Enclosure
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Vol. II

BOEING

(NASA-CR-150834) LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATOR SUBSYSTEM DROP TEST VEHICLE. VOLUME 2: (Boeing Co.) HC A04/MF A01 N79-10049 Unclas G3/05 33922

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TITLE LOAD AND DYNAMIC ASSESSMENT OF B-52B-008 CARRIER AIRCRAFT FOR FINNED CONFIGURATION 1 SPACE SHUTTLE SOLID ROCKET BOOSTER DECELERATOR SUBSYSTEM DROP TEST VEHICLE - VOLUME II, AIRPLANE FLUTTER AND LOAD ANALYSIS RESULTS

ORIGINAL RELEASE DATE

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ABSTRACT

This volume presents in detail the airplane flutter and maneuver-gust load analysis results obtained during B-52B/DTV Configuration 1 (with fins) evaluation. These data are presented as supplementary data to that given in Volume I of this document. In addition, a brief mathematical description of airspeed notation and gust load factor criteria are provided as a help to the user of this document. References are defined which provide mathematical descriptions of the airplane flutter and load analysis techniques. Airspeed-load factor (V-n) diagrams are provided for the airplane weight configurations reanalyzed for finned DTV Configuration 1.

The other three volumes of this document contain the following information:

- Volume I Summary of airplane flutter and load-strength evaluation analysis results and a comparison study of pylon loads resulting from the DTV.
- Volume III Pylon loading at the DTV and wing interface attach points using Stiffness Method 1.
- Volume IV Pylon loading at the DTV and wing interface attach points using Stiffness Method 2.

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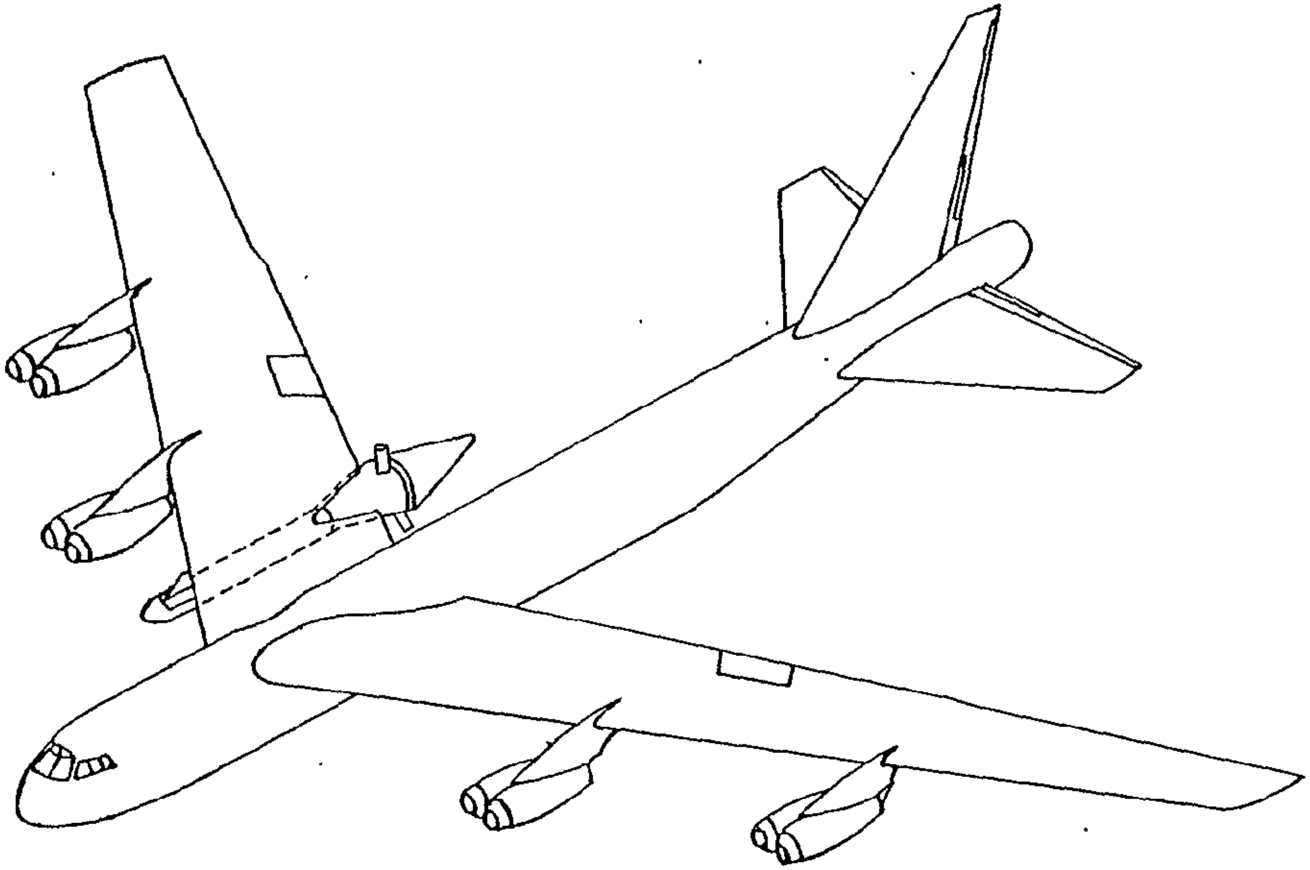
1.0 SUMMARY

The results of unsymmetric airplane flutter and load analyses for B-52B-008 with and without Drop Test Vehicle (DTV) Configuration 1 (with fins) suspended from the right hand wing pylon are presented in this volume. A sketch of B-52B-008 with the finned DTV Configuration attached to the pylon is shown in Figure 1. In addition to the analysis results, a brief mathematical description of airspeed notation and gust load factor determination are provided. The flight load analysis technique is described in Reference 3 while the flutter analysis method is given in Reference 2.

