FLIGHT-WIND RESTRICTIONS PROCEDURE, ATLAS/CENTAUR AC-10 THROUGH AC-15

Addendum I

(Backup Procedure)

Report Number GDC-BTD66-063

Addendum I

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FOREWORD

This report has been prepared and published in compliance with the provisions of Contract NAS3-8701 which specify structural dynamic-loads and design-determination requirements as outlined in Item 148 of the Centaur Documentation Requirements Plan, Report Number 55-00207F, dated 15 July 1965 and revised 18 March 1966 (General Dynamics Convair).

This report presents a backup procedure for rapidly evaluating wind profiles shortly before launch if there is a breakdown in communciations between San Diego and Cape Kennedy.

SUMMARY

This Backup Flight-Wind Restriction Procedure will generally ensure booster-vehicle structural integrity as the vehicle flies through a wind that is determined by a wind sounding just prior to launch.

The procedure has a primary method presented in GDC-BTD66-063, dated 29 April 1966, a vehicle flight simulation that uses an IBM 7094 computer. The backup method presented herein does not rely on an IBM 7094 computer, but uses an IBM 1401 computer, or desk calculator, and gives slightly conservative results.

Bending moments at three vehicle stations are possibly critical. Therefore allowable values are compared with calculated values to determine a launch recommendation. Engine deflection is ignored in this procedure since bending moment loads are almost always more critical.

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SECTION 1

DISCUSSION

1.1 INTRODUCTION

The AC-10 flight-wind restriction backup procedure has been devised to be used only in the event that the primary procedure (GDC-BTD66-063, dated 29 April 1966) cannot be used. The backup procedure allows bending moments to be calculated at three critical stations - 217, 413, and 570 - for an altitude range of 0 to 60,000 feet. This bending moment is then compared to a predetermined bending allowable from which the launch restriction can be determined. The assumptions for calculating the bending moments are the same as those used in the primary procedure.

The backup procedure employs a triangular impulse superposition process as suggested by Trembath in Reference 1-1. The method used in the calculations (as given in the following subsection) could be followed employing a desk calculator if necessary. Reference 1-2 provides information on the digital program and its use on the AC-4 vehicle.

1.2 VEHICLE BENDING MOMENTS

The actual wind profile will be evaluated in feet per second and degrees azimuth at the following altitudes:

0 feet	18, 000 feet	33,000 feet	48, 000 feet
3, 000 feet	21, 000 feet	36, 000 feet	51, 000 feet
6, 000 feet	24, 000 feet	39, 000 feet	54, 000 feet
9, 000 feet	27, 000 feet	42, 000 feet	57, 000 feet
12, 000 feet	30, 000 feet	45, 000 feet	60, 000 feet
15, 000 feet			

1.2.1 FLIGHT-WIND COMPONENTS. Each of the wind vectors is then broken into the pitch and yaw planes. This is done as follows (see Figure 1-1 for components and definitions):

Axialwind $= V_A = -V_W \times \sin(\theta_W - \theta_Z - 90°)$

$= -113.3$ feet/second (tailwind is negative)

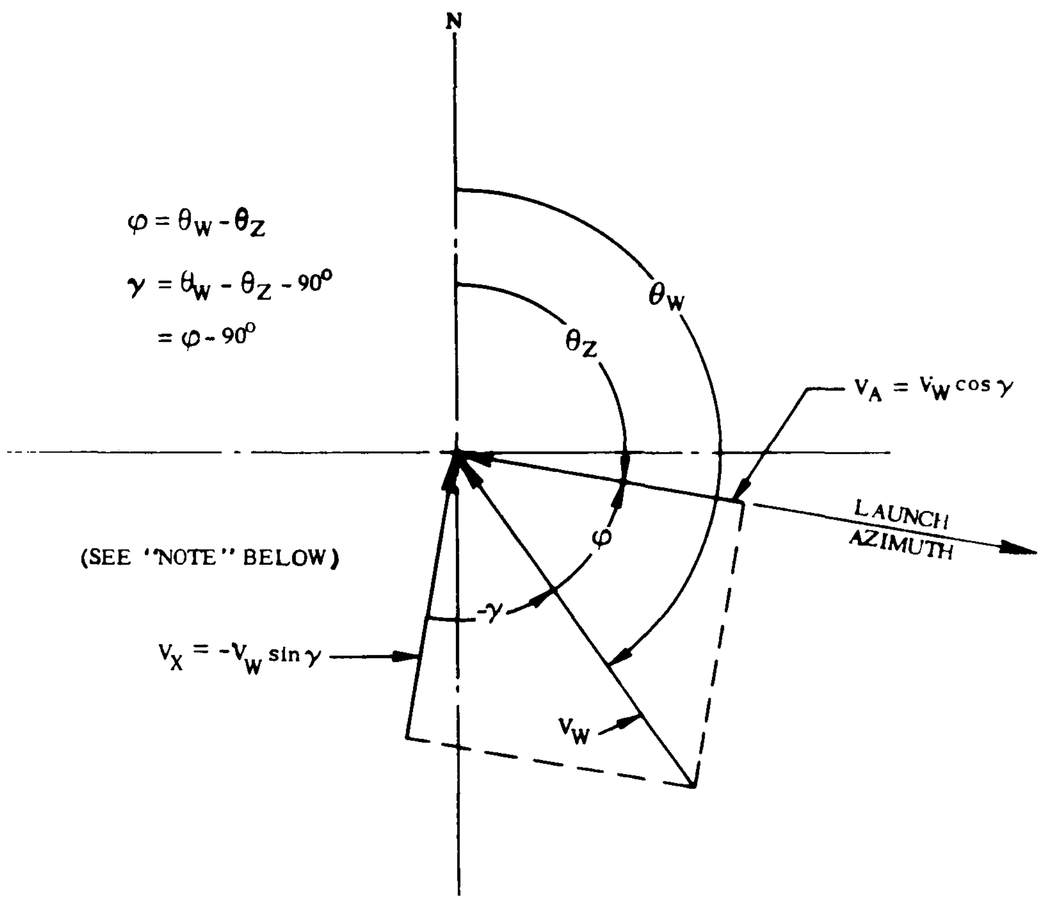
Example:
$V_W = 179.0$ fps
$\theta_W = 237°$
$\theta_Z = 111°$

Crosswind $= V_X = V_W \times \cos(\theta_W - \theta_Z - 90°)$

$= 140.0$ feet/second (southwind is positive)

1.2.2 COMPUTATION. The following steps are to be followed in computing the total bending moment:

1.2.2.1 At each of the previous altitudes, divide the incremental velocity at that altitude by ten and form a column matrix for each plane, i.e.;



where:

θ_Z = Launch azimuth — measured from North (clockwise is +)

θ_W = Azimuth—measured from North—of direction from which the wind is blowing

γ = $\theta_W - \theta_Z - 90^\circ$ (γ is - when a headwind component exists), $-180^\circ \leq \gamma \leq 180^\circ$

V_W = Windspeed relative to earth

V_A = Axial component of V_W (headwind is +)

V_X = Crosswind component of V_W (right crosswind or southwind is +)

4E23SV

Figure 1-1. Components of the Flight-Wind Vector

NOTE: The above convention agrees with COMBO as used in the primary flight-wind restriction procedure.

α - Plane

$$\begin{bmatrix} \frac{V_{A_0}}{10} \\ \frac{V_{A_{3000}}}{10} \\ \frac{V_{A_{6000}}}{10} \\ \vdots \end{bmatrix}$$

β - Plane

$$\begin{bmatrix} \frac{V_{X_0}}{10} \\ \frac{V_{X_{3000}}}{10} \\ \frac{V_{X_{6000}}}{10} \\ \vdots \end{bmatrix}$$

1.2.2.2 Premultiply each column of Paragraph 1.2.2.1 by the triangular matrix corresponding to the particular vehicle station in question (Tables 1-1 through 1-3). This results in columns $\left[BM_\alpha\right]$ and $\left[BM_\beta\right]$, which are the bending moments in pitch and yaw due only to the wind profile:

$$\left[\frac{\partial BM_{STA\ i}}{\partial V_h/10}\right] \cdot \left[\frac{V_{A_h}}{10}\right] = \left[BM_\alpha\right], \text{ or}$$

$$\begin{bmatrix} a_{11} & & \\ a_{12} & a_{22} & \\ a_{13} & a_{23} & a_{33} \\ \vdots & \vdots & \vdots \end{bmatrix} \cdot \begin{bmatrix} \frac{V_{A_0}}{10} \\ \frac{V_{A_{3000}}}{10} \\ \frac{V_{A_{6000}}}{10} \\ \vdots \end{bmatrix} = \begin{bmatrix} a_{11}\frac{V_{A_0}}{10} \\ a_{12}\frac{V_{A_0}}{10} + a_{22}\frac{V_{A_{3000}}}{10} \\ a_{13}\frac{V_{A_0}}{10} + a_{23}\frac{V_{A_{3000}}}{10} + a_{33}\frac{V_{A_{6000}}}{10} \\ \vdots \end{bmatrix}$$

and

$$\left[\frac{\partial BM_{STA\ i}}{\partial V_h/10}\right] \left[\frac{V_{X_h}}{10}\right] = \left[BM_\beta\right]$$

The sub$_h$ refers to the altitude; and the same triangular matrix is used in each plane.

