-35.873	5.156	-.180	5.326	.527	284.475
1588.0	9941.6	577.6	-19.388	-35.097	8.634	-.112	5.389	.522	283.116
1590.0	9566.4	572.1	-19.006	-34.001	8.647	.309	5.327	.516	280.864
1592.0	9203.6	566.8	-18.183	-33.212	5.798	.355	6.181	.511	278.620
1594.0	8870.0	560.1	-16.466	-32.394	5.659	.403	6.443	.504	274.766
1596.0	8570.4	553.7	-15.141	-31.729	3.107	.335	5.871	.498	270.860
1598.0	8289.5	548.6	-14.919	-31.403	1.084	.454	4.975	.493	268.108
1600.0	8004.8	545.9	-15.542	-31.520	-.254	.006	4.787	.490	267.747
1602.0	7706.6	544.6	-16.462	-31.459	2.549	-.314	4.655	.488	268.859
1604.0	7390.4	544.6	-17.576	-31.196	3.061	-.484	4.416	.488	271.347
1606.0	7055.6	545.3	-18.448	-31.314	2.798	-.688	4.351	.491	276.542
1608.0	6706.0	545.9	-19.000	-31.094	2.329	-.240	5.037	.492	280.549
1610.0	6354.1	544.2	-18.971	-30.877	-.845	-.357	4.890	.490	282.511
1612.0	6006.0	539.9	-18.723	-30.584	.030	-.379	4.719	.487	281.827
1614.0	5661.7	536.0	-18.803	-30.198	-1.414	.295	4.680	.483	281.335
1616.0	5317.9	533.8	-18.979	-30.002	-1.231	.376	4.778	.481	282.512
1618.0	4973.5	531.5	-18.992	-29.800	.157	.109	4.925	.479	283.482

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1620.0	4632.5	526.8	-18.762	-29.422	2.480	.116	5.088	.474	281.685
1622.0	4299.4	521.8	-18.691	-29.284	2.870	-.264	4.856	.469	279.124
1624.0	3967.4	518.1	-18.719	-28.958	3.652	-.401	5.226	.466	278.017
1626.0	3639.8	514.9	-18.557	-28.582	2.372	-.431	5.146	.462	277.356
1628.0	3315.6	512.9	-18.484	-28.345	1.607	-.428	5.241	.460	278.059
1630.0	2993.5	511.0	-18.384	-27.924	1.285	.274	5.332	.458	278.833
1632.0	2676.2	508.6	-18.295	-27.821	-.455	.581	4.918	.456	278.793
1634.0	2358.6	506.0	-18.485	-28.001	-1.335	.532	4.980	.453	278.268
1636.0	2039.0	505.2	-18.516	-28.267	-2.153	.545	4.857	.451	279.701
1638.0	1720.9	507.9	-18.513	-28.698	-2.428	.349	4.861	.453	284.936
1640.0	1393.3	512.5	-19.135	-29.170	-1.731	-.067	5.749	.456	292.645
1642.0	1065.2	515.1	-18.030	-29.581	-.779	-.219	7.066	.458	298.268
1644.0	770.4	514.3	-15.427	-29.860	-.910	-.526	7.435	.456	299.506
1646.0	524.9	509.7	-12.618	-30.119	-.729	-.568	7.329	.452	295.914
1648.0	327.7	502.4	-9.979	-30.080	1.516	-.330	7.465	.445	288.835
1650.0	174.5	493.4	-8.128	-29.913	2.517	-.624	7.592	.437	279.686
1652.0	56.9	481.5	-6.177	-29.677	-.295	-.606	7.610	.426	267.051
1654.0	-26.9	465.5	-4.290	-29.785	.200	-.657	7.641	.411	250.121
1656.0	-84.8	449.0	-3.114	-29.682	-.061	-.500	8.217	.397	232.991
1658.0	-121.3	432.5	-2.200	-29.670	.064	-.341	7.586	.382	216.380
1660.0	-151.8	417.4	-2.097	-29.779	.706	-.773	8.268	.369	201.741
1662.0	-175.7	402.0	-1.370	-29.746	.993	-.976	8.756	.355	187.188
1664.0	-182.9	386.4	-.138	-29.665	.086	-1.135	7.547	.341	173.003
1666.0	-184.7	372.7	-.220	-29.483	.997	-.776	7.564	.329	160.985
1668.0	-186.4	359.1	-.241	-29.200	.547	-.340	7.430	.317	149.404
1670.0	-186.1	346.7	-.003	-28.942	.076	.494	6.240	.306	139.250
1672.0	-182.0	336.0	.223	-29.249	1.225	1.661	5.911	.297	130.845
1674.0	-183.3	325.6	-.498	-30.015	.522	1.113	5.803	.288	122.865
1676.0	-180.7	315.9	.072	-29.784	.052	.695	6.361	.279	115.614
1678.0	-180.6	306.0	-.259	-29.820	.132	.724	5.846	.270	108.527