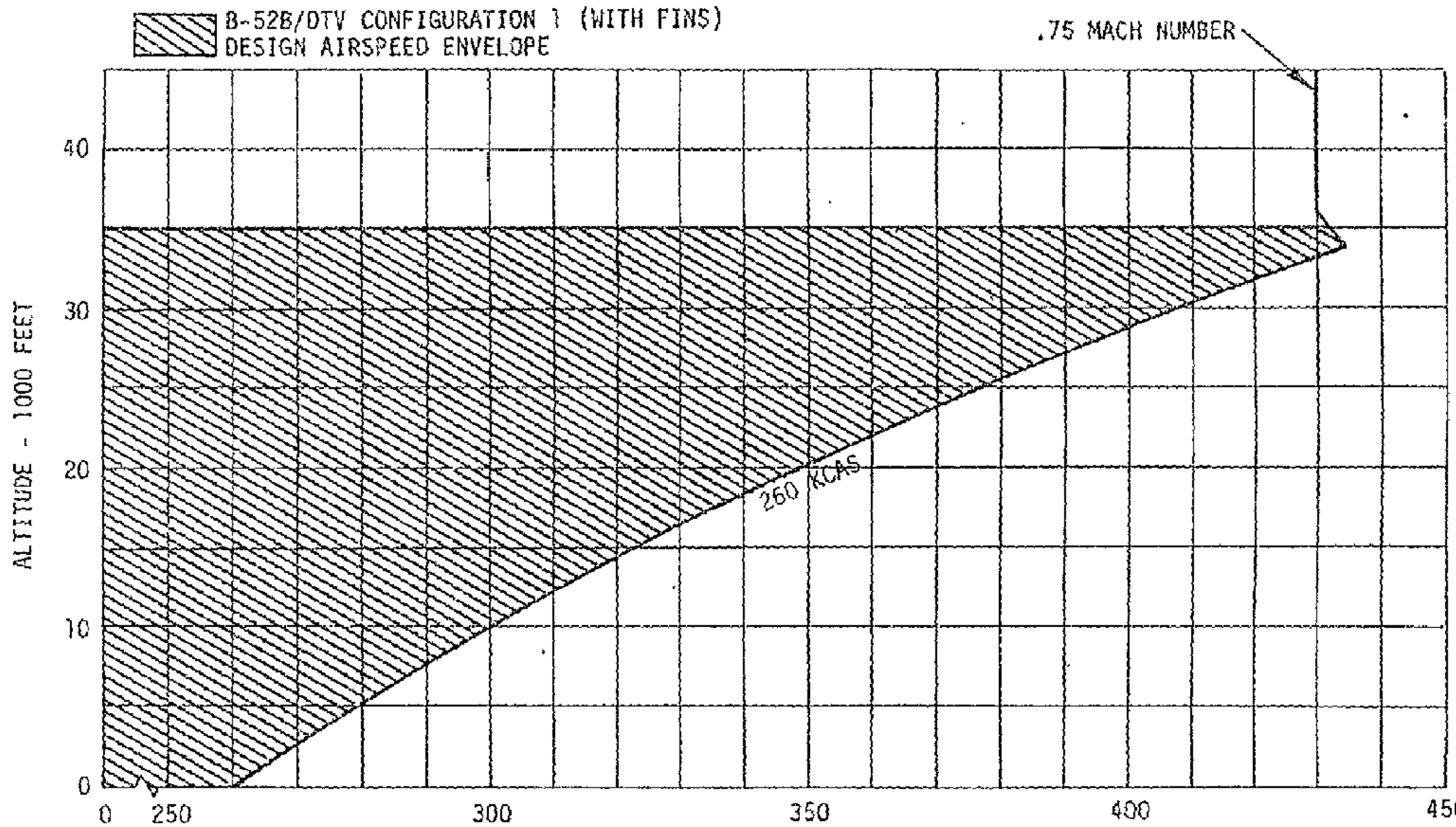
Unsymmetric flutter analyses were accomplished for 2 fuel configurations with the finned DTV Configuration 1 external store at right BBL (Body Buttock Line) 208. The flutter analysis results as presented in Section 3.0 of this volume indicate that the configurations are flutter free (including 15 percent margin of safety) for airspeeds up to 300 KCAS or Mach .75, whichever is less.

Flight load analyses were conducted for 15 gross weight configurations. A complete description of the maneuver-gust load factor and speed - altitude restrictions applicable to these analyses is given in Paragraph 4.1 of this volume. Taxi-takeoff and ground turn analyses were made for the airplane at a maximum weight of 336,344 pounds. Based on these load analyses, the wing shear, moment and torsion design load envelopes given in Paragraph 4.2 were developed. In addition, wing center section and gear loading are presented in Paragraphs 4.3 and 4.4. Based on a strength evaluation of the airframe (detail strength evaluation presented in Section 5.0, Volume I of this document), the airplane structure is substantiated for flying the drop test mission. However, the speed restriction defined in Figure 2 and the 1.8 g limit maneuver flight load factor restriction for weights above 306,000 pounds apply.



B-52B-008/DTV CONFIGURATION 1 (WITH FINS) DESCRIPTION

FIGURE 1



B-52B/DTV CONFIGURATION 1 (WITH FINS)
DESIGN AIRSPEED ENVELOPE
FIGURE 2

2.0 ANALYSIS METHOD DESCRIPTION

The design airspeed - altitude envelope shown in Figure 2 is given in terms of calibrated and true airspeed. Load analyses are generally accomplished using either true or equivalent airspeed notation. During flutter and structural demonstration testing, it is often convenient to use indicated airspeed terminology. Therefore, Paragraph 2.1 is provided so that the user of this document can readily convert from one airspeed notation system to another.

Paragraph 2.2 of Reference 2 gives a brief mathematical description of the flutter analysis equations. The unsymmetrical mathematical model was developed using:

- Beam theory free-free coupled mode vibration analysis.
  - 49 airplane modes (rigid body and elastic).
  - 3 drop test vehicle modes.
- Doublet lattice unsteady lifting surface theory which accounts for Mach number and finite span effects. It also includes aerodynamic coupling between all airplane components. However, the drop test vehicle aerodynamic gradients (slopes) were as defined by MSFC and coupling between the DTV and airplane components aerodynamically was ignored.
  - 120 aerodynamic boxes were used to define the lifting surfaces, Figure 3.
  - Quasi-steady vertical force, lateral force, pitching moment and yawing moment derivatives defined the DTV aerodynamics.

Flight load analyses were accomplished using a mathematical approach similar to that described in Reference 3. The maneuver load factor criteria used in the analyses were:

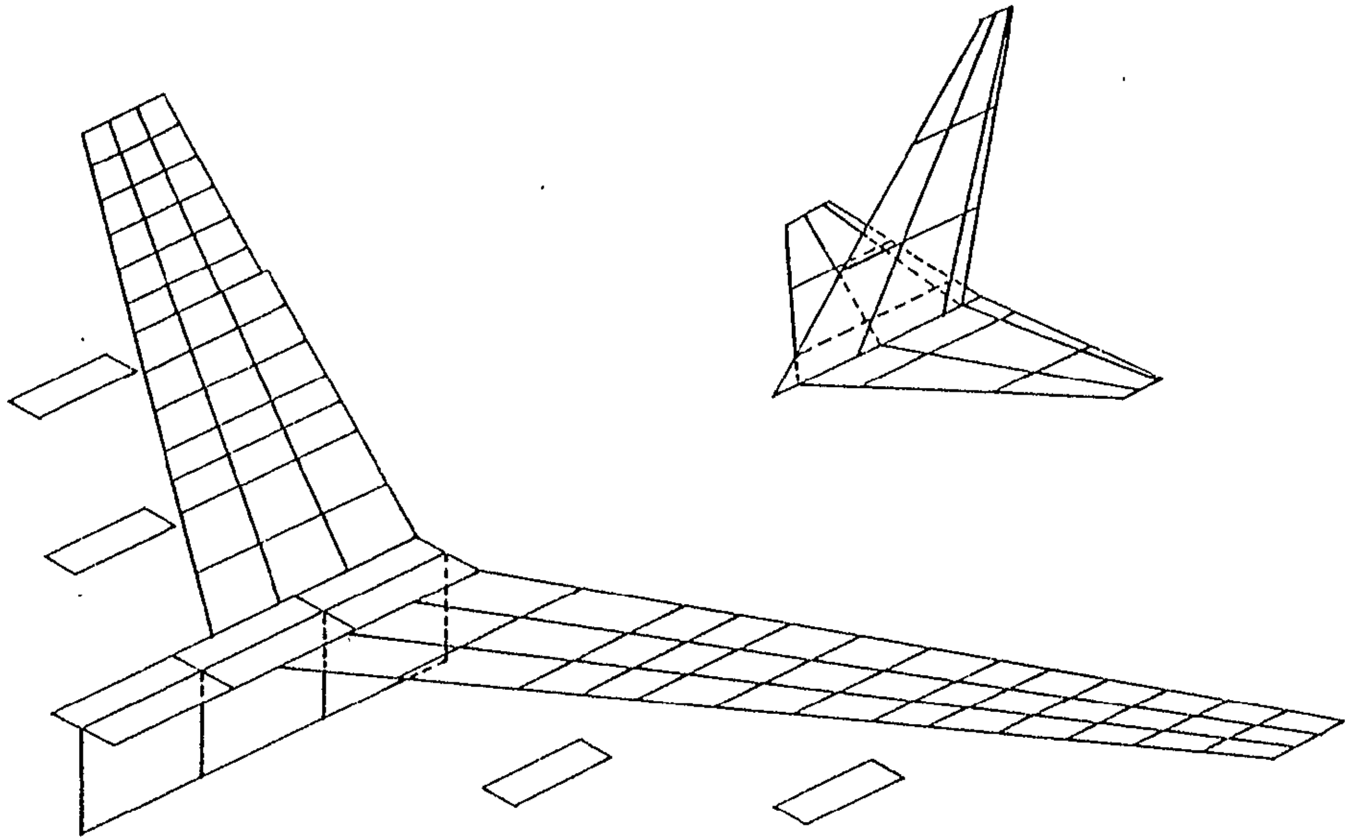
- Positive limit load factor of 1.8 g's for weights in excess of 306,000 pounds. For weights below 306,000 pounds, a 2.0 g limit load factor applies.
- Negative limit load factor of -.67 g's for all gross weights.

Gust load factors were determined from criteria given on page 7 of Reference 1 and page B-5 of Reference 4. A mathematical description of these criteria is given in Paragraph 2.2.

Ground loads and ground clearance were determined using static-elastic analysis techniques which included gear nonlinear characteristics. The load factor criteria were:

- Taxi-takeoff, 3.0 g ultimate vertical load factor.
- Ground turn, 1.0 g limit vertical load factor along with a .27 g limit side load factor.

Typical taxi-takeoff and ground turn analysis methods are given in Paragraph 2.4 of Reference 2.



AERODYNAMIC PATCH PANELING
B-52B/DTV

FIGURE 3

2.1 STANDARD AIRSPEED NOTATION

$$V_c = V_I - \Delta V$$

WHERE:

V_c = CALIBRATED AIRSPEED, KNOTS

V_I = INDICATED AIRSPEED, KNOTS

ΔV = AIRSPEED CORRECTION DUE TO INSTRUMENT ERROR AND SOURCE ERROR, KNOTS

$$V_e = \frac{3600\, a_{ss} \left(\rho/\rho_o\right)^{\frac{1}{2}}}{6080.20} \left\{ 5 \left[\left(\frac{1}{\left(\frac{P}{P_o}\right)} \left\{ \left[1 + .2 \left(\frac{V_c}{661.5} \right)^2 \right]^{3.5} - 1 \right\} + 1 \right)^{.286} - 1 \right] \right\}^{\frac{1}{2}}$$

WHERE:

V_e = EQUIVALENT AIRSPEED, KNOTS

a_{ss} = SPEED OF SOUND, FPS

ρ/ρ_o = DENSITY RATIO

P/P_o = PRESSURE RATIO

$$V_T = V_e / (\rho/\rho_o)^{\frac{1}{2}}$$

WHERE:

V_T = TRUE AIRSPEED, KNOTS

2.2 GUST LOAD FACTOR

$$n = 1.0 \pm \frac{5.0\, K_G\, a\, V_T\, (6080.20/5280)\, \sigma^{\frac{1}{2}}}{W/S}$$ [1]

WHERE:

a = RATE OF CHANGE OF C_{N_A} WITH RESPECT TO ANGLE OF ATTACK PER DEGREE

V_T = AIRSPEED, KNOTS TRUE

σ = DENSITY RATIO, ρ/ρ_0

W = AIRPLANE WEIGHT, POUNDS

S = 4000 SQUARE FEET

$$K_G = \frac{1}{2}\left(1.33 - \frac{2.67}{(W/S)^{3/4}}\right)$$ [2]

HOWEVER, NOTING THAT $V_T = V_e / (\sigma)^{\frac{1}{2}}$, THE EXPRESSION FOR GUST LOAD FACTOR CAN BE EXPRESSED AS FOLLOWS:

$$n = 1.0 \pm \frac{5.0\, K_G\, a\, V_e\, (6080.20/5280)}{W/S}$$

WHERE:

V_e = AIRSPEED, KNOTS EQUIVALENT

[1] REFERENCE R-1803-2B, PAGE 7

[2] REFERENCE D-10754 VOLUME I, PAGE B-5

3.0 FLUTTER ANALYSIS RESULTS

Results of the unsymmetric flutter analyses for B-52B-008/DTV Configuration 1 (with fins) are presented. The analyses were accomplished for the fuel loadings defined in Table I. The drop test vehicle-pylon frequencies and frequency variations thereof for DTV Configuration 1 are shown in Table II. The flutter analyses (conducted at 27,450 feet to be compatible with the Reference 2 flutter analysis) show the airplane free of flutter (including 15 percent margin of safety) for a 300 KCAS/Mach .75 airspeed envelope. At 27,450 foot altitude, V_D is 447 knots true airspeed (300 KCAS/Mach .75) while 1.15 V_D is 514 knots true airspeed. Since all flutter analyses were made without structural damping and the minimum structural damping of the B-52 is .015, the analyses are conservative. For a description of the flutter analysis mathematical model, see Paragraph 2.2 of Reference 2.

Results of the unsymmetric flutter analyses for the 315,435 pound configuration (including pylon frequency variations as given in Table II) are shown in Figures 4 through 12. Results for the 272,441 pound configuration are shown in Figures 13 through 21.