TABLE 1-1. INFLUENCE MATRIX ($\partial BM_{STA\ 217} \times 10^{-6} / \partial V_h/10$)
(All values are given in in. -lb sec/ft.)

AC-10

0000																				
0007-	0056																			
0004-	0007-	0077																		
0005-	0012-	0018-	0095																	
0005-	0011-	0016-	0031-	0108																
0004-	0009-	0012-	0019-	0036-	0118															
0003-	0007-	0009-	0012-	0020-	0034-	0125														
0002-	0005-	0006-	0008-	0011-	0017-	0029-	0124													
0001-	0002-	0003-	0003-	0004-	0005-	0011-	0027-	0042												
0001-	0002-	0002-	0003-	0003-	0004-	0005-	0010-	0011-	0055											
0001-	0001-	0002-	0002-	0002-	0003-	0003-	0006-	0017-	0047-	0066										
0001-	0002-	0002-	0002-	0003-	0003-	0003-	0004-	0006-	0019-	0016-	0075									
0001-	0002-	0002-	0002-	0002-	0003-	0003-	0003-	0005-	0009-	0029-	0059-	0083								
0001-	0002-	0002-	0002-	0003-	0003-	0003-	0003-	0004-	0006-	0012-	0037-	0054-	0146							
0001-	0001-	0002-	0002-	0002-	0002-	0003-	0003-	0003-	0004-	0006-	0011-	0038-	0050-	0135						
0001-	0001-	0001-	0001-	0002-	0002-	0002-	0002-	0003-	0003-	0003-	0005-	0008-	0037-	0044-	0125					
0001-	0001-	0001-	0001-	0001-	0001-	0002-	0002-	0002-	0003-	0003-	0003-	0003-	0007-	0037-	0039-	0111				
0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0002-	0002-	0002-	0003-	0003-	0004-	0009-	0033-	0030-	0097			
0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0002-	0002-	0002-	0002-	0002-	0003-	0004-	0010-	0027-	0022-	0085		
0002-	0003-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0002-	0002-	0002-	0003-	0003-	0005-	0010-	0022-	0013-	0070	
0000	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0002-	0003-	0004-	0008-	0018-	0011-	0062

TABLE 1-2. INFLUENCE MATRIX ($\partial BM_{STA\ 413} \times 10^{-6} / \partial V_h / 10$)
(All values are given in in. -lb sec/ft)

AC-10

0000																				
0017-	0139																			
0016-	0030-	0217																		
0015-	0037-	0065-	0267																	
0011-	0026-	0038-	0067-	0234																
0010-	0022-	0028-	0042-	0074-	0290															
0009-	0020-	0023-	0030-	0050-	0077-	0312														
0008-	0018-	0021-	0025-	0034-	0052-	0082-	0330													
0001-	0002-	0003-	0003-	0004-	0006-	0015-	0050-	0188												
0002-	0005-	0006-	0006-	0007-	0008-	0012-	0022-	0028-	0288											
0002-	0005-	0005-	0006-	0007-	0007-	0009-	0014-	0031-	0037-	0293										
0002-	0005-	0006-	0007-	0007-	0008-	0009-	0011-	0017-	0066-	0090-	0312									
0003-	0005-	0006-	0007-	0008-	0008-	0009-	0011-	0013-	0031-	0102-	0149-	0393								
0002-	0005-	0006-	0006-	0007-	0007-	0008-	0009-	0011-	0016-	0032-	0098-	0147-	0375							
0002-	0004-	0004-	0005-	0006-	0006-	0006-	0007-	0008-	0011-	0015-	0027-	0094-	0124-	0338						
0000	0000	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0001-	0031-	0178					
0001-	0001-	0002-	0003-	0003-	0004-	0004-	0004-	0006-	0007-	0007-	0007-	0008-	0017-	0093-	0100-	0289				
0001-	0002-	0002-	0003-	0003-	0003-	0004-	0004-	0005-	0006-	0006-	0006-	0007-	0009-	0022-	0083-	0079-	0260			
0001-	0001-	0002-	0002-	0003-	0003-	0003-	0003-	0004-	0005-	0005-	0005-	0006-	0007-	0011-	0026-	0071-	0058-	0226		
0001-	0003-	0004-	0005-	0005-	0005-	0005-	0006-	0006-	0005-	0006-	0006-	0007-	0008-	0011-	0016-	0023-	0069-	0080-	0267	
0001-	0001-	0001-	0002-	0002-	0002-	0002-	0002-	0003-	0003-	0003-	0003-	0003-	0004-	0004-	0007-	0011-	0022-	0047-	0031-	0166

TABLE 1-3. INFLUENCE MATRIX ($\partial BM_{STA\ 570} \times 10^{-6}/\partial V_h/10$)
(All values are given in in.-lb sec/ft.)

AC-10

0000																				
0024-	0193																			
0016	0053	0222																		
0018	0045	0082	0064																	
0016	0037	0055	0102	0164-																
0014	0031	0040	0064	0114	0295-															
0013	0028	0034	0046	0075	0134	0417-														
0012	0025	0031	0038	0052	0086	0160	0503-													
0010	0021	0025	0029	0036	0049	0089	0207	0533-												
0007	0016	0019	0022	0026	0031	0046	0103	0223	0547-											
0006	0013	0016	0019	0021	0023	0029	0052	0117	0245	0583-										
0004	0010	0013	0014	0016	0017	0020	0028	0048	0120	0270	0587-									
0004	0008	0010	0011	0012	0013	0014	0016	0021	0045	0160	0254	0596-								
0003	0004	0009	0010	0011	0011	0012	0013	0016	0023	0047	0142	0227	0568-							
0003	0006	0007	0008	0009	0009	0009	0011	0013	0016	0022	0039	0138	0203	0499-						
0001	0003	0004	0005	0006	0006	0007	0008	0010	0011	0012	0014	0024	0120	0144	0465-					
0001	0003	0003	0004	0005	0005	0006	0006	0008	0009	0010	0011	0012	0023	0140	0159	0416-				
0001	0002	0003	0004	0004	0004	0005	0005	0007	0007	0008	0009	0009	0013	0030	0123	0120	0363-			
0001	0001	0002	0003	0003	0004	0004	0004	0006	0006	0007	0008	0008	0009	0015	0036	0102	0086	0313-		
0001	0001	0002	0002	0003	0003	0003	0003	0005	0005	0006	0006	0007	0007	0010	0017	0034	0081	0064	0265-	
0001	0001	0001	0002	0003	0003	0003	0003	0004	0005	0005	0006	0006	0006	0008	0011	0017	0031	0063	0043	0227-

1.2.2.3 Add to $\left|BM_{\alpha}\right|$ the values from Table 1-4, which are the bending moments due to vehicle response in a no-wind condition.

1.2.2.4 Take the square root of the sum of the squares of $(BM_{\alpha} + BM_{NO\ WIND})$ and (BM_{β}) at each altitude to get the resultant bending moment:

$$\left|BM_R\right| = +\sqrt{(BM_{\alpha} + BM_{NO\ WIND})^2 + (BM_{\beta})^2}$$

1.2.2.5 Add the bending moment due to gust, which is given in Table 1-5, to BM_R to get total bending moment:

$$\left|BM_T\right| = \left|BM_R\right| + \left|BM_{GUST}\right|$$

TABLE 1-4. NOMINAL NO-WIND TRAJECTORY PARAMETERS
(BENDING MOMENT x 10^{-6})
(All values are given in in.-lb.)

Altitude (feet)	Time (second)	Station 217	Station 413	Station 570
0	0	-0.002	-0.017	0.051
3,000	24.3	-0.043	-0.115	0.169
6,000	33.0	0.018	0.027	0.032
9,000	39.3	0.051	0.111	-0.134
12,000	44.5	0.098	0.218	0.272
15,000	48.9	0.135	0.297	-0.395
18,000	52.8	0.183	0.388	-0.493
21,000	56.3	0.223	0.524	-0.625
24,000	59.5	0.250	0.735	-0.867
27,000	62.5	0.263	0.818	-0.987
30,000	65.4	0.317	0.738	-0.861
33,000	68.1	0.218	0.562	-0.618
36,000	70.6	0.249	0.414	-0.423
39,000	73.1	0.165	0.227	-0.306
42,000	75.4	0.086	0.627	-0.228
45,000	77.6	-0.029	0.160	-0.251
48,000	79.7	-0.105	-0.300	0.509
51,000	81.9	-0.213	-0.464	0.723
54,000	83.9	-0.214	-0.605	0.909
57,000	85.8	-0.232	-0.668	1.007
60,000	87.7	-0.072	-0.218	0.369

TABLE 1-5. BENDING MOMENTS DUE TO GUST (ABSOLUTE VALUE) (BENDING MOMENT $\times 10^{-6}$)
(All values are given in in.-lb.)