TIME (SEC)	ALTDE (FT)	VELA (FPS)	GAMA (DEG)	HDGA (DEG)	SIGMAA (DEG)	BETAA (DEG)	ALPHAA (DEG)	MACHA (-)	QA (PSF)
1680.0	-182.0	296.2	-.161	-29.646	-.301	-.006	3.034	.262	101.682
1682.0	-183.3	284.3	-.334	-29.296	.217	.644	-.984	.251	93.641
1684.0	-183.3	269.1	-.108	-29.746	.359	.765	-3.387	.238	83.937
1686.0	-184.4	258.7	-.057	-29.951	-.019	.278	-3.842	.228	77.537
1688.0	-183.2	248.9	-.047	-29.676	-.410	-.077	-3.858	.220	71.761
1690.0	-183.2	239.7	-.165	-28.767	-.305	-.549	-3.742	.212	66.568
1692.0	-183.4	230.8	-.184	-28.802	.636	2.039	-3.867	.204	61.743
1694.0	-183.9	222.4	-.179	-29.661	.439	.932	-3.729	.196	57.332
1696.0	-184.2	214.6	-.164	-29.498	.336	.867	-3.774	.190	53.389
1698.0	-184.6	204.0	-.185	-29.760	.267	.549	-3.821	.180	48.222
1700.0	-185.1	187.2	-.174	-29.876	.123	.313	-3.760	.165	40.628
1702.0	-185.2	172.8	-.155	-29.485	-.081	.128	-3.857	.153	34.606
1704.0	-185.4	156.9	-.184	-29.209	-.118	.458	-3.841	.139	28.512
1706.0	-185.8	142.1	-.178	-29.083	-.090	.538	-3.857	.125	23.389

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APPENDIX D

STS-17 (41-G) Source and Output Products for Archival

D.1 STS-17 Output Products

(a) FILES

NAME	USER CATALOG	DESCRIPTION
BT17N26	169750N	Final reconstructed trajectory (40 word format per AMA 81-1)
ST17BET	274885C	Final extended BET (66 word format per AMA 81-11)
NAVB41G	389102C	STS-17 onboard nav BET (66 word format)
FLAIR17	274885C	Final LAIRS file (ST17MET/ UN=712662N with NOAA atmosphere below 7.25 kft)
TRWS41G	274885C	Reformatted JSC/TRW BET (66 word format)
IMRGA17	274885C	Signal difference file (IMU2 - RGA1/AA1)

(b) TAPES

REEL NO.	DESCRIPTION
NJ0333	STS-17 AEROBET (201 words per AMA 82-9)
NJ0346	Duplicate of above
NJ0523	25 Hz IMU2 GTFILE (62 words per AMA 81-20)
NJ0568	25 Hz RGA1/AA1 GTFILE (62 words per AMA 81-20)
NN0259	25 Hz RGA1/AA1 for NJ0568
NP1167	25 Hz bias rectified RGA1/AA1 file for GTFILE generation
NB0923	Final STS-17 residuals for BT17N26
NN0136	Edited tracking tape
NN0231	1 Hz OI-2 for AEROBET
NN0137	20 Hz IMU2 file in body axes for ST17BET, AEROBET, and GTFILE (uncalibrated)
NC0423	Dynamic data (input for trajectory reconstruction)- 20 Hz IMU2 data in platform coordinates (second CDC record)

D.2 Source Tapes Received via NASA LaRC

(a) T/M TAPES

REEL NO.	DESCRIPTION
NL1067	OI-1
NL0756/NB0486	OI-2
NS0515	OI-3 (source for RGA1/AA1 data)
NX0485	OI-4
NN0138	OI-1 from CBET1F

(b) TRACKING TAPES

REEL NO.	DESCRIPTION
NL1180	JSC/TRW tracking data
NK1135	Goddard Space Flight Center data

(c) OTHER

REEL NO.	DESCRIPTION
NH0106	JSC/TRW Descent BET

[redacted]

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16. Abstract
Development and summary results from the STS-17 (41-G) post-flight products are presented. Operational Instrumentation recorder gaps, coupled with the limited tracking coverage available for this high inclination entry profile, necessitated selection of an anchor epoch for reconstruction corresponding to an unusually low altitude of h~297 kft. The final inertial trajectory obtained, BT17N26/UN=169750N, is discussed in Section I. Therein are discussions relative to the problems encountered with the OI and ACIP recorded data on this Challenger flight. Atmospheric selection, again in view of the ground track displacement from the remote meteorological sites, constituted a major problem area as discussed in Section II. The LAIRS file provided by Langley was adopted, with NOAA data utilized over the lowermost ~7 kft. As discussed in Section II, the Extended BET, ST17BET/UN=274885C, suggests a limited upper altitude (h~230 kft) for which meaningful flight extraction can be expected. This is further demonstrated, though not considered a limitation, in Section III wherein summary results from the AEROBET (NJ0333 with NJ0346 as duplicate) are presented. GTFILEs were generated only for the selected IMU (IMU2) and the Rate Gyro Assembly/Accelerometer Assembly data due to the loss of ACIP data. Appendices attached present inputs for the generation of the post-flight products (Appendix A), final residual plots (Appendix B), a two second spaced listing of the relevant parameters from the Extended BET (Appendix C), and an archival section (Appendix D) denoting input (source) and output files and/or physical reels.

17. Key Words (Suggested by Author(s))
STS-17, Mission 41-G, Best Estimate Trajectory, aerodynamic comparisons, atmosphere evaluations

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