TABLE I

FUEL LOADING - FLUTTER ANALYSIS

OWE* (LBS)	DTV (LBS)	FUEL LOADING LEFT OUTBD. (LBS)	MAIN 1 (LBS)	MAIN 2 (LBS)	CENTER WING (LBS)	MAIN** 3 (LBS)	MAIN 4 (LBS)	RIGHT OUTBD. (LBS)	FWD. BODY (LBS)	MID BODY (LBS)	AFT BODY (LBS)	H_2O (LBS)	TOTAL A/P GROSS WEIGHT (LBS)
B-52B/DTV CONFIGURATION 1													
181344	48571	7160	13837	10436	5000	---	13837	0	0	0	35250	0	315435
181344	48571	14317	5000	5776	0	---	5000	0	0	0	12433	0	272441

* OWE - Operating Weight Empty (Includes Pylon and Crew)

** Main Fuel Cell No. 3 has been removed from B-52B-008

TABLE II

DTV-PYLON CANTILEVER FREQUENCIES

CONFIGURATION / MODE	X-15 + PYLON [1]	DTV CONFIGURATION 1 (WITH FINS) + PYLON [2]	
	FREQUENCY	NOMINAL FREQUENCY	FREQUENCY VARIATIONS
LATERAL (F_1) [3]	4.29 Hz	1.88 Hz	±10%
LATERAL (F_2) [4]	4.75 Hz	2.40 Hz	±10%
PITCH (F_3) [5]	5.34 Hz	2.31 Hz	±10%, ±20%

[1] X-15 INERTIA PROPERTIES; WEIGHT = 12636 POUNDS, I_{PITCH} = 75151 SLUG-FT^2, I_{YAW} = 76620 SLUG-FT^2, I_{ROLL} = 3373 SLUG-FT^2, REFERENCE D3-1652, PAGE 7. X-15 + PYLON FREQUENCY DATA OBTAINED FROM D3-2121, PAGE 2

[2] DTV CONFIGURATION 1 (WITH FINS) INERTIA PROPERTIES; WEIGHT = 48571 POUNDS, I_{PITCH} = 406995 SLUG-FT^2, I_{YAW} = 406995 SLUG-FT^2, I_{ROLL} = 9831 SLUG-FT^2

[3] PRIMARILY A DTV-PYLON YAW (TORSION) MODE WITH SOME SIDE BENDING

[4] PRIMARILY A DTV-PYLON SIDE BENDING MODE WITH SOME YAW (TORSION)

[5] A DTV-PYLON PITCH MODE

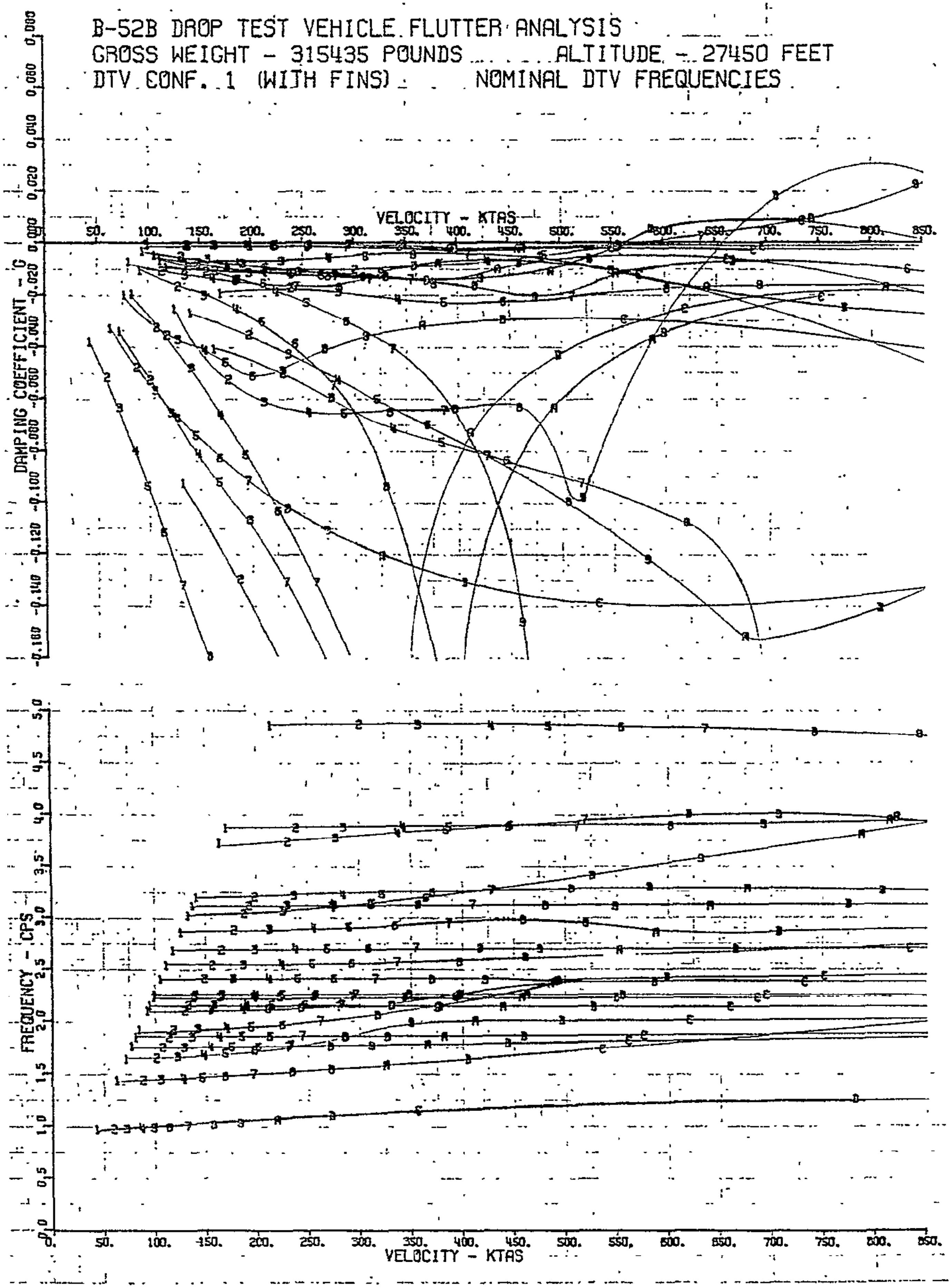


FIGURE 4

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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS   ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS)   F1 = 0.9 X NOMINAL DTV FREQ.