Altitude (feet)	Time (second)	Station 217	Station 413	Station 570
0	0	0	0	0
3,000	24.3	0.156	0.362	0.478
6,000	33.0	0.214	0.453	0.600
9,000	39.3	0.241	0.547	0.765
12,000	44.5	0.315	0.722	0.880
15,000	48.9	0.491	0.796	1.296
18,000	52.8	0.615	1.008	1.233
21,000	56.3	0.620	1.034	1.317
24,000	59.5	0.591	1.137	1.667
27,000	62.5	0.677	1.375	1.717
30,000	65.4	0.594	1.326	1.739
33,000	68.1	0.735	1.300	1.753
36,000	70.6	0.455	1.236	1.591
39,000	73.1	0.471	1.246	1.527
42,000	75.4	0.453	1.164	1.568
45,000	77.6	0.460	1.232	1.408
48,000	79.7	0.353	1.045	1.063
51,000	81.9	0.327	0.875	1.330
54,000	83.9	0.378	1.121	1.257
57,000	85.8	0.381	1.077	1.240
60,000	87.7	0.444	1.187	1.290

Table 1-7 shows the results of calculations involving the influence coefficients of Table 1-1 and the wind components of Table 1-6.

TABLE 1-6. SAMPLE CALCULATION FOR ETR WIND 6 JUNE 1959

Altitude (feet)	Time (sec)	θ_W (deg)	θ_W -198 (deg)	Sin (θ_W -198)	V_W (ft/sec)	Cos (θ_W -198)	$\frac{V_A}{10}$ (ft/sec)	$\frac{V_X}{10}$ (ft/sec)
0	0	230	32	0.5299	3.2	0.8480	-0.1695	0.2713
3,000	24.3	222	24	0.4067	7.4	0.9135	-0.3009	0.6759
6,000	33.0	260	62	0.8829	15.9	0.4695	-1.4038	0.7465
9,000	39.3	250	52	0.7880	22.0	0.6157	-1.7336	1.3545
12,000	44.5	280	82	0.9903	33.9	0.1392	-3.3571	0.4719
15,000	48.9	280	82	0.9903	39.4	0.1392	-3.9017	0.5484
18,000	52.8	280	82	0.9903	36.1	0.1392	-3.5749	0.5025
21,000	56.3	270	72	0.9511	36.5	0.3090	-3.4715	1.1278
24,000	59.5	283	85	0.9962	47.8	0.0872	-4.7618	0.4168
27,000	62.5	290	92	0.9994	61.0	-0.0349	-6.0963	-0.2129
30,000	65.4	290	92	0.9994	79.3	-0.0349	-7.9252	-0.2767
33,000	68.1	290	92	0.9994	98.0	-0.0349	-9.7941	-0.3420
36,000	70.6	300	102	0.9782	100.0	-0.2079	-9.7820	-2.0790
39,000	73.1	303	105	0.9659	128.8	-0.2588	-12.4407	-3.3333
42,000	75.4	310	112	0.9272	151.1	-0.3746	-14.0099	-5.6602
45,000	77.6	301	103	0.9744	121.5	-0.2249	-11.8389	-2.7325
48,000	79.8	290	92	0.9994	97.7	-0.0349	-9.7641	-0.3409
51,000	81.9	297	99	0.9877	60.0	-0.1564	-5.9262	-0.9384
54,000	83.9	282	84	0.9945	37.0	0.1045	-3.6796	0.3866
57,000	85.8	310	112	0.9272	20.0	-0.3746	-1.8544	-0.7492
60,000	87.7	290	92	0.9994	14.5	-0.0349	-1.4491	-0.0506

TABLE 1-7. BACKUP PROCEDURE FOR 6 JUNE 1959, STATION 217

Altitude (feet)	Time (sec)	$\frac{V_A}{10}$ (ft/sec)	$\frac{V_X}{10}$ (ft/sec)	$BM_\alpha \times 10^{-6}$ (in.-lb)	$(BM_\alpha + BM_{NO\ WIND}) \times 10^{-6}$ (in.-lb)	$BM_\beta \times 10^{-6}$ (in.-lb)	$BM_R \times 10^{-6}$ (in.-lb)	$BM_T \times 10^{-6}$ (in.-lb)
0	0	-0.1695	0.2713	0	-0.002	0	0.002	0.002
3,000	24.3	-0.3009	0.6759	-0.016	-0.059	0.036	0.061	0.217
6,000	33.0	-1.4038	0.7465	-0.105	-0.087	0.051	0.101	0.315
9,000	39.3	-1.7336	1.3545	-0.135	-0.083	0.104	0.134	0.374
12,000	44.5	-3.3571	0.4719	-0.280	-0.182	-0.011	0.182	0.497
15,000	48.9	-3.9017	0.5484	-0.286	-0.151	0.006	0.151	0.642
18,000	52.8	-3.5749	0.5025	-0.208	-0.025	0.005	0.026	0.641
21,000	56.3	-3.4715	1.1278	-0.199	0.024	0.091	0.094	0.713
24,000	59.5	-4.7618	0.4168	-0.026	0.224	-0.030	0.226	0.817
27,000	62.5	-6.0963	-0.2129	-0.198	0.065	-0.043	0.076	0.754
30,000	65.4	-7.9252	-0.2767	-0.091	0.226	-0.032	0.228	0.823
33,000	68.1	-9.7941	-0.3420	-0.410	-0.192	-0.034	0.195	0.930
36,000	70.6	-9.7820	-2.0790	-0.119	0.368	-0.158	0.401	0.856
39,000	73.1	-12.4407	-3.3333	-0.716	-0.551	-0.358	0.657	1.128
42,000	75.4	-14.0099	-5.6602	-0.659	-0.573	-0.531	0.781	1.233

1.2.3 COMPARISON WITH ALLOWABLES. The allowable bending moments at each station, for use only in this backup procedure, are specified in Figure 1-2. If the $|BM_T|$'s exceed the allowable values, the 1401 program prints out the word DANGER. Note that the primary procedure uses both bending moment and axial load to obtain a higher launch availability than is possible with this abbreviated procedure.

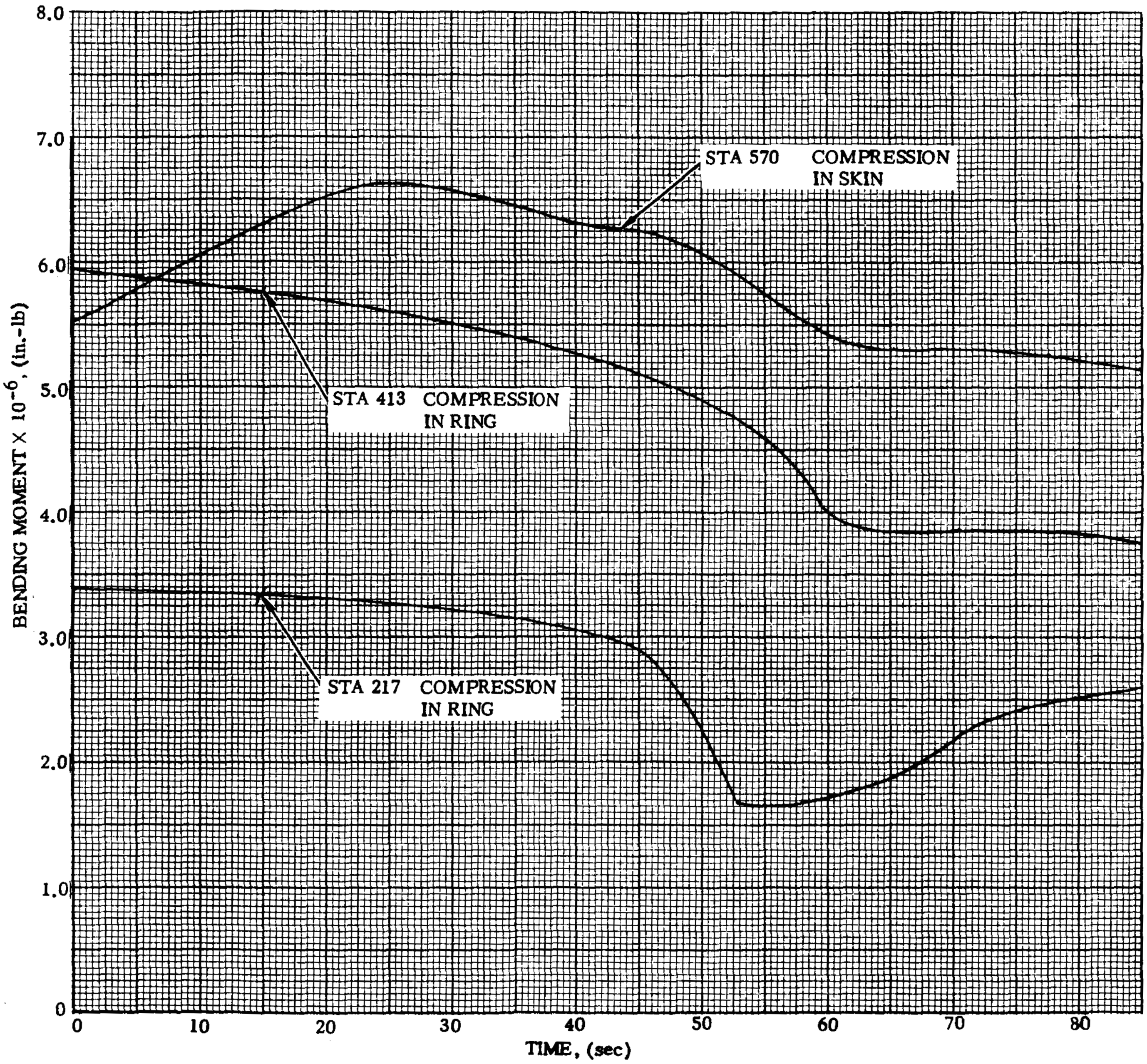


Figure 1-2. AC-10 Allowable Bending Moments for Simplified Backup Procedure

1.3 BACKUP PROCEDURE VERSUS PRIMARY PROCEDURE

1.3.1 COMPARISONS. Table 1-8 shows the percentage difference, at maximum bending (primary procedure), of the backup as compared with the primary procedure. In Appendix A, Figures A-1 through A-6 show comparisons of the bending moments from the backup procedure and the primary (COMBO) procedure. Three winds measured at Cape Kennedy, 6 June 1959, 6 June 1960, and 26 May 1961, were used for comparison.

TABLE 1-8. PERCENTAGE DIFFERENCE AT MAXIMUM BENDING (PRIMARY PROCEDURE) OF THE BACKUP PROCEDURE VERSUS PRIMARY PROCEDURE

Date	Station 217	Station 413	Station 570
6 June 1959	0%	0%	4% high
6 June 1960	3% high	2% high	6% high
26 May 1961	2% high	10% low	7% low

1.3.2 CORRECTION FOR EXCESSIVE WIND-SHEAR RATES. Although the backup procedure was designed to give conservative results, inspection of the plots shows an inconsistency. This inconsistency is due to the fine-mesh flight simulation which the primary procedure maintains. Also, the primary program uses an elliptical interpolation for gust bending moment, while this simplified backup procedure uses an average value. Station 570 occasionally shows a relatively high bending moment because the average gust bending moment is used.

Significant wind shears frequently occur over a shorter altitude range than that of the 3,000 foot integration mesh of this backup procedure. This program has the effect of spreading the wind shear over the 3,000 foot interval and thus reducing the magnitude of the applied aerodynamic load.

Whenever the backup program is used because of the unavailability of the primary flight-wind restriction results, the wind-shear rate must be examined. If the wind-shear rate exceeds 6.7 fps per thousand feet, the 1401 bending moments are to be multiplied by the $f_{W.S.}$ factor from Figure A-7 in order to obtain reasonable values. The wind-shear rate should be taken from the AN-GMD-1 balloon data, which is interpolated at altitude intervals of approximately one hundred feet.

1.4 CONFIGURATION APPLICABILITY

1.4.1 AC-10 CONFIGURATION. Though the general procedures of this report are not expected to change for the next 8 vehicles, the specific data displayed in the tables of Section 1.2 and the graphs of Appendix A are applicable to the AC-10 flight only. The nose fairing and insulation panels are to be jettisoned as before. This is the first flight of the Surveyor spacecraft. The Surveyor is to be separated from the Centaur. In addition to the payload, several telemetry channels and associated measuring devices will be on board for R&D purposes.

1.4.2 FUTURE CONFIGURATIONS. Future configurations should not differ greatly from the AC-10 configuration. Also the digital computer program method used in this procedure will be the same for future flights. Therefore this report is considered applicable for flights AC-10 through AC-15. (Vehicles AC-7 and AC-9 are included in this group configuration since they are scheduled to fly after AC-10.) Relatively minor changes in vehicle parameters, coefficients, gust response, zero-wind bending moment, etc., will be made, if necessary, for each vehicle without changing the report. Should a major configuration or program change occur, however, this report will be revised.

SECTION II

DIGITAL COMPUTER PROGRAM METHOD

The backup flight-wind procedure employs an IBM 1401 digital computer. The deck setup for the BURP program (Revision A), used in this procedure, is illustrated in Figure 2-1 and explained in Table 2-1. Figure 2-2 diagrams the logic flow.

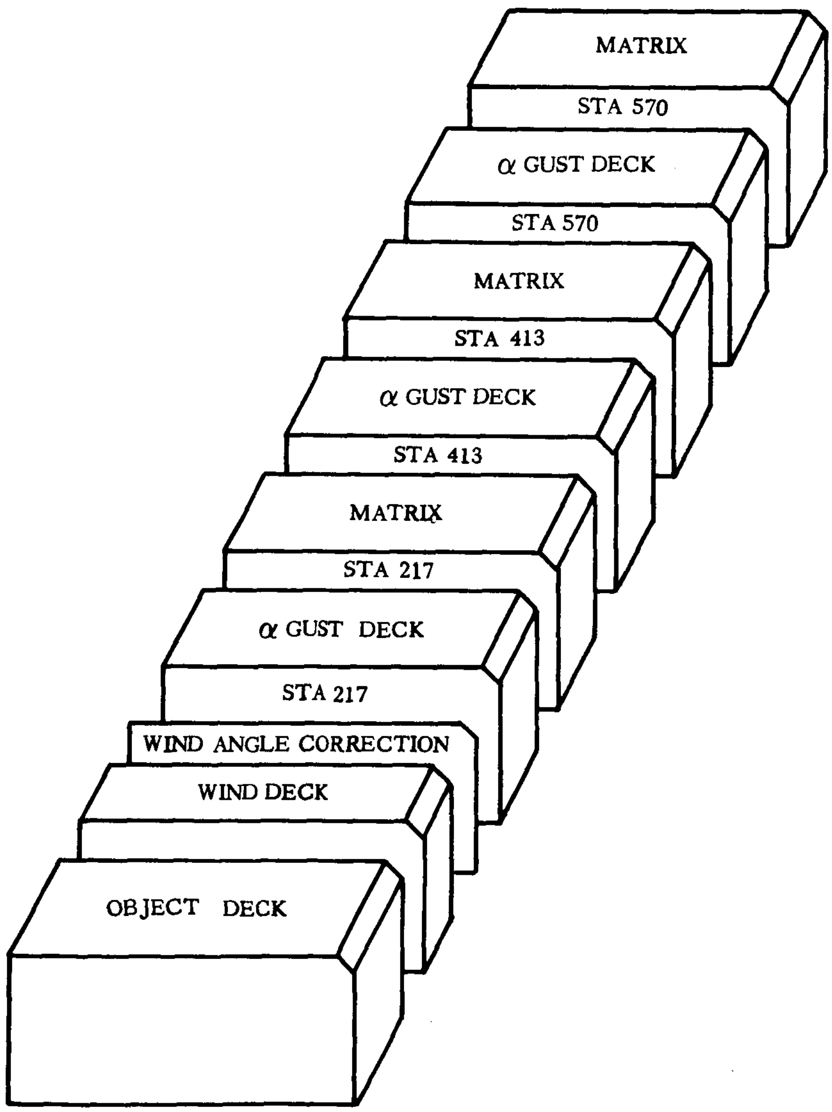


Figure 2-1. Deck Setup for BURP, Revision A

TABLE 2-1. DECK DESCRIPTION FOR **BURP**, REVISION A

Columns	Data	Units	Digits
1. Wind Data Deck (22 Cards)			
30-40 (First Card)	Date of Wind		
1-5	Altitude	feet	(XXXXX‸)
11-14	Wind Speed	fps	(XXX‸)
21-23	Wind Angle	degrees	(XXX‸X)
Example: Col 1: 28000	Col 12: 017	Col 21: 353	
2. Wind Angle Correction Card (1 Card)			
1-3	Correction Angle	degrees	(XXX‸)
3. α Gust Deck (21 Cards)			
1-4	α Gust	in.-lbs	(X‸XXX)
11-14	Design Limit	in.-lbs	(X‸XXX)
21-24	α No Wind	in.-lbs	(X‸XXX)
30-33 (First Card)	Station Number		
Example: Col 1: 0682	Col 11: 1350	Col 21: 0420	
4. Matrix Deck (22 Cards)			
One row per card with the 21st row being an exception. Card 21 contains 20 elements of Row 21 and Card 22 contains the last element of Row 21 (see Tables 1-1 through 1-3).			
30-40 (First Card)	Title of Run		
	Field Width Equal 4		(X‸XXX)
Example: Col 1: 0005	Col 5: 0015	Col 9: 0022	Col 13 (4th Card): 0080

NOTES: 1. All data are right adjusted in designated fields. Zeros are used in place of blanks.