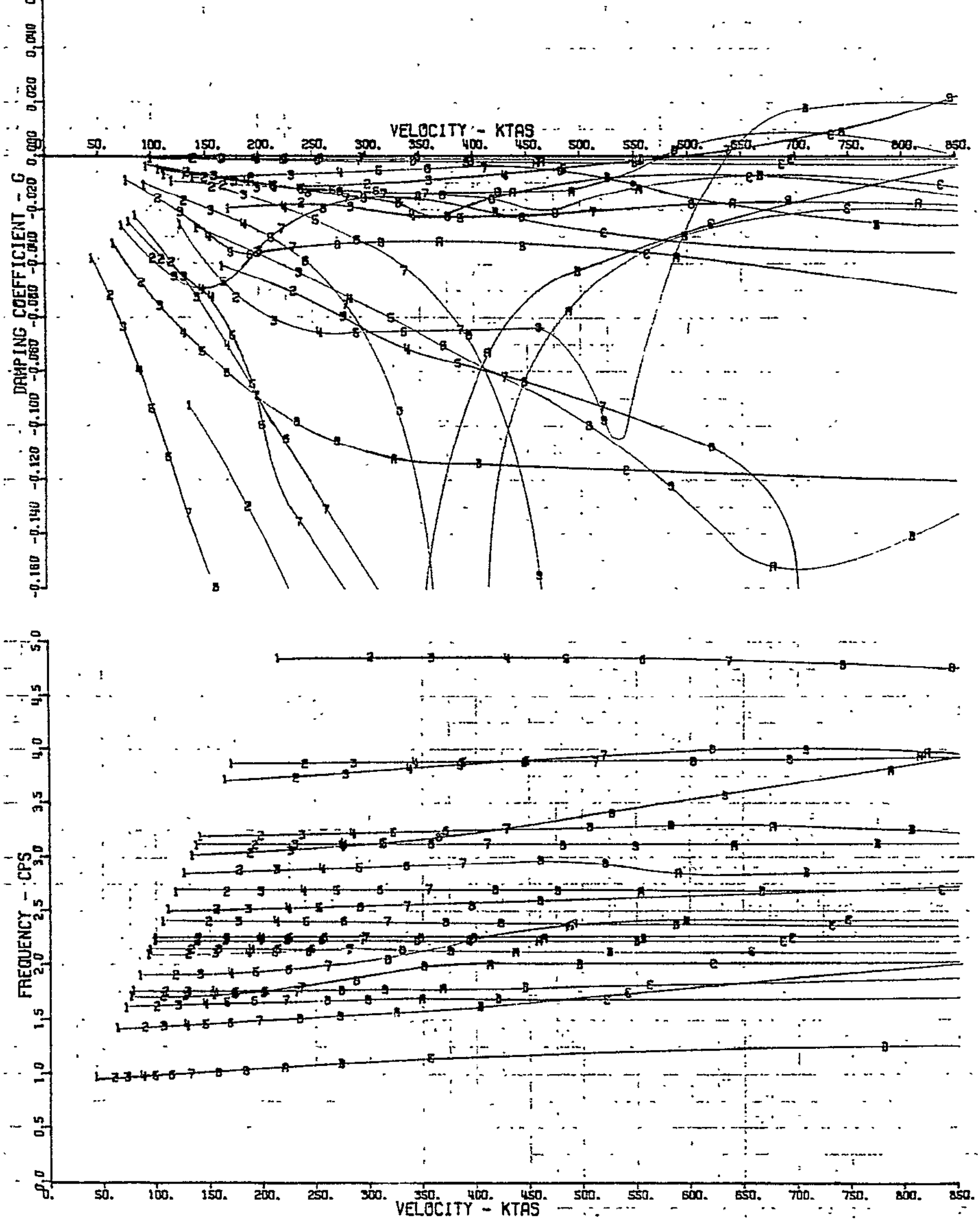

FIGURE 5
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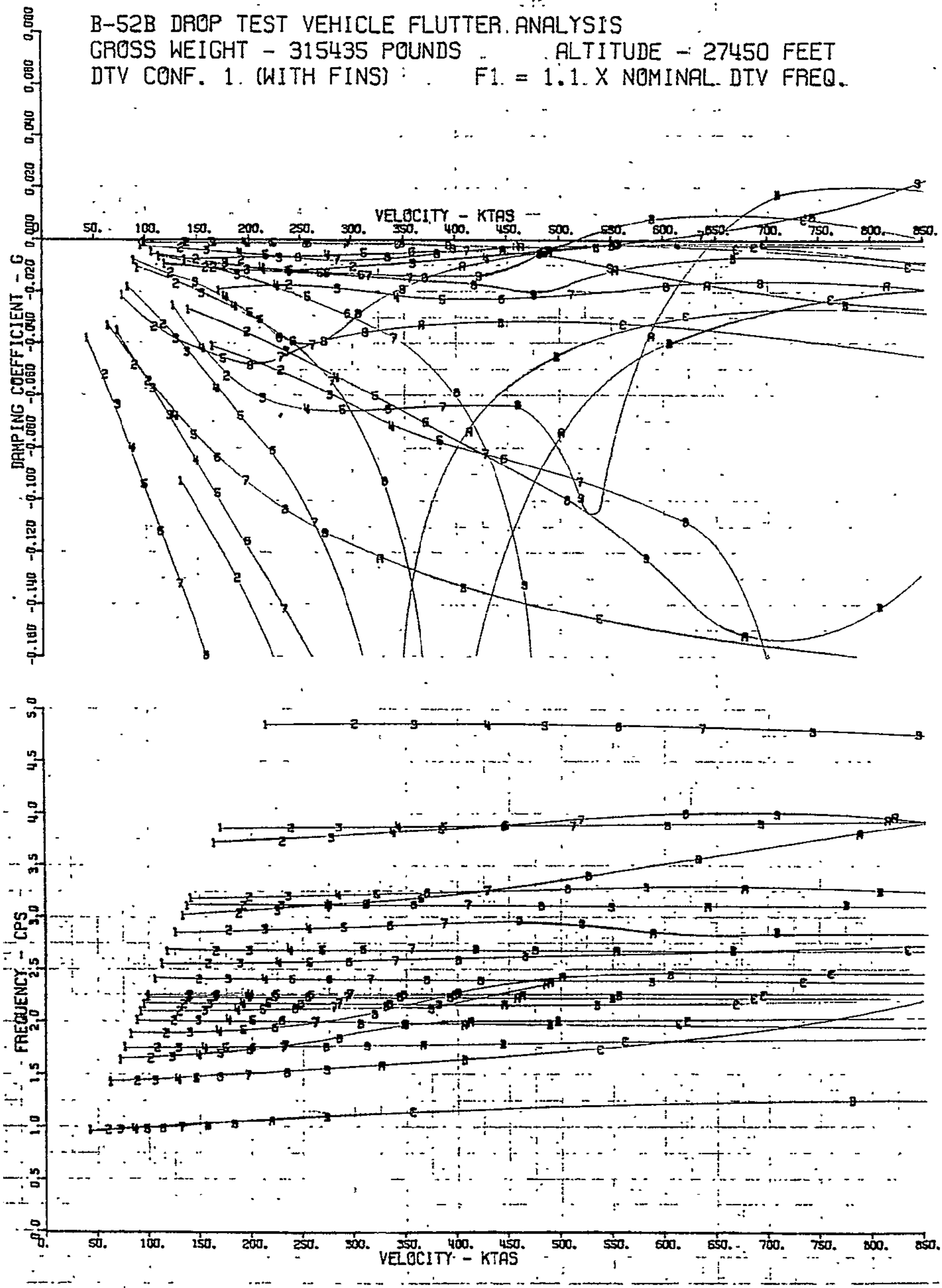
B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS . ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F1 = 1.1 X NOMINAL DTV FREQ.



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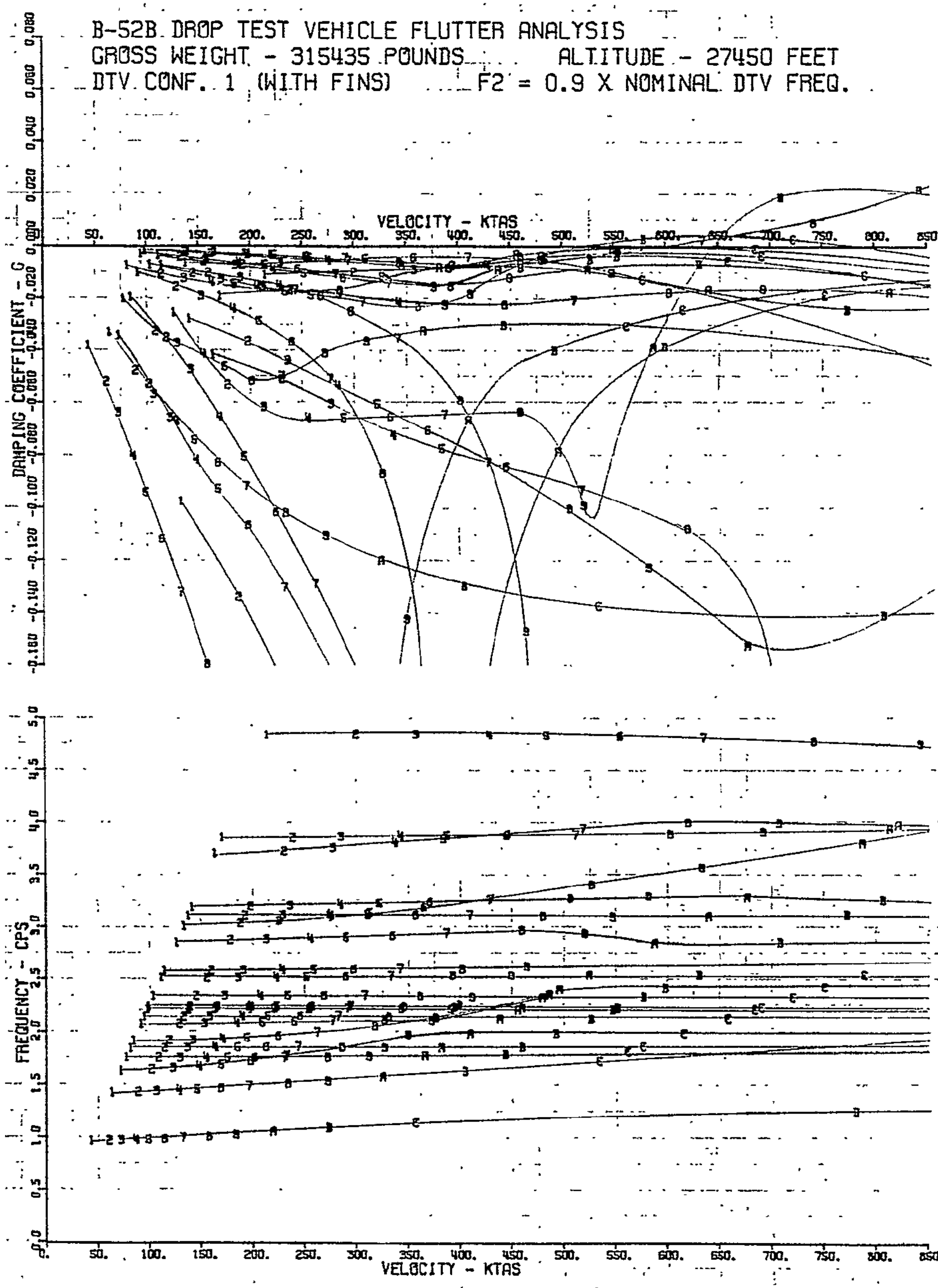

FIGURE 7
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APPROVED BY DDR DATE 2-25-78

B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F2 = 1.1 X NOMINAL DTV FREQ.