2. All negative numbers must have a minus sign over-punched in the low order position of the field.

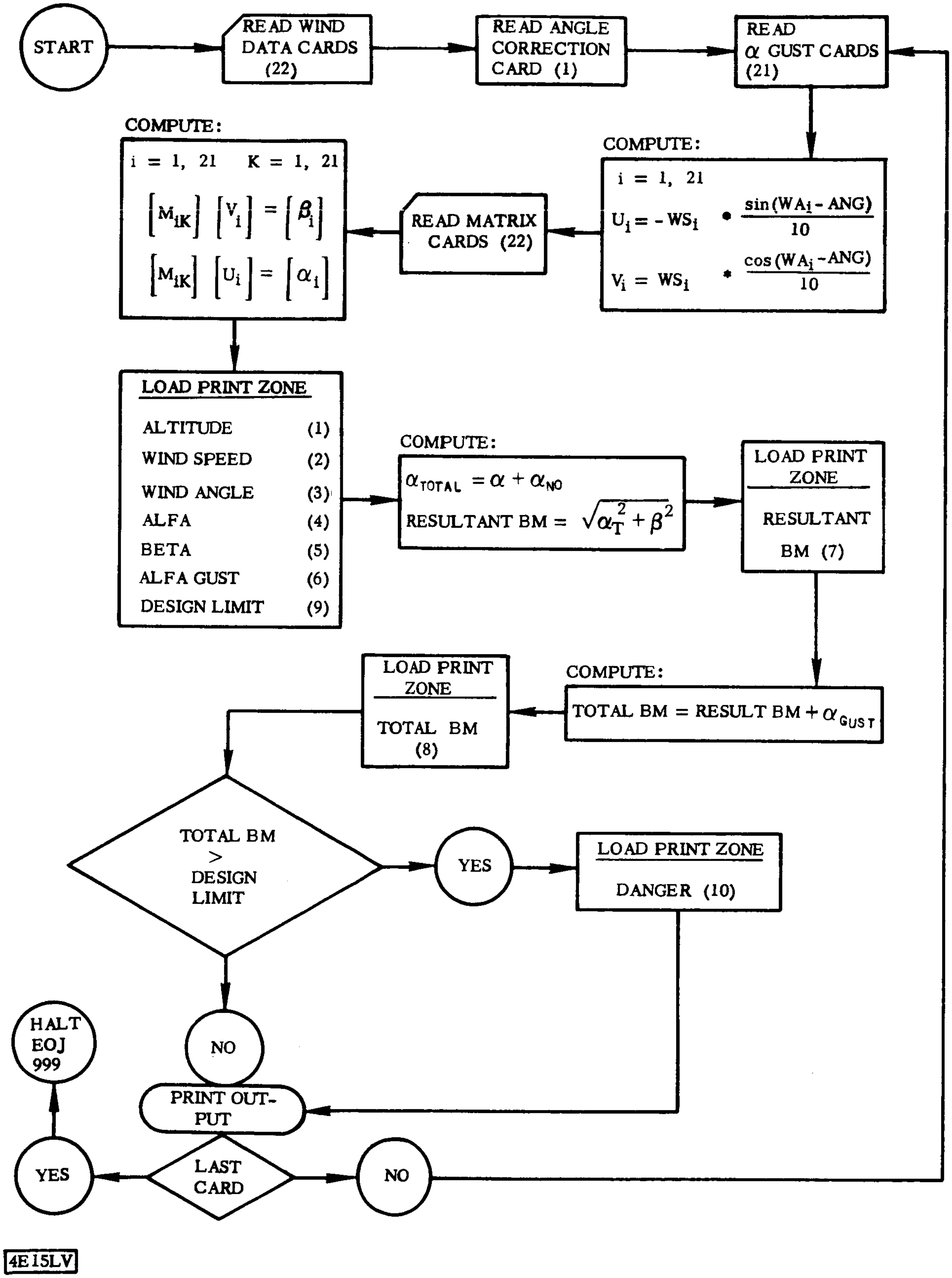


Figure 2-2. Logic Flow for BURP Program, Revision A

SECTION III

REFERENCES

1-1. Control System Design Wind Criteria, N. W. Trembath. 30 June 1958 (Space Technology Laboratories).

1-2. Backup Wind Restriction Procedure; Computer Program 10105, R. James. 10 September 1963 (Computer Laboratory, General Dynamics/Convair).

1-3. Flight-Wind Restrictions Procedure, Atlas/Centaur AC-10 through AC-15, R. T. Mattson. Report Number GDC-BTD66-063, 29 April 1966 (General Dynamics Convair).

APPENDIX A

Figures A-1 through A-7.

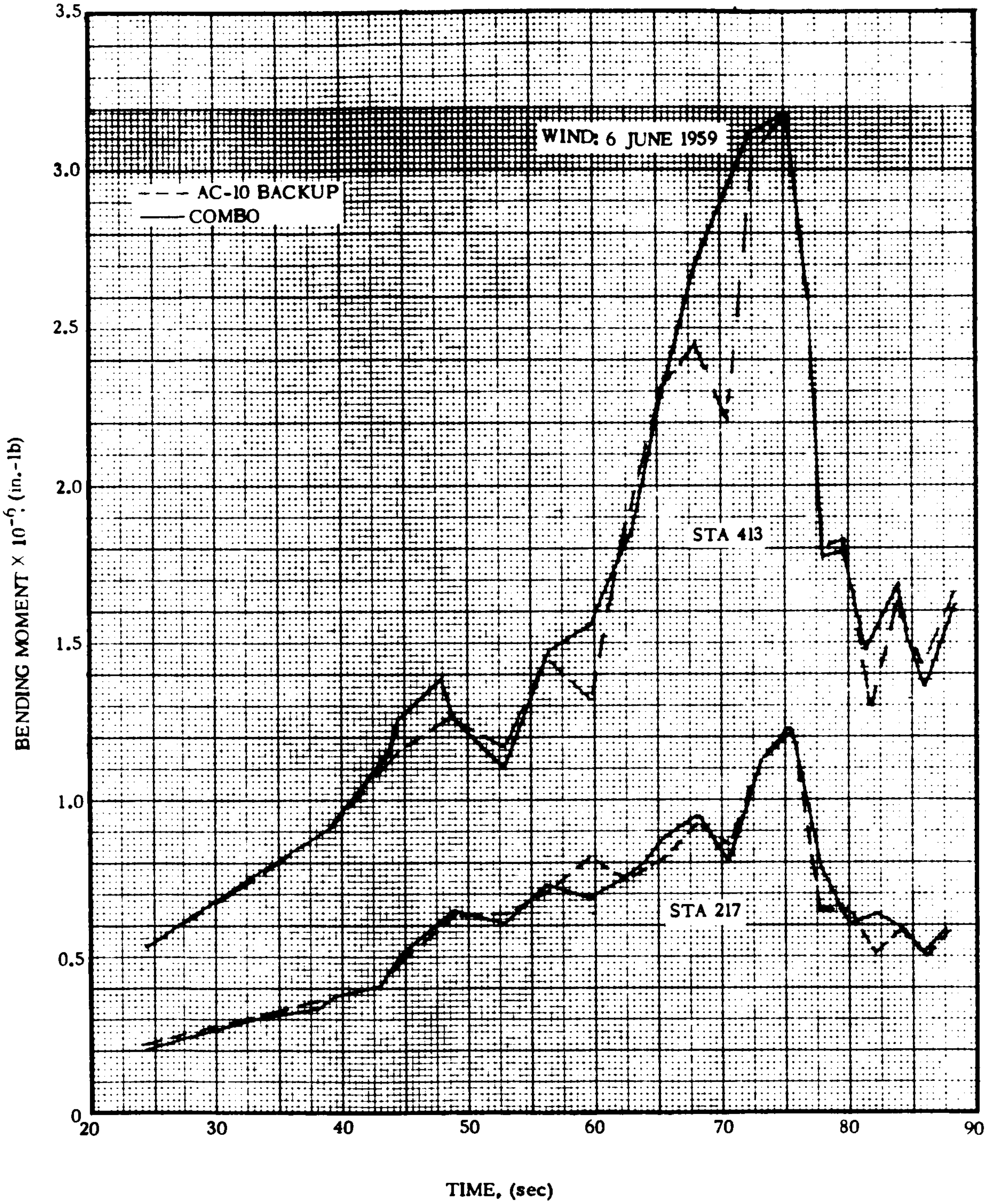


Figure A-1. Comparison of COMBO and Backup Methods, 6 June 1959 Wind, Stations 217 and 413