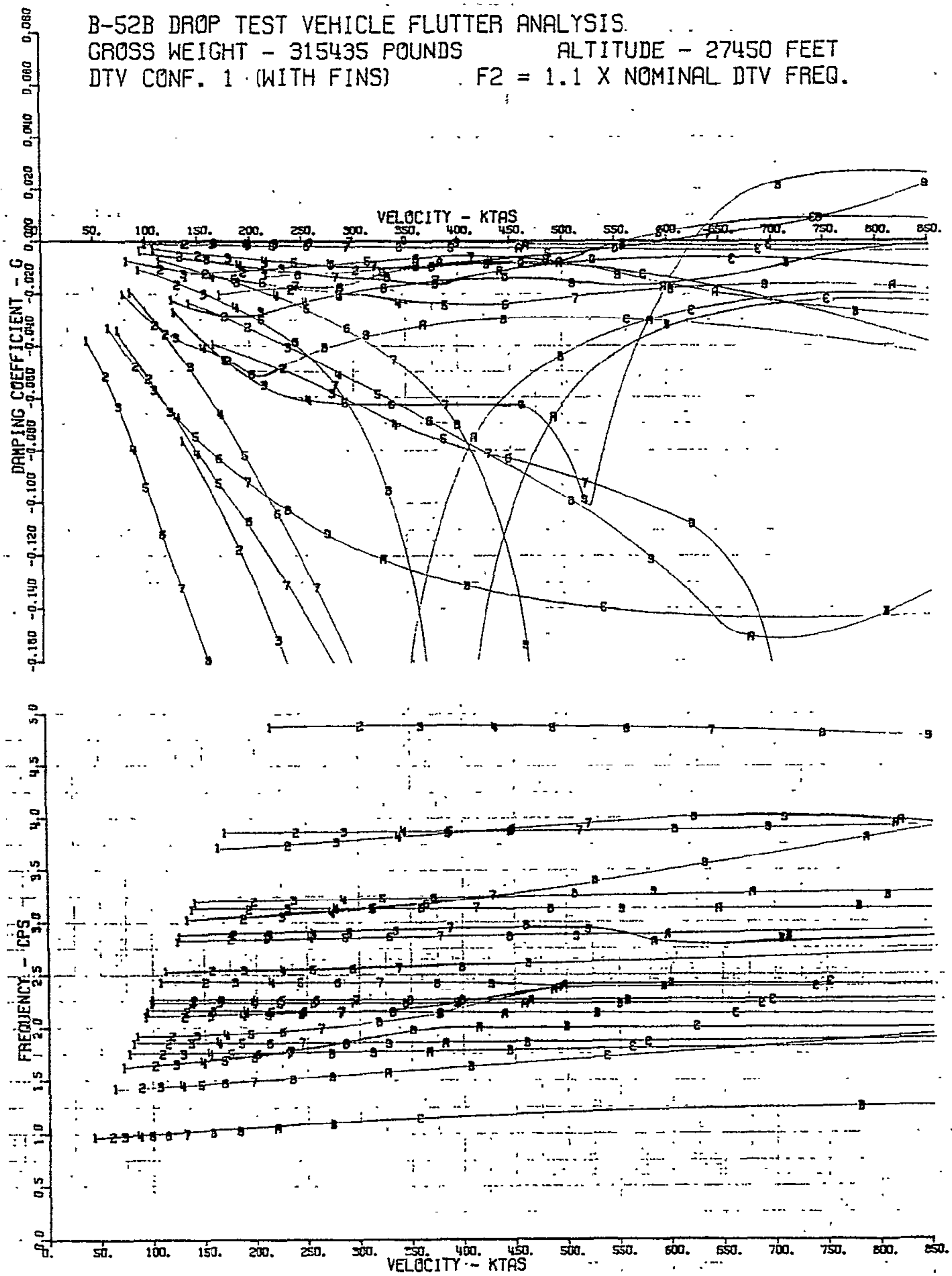

FIGURE 8
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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS   ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS)   F3 = 0.8 X NOMINAL DTV FREQ.