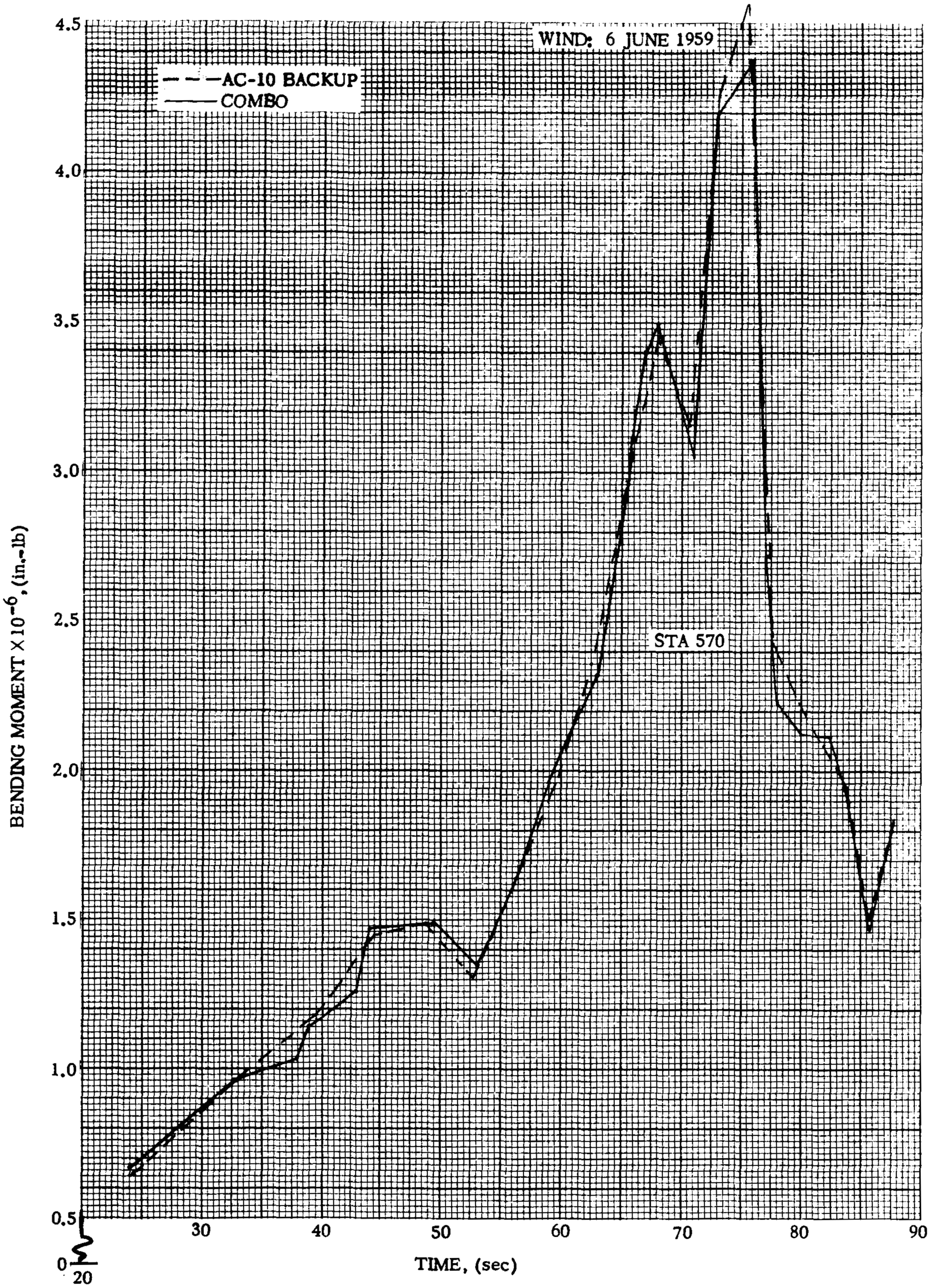
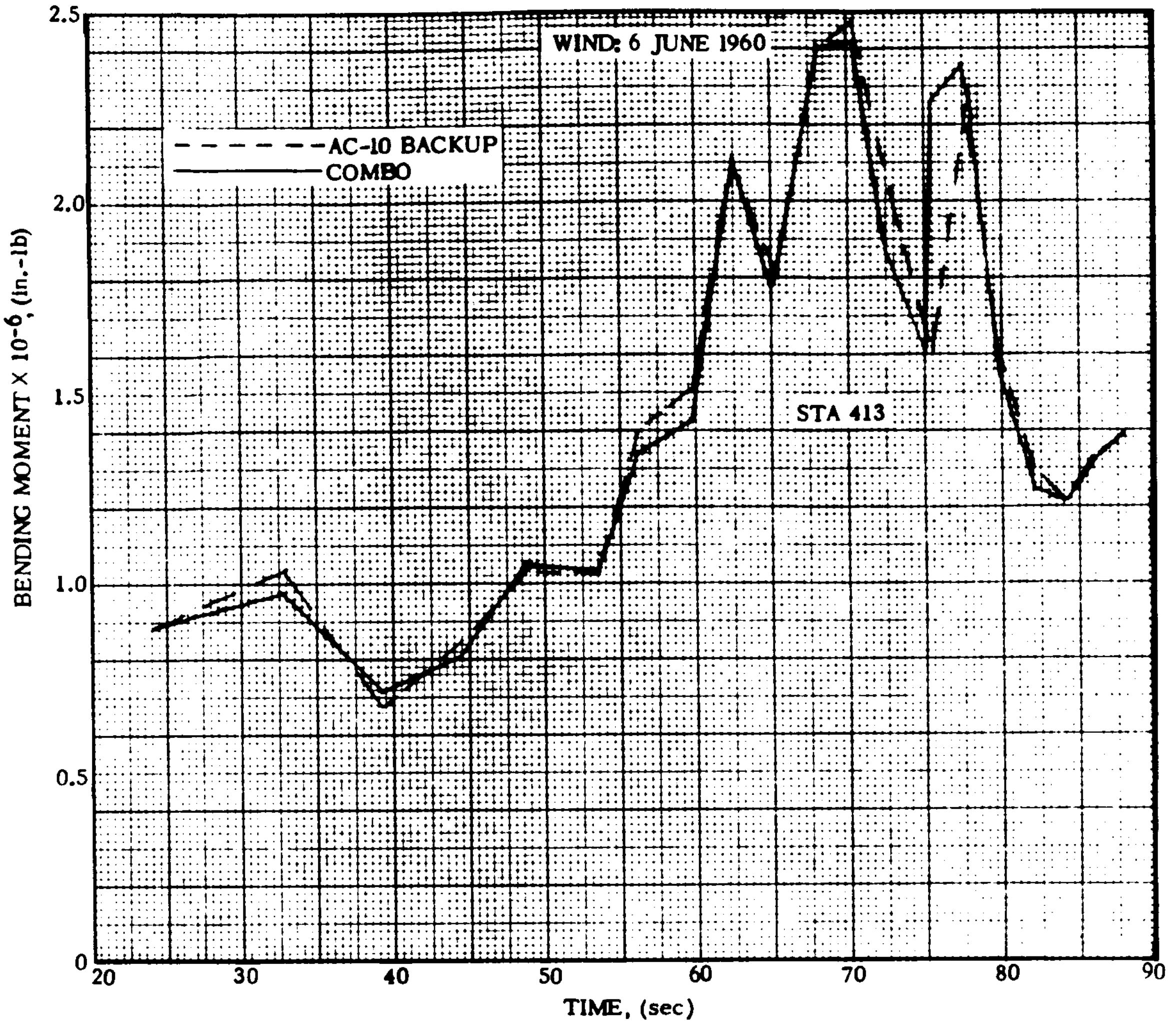


Figure A-2. Comparison of COMBO and Backup Methods, 6 June 1959 Wind, Station 570



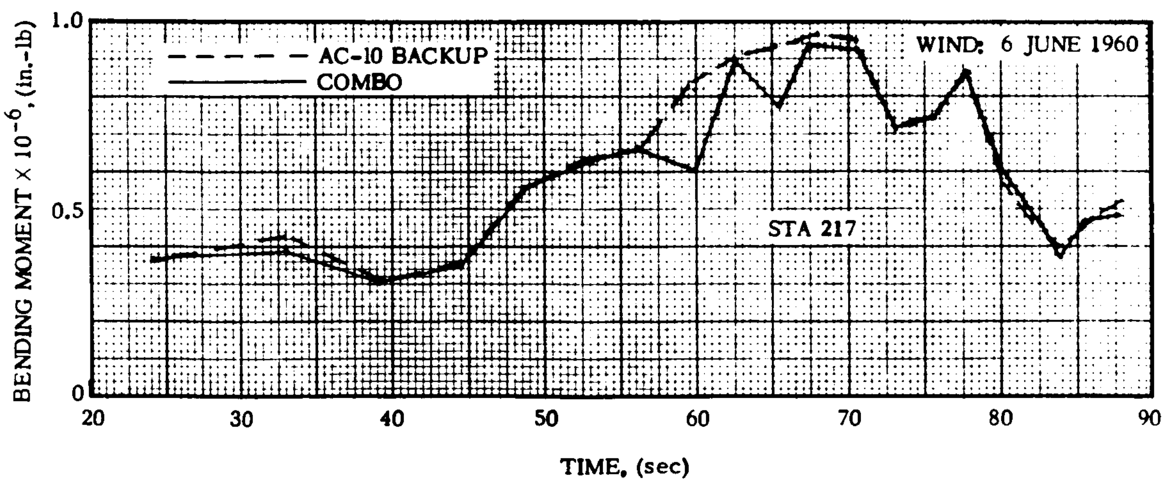


Figure A-3. Comparison of COMBO and Backup Methods, 6 June 1960 Wind, Stations 217 and 413

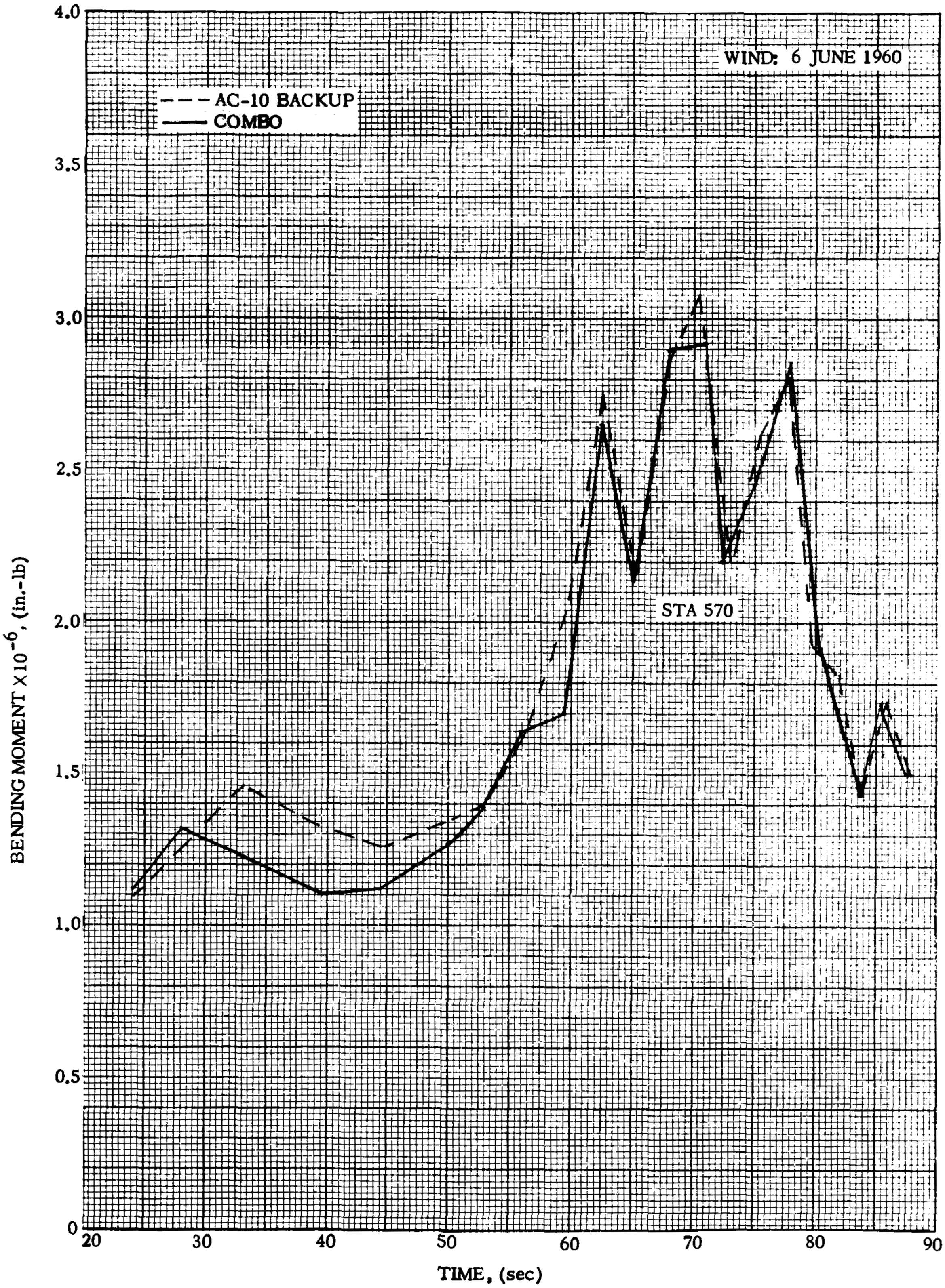
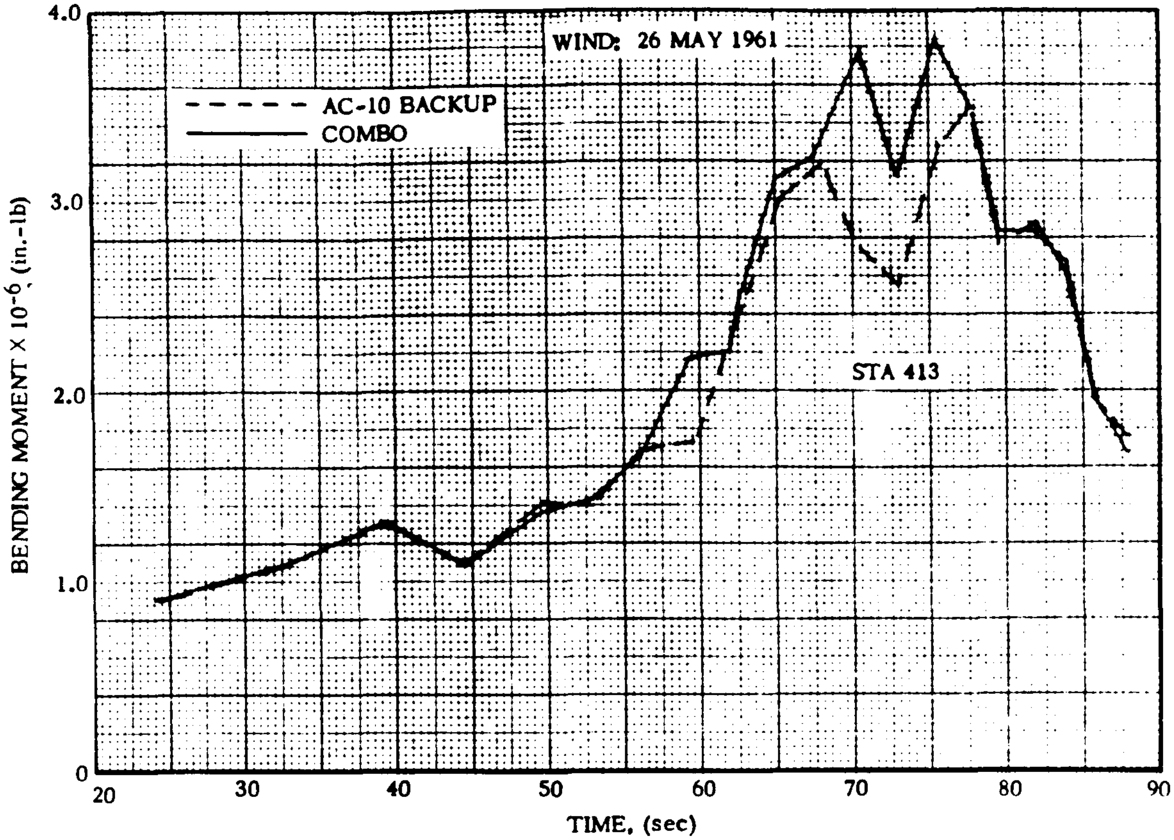


Figure A-4. Comparison of COMBO and Backup Methods, 6 June 1960 Wind, Station 570



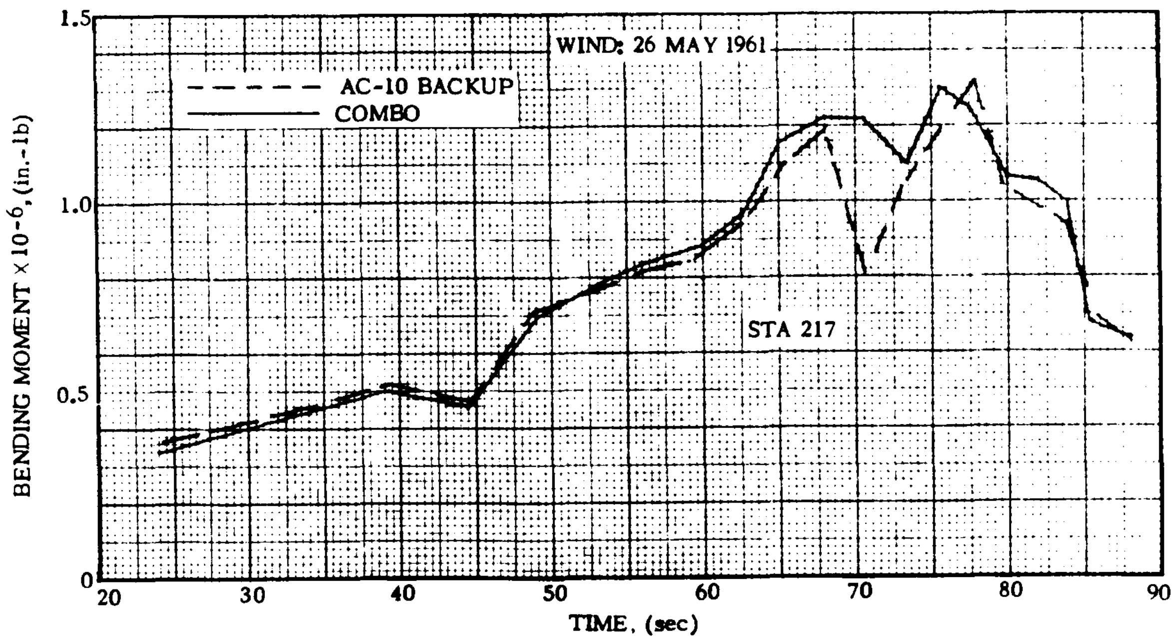


Figure A-5. Comparison of COMBO and Backup Methods, 26 May 1961 Wind, Stations 217 and 413

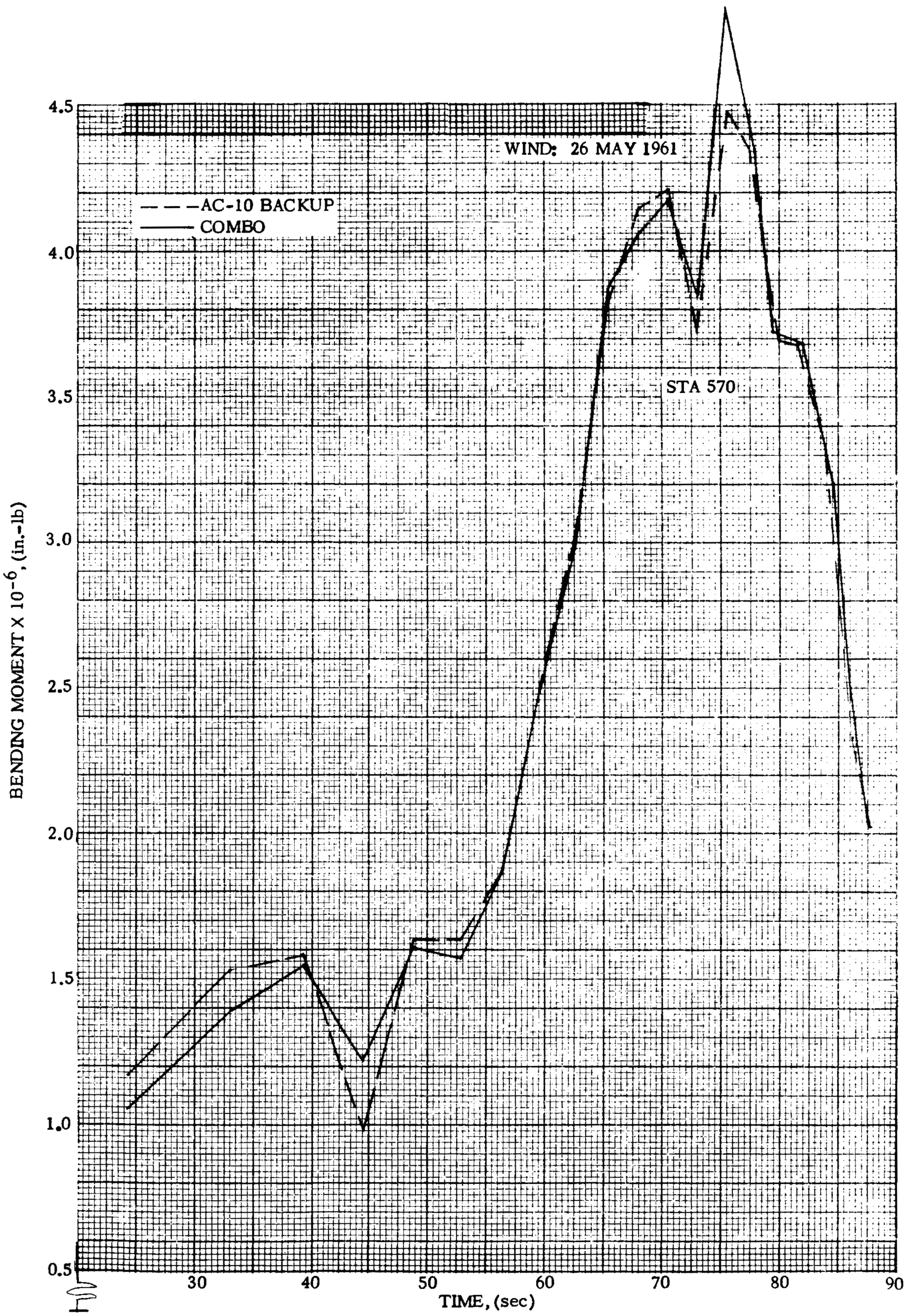


Figure A-6. Comparison of COMBO and Backup Methods, 26 May 1961 Wind, Station 570

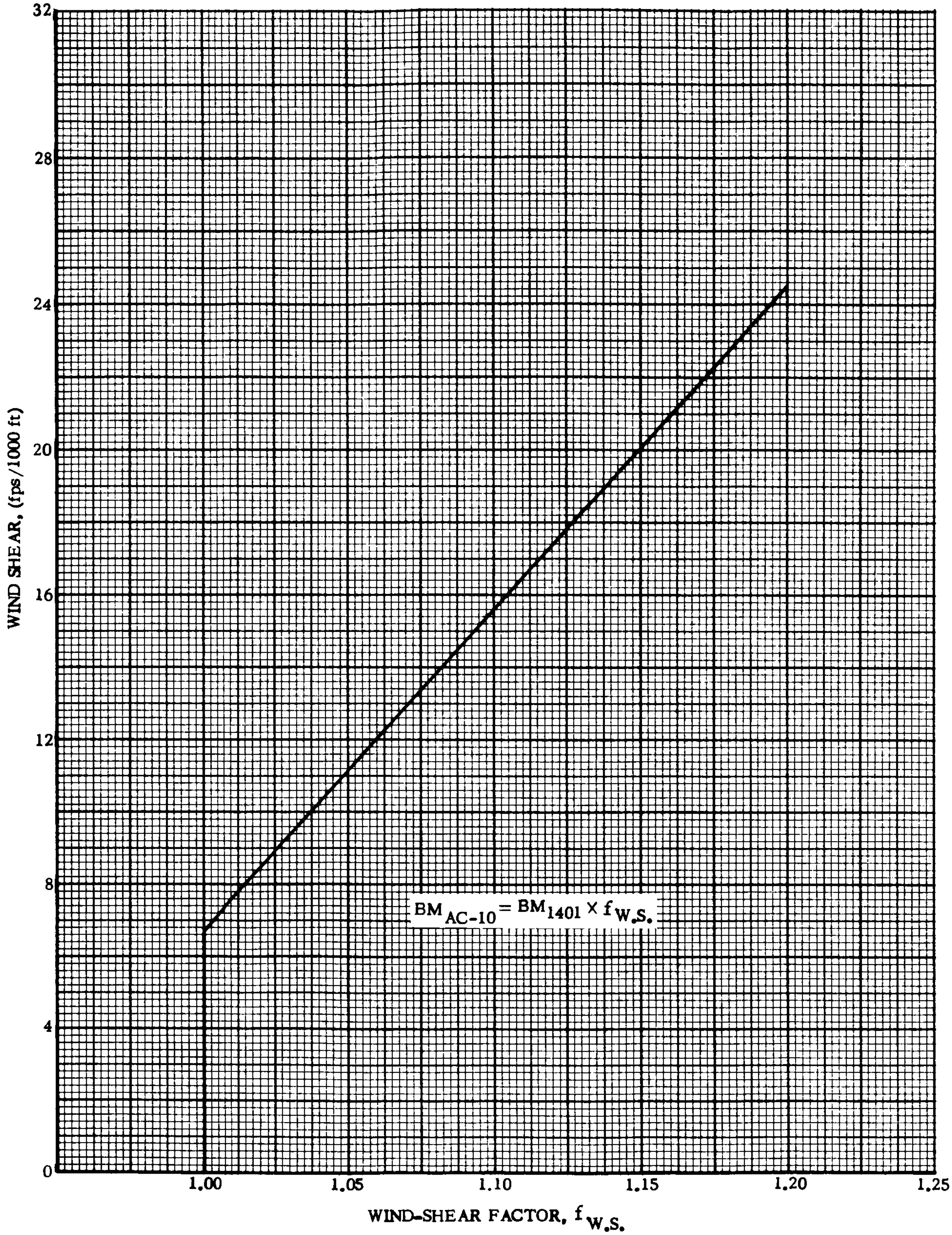


Figure A-7. AC-10 Wind-Shear Correction Factor for Backup (1401) Flight-Wind Restriction Procedure