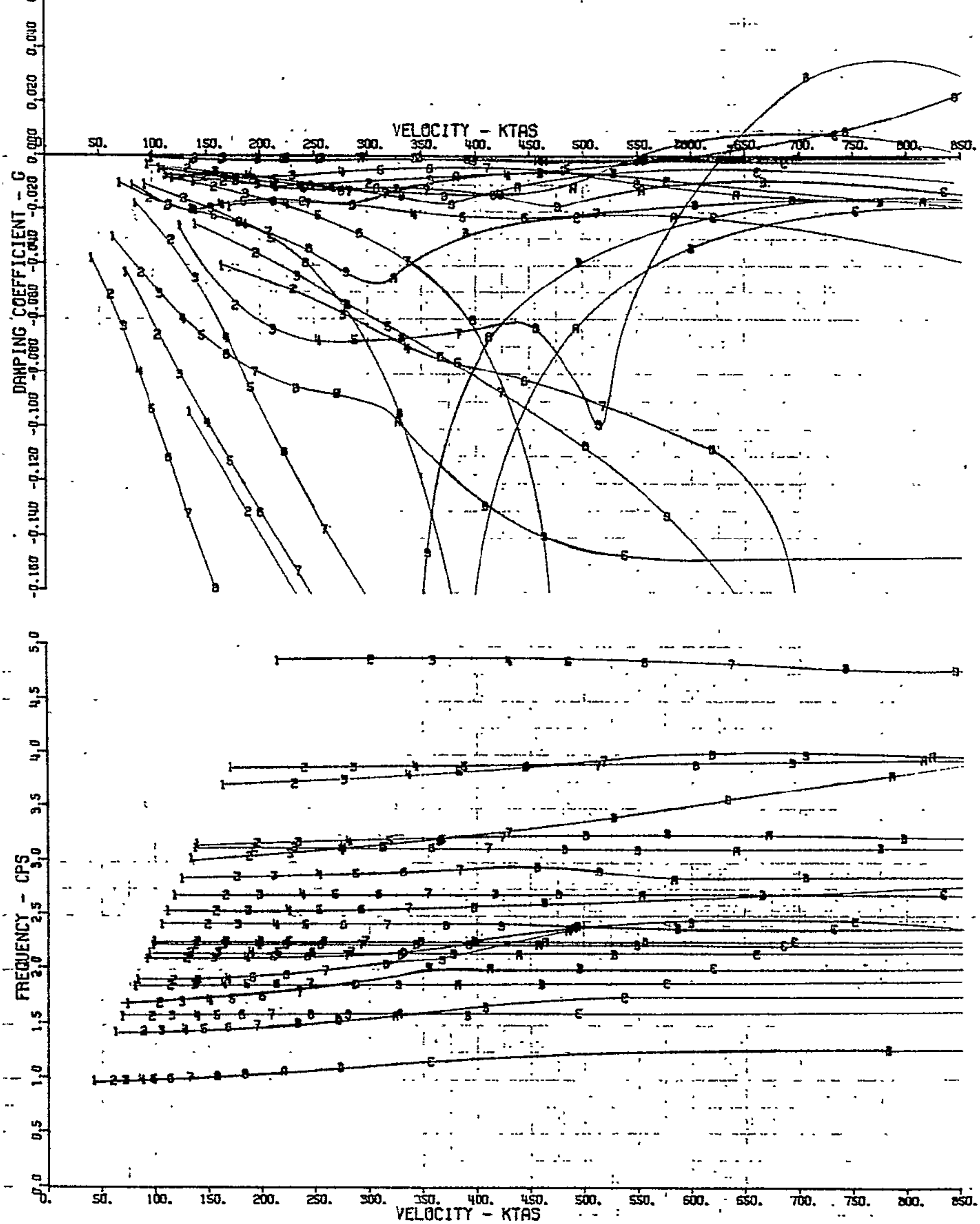

FIGURE 9

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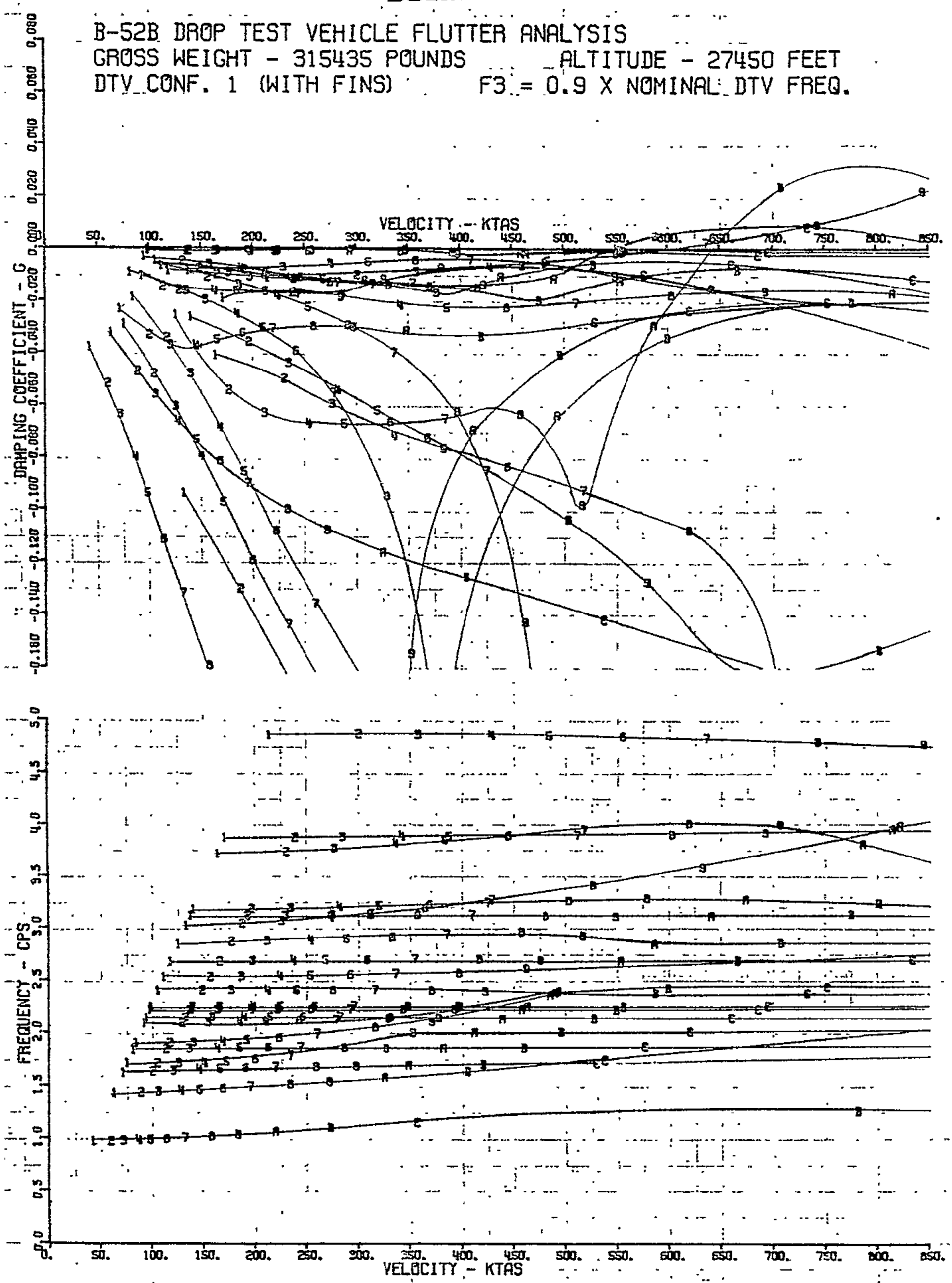

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FIGURE 10

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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F3 = 1.1 X NOMINAL DTV FREQ.

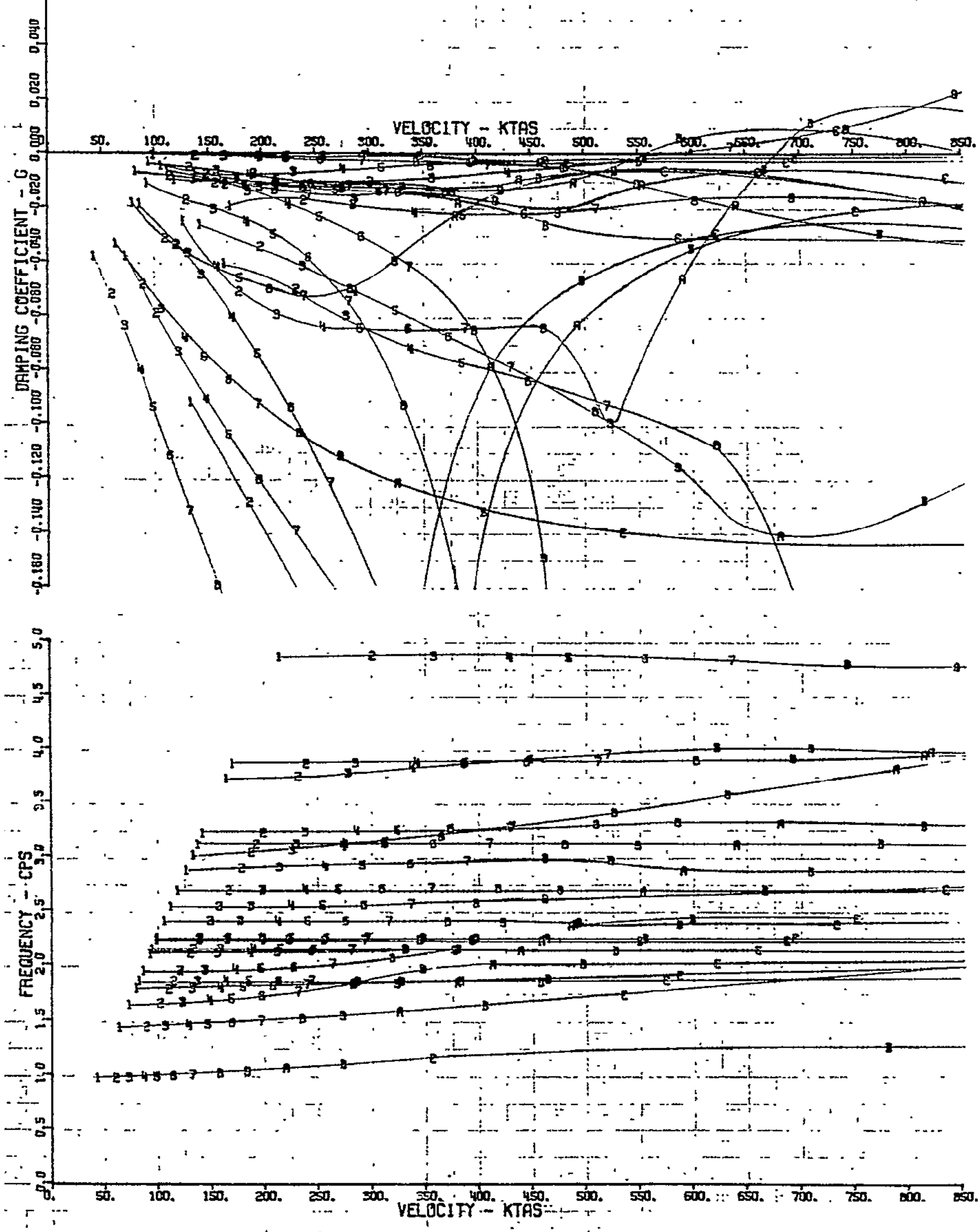

FIGURE 11
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APPROVED BY DG2 DATE 2-28-78

B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 315435 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F3 = 1.2 X NOMINAL DTV FREQ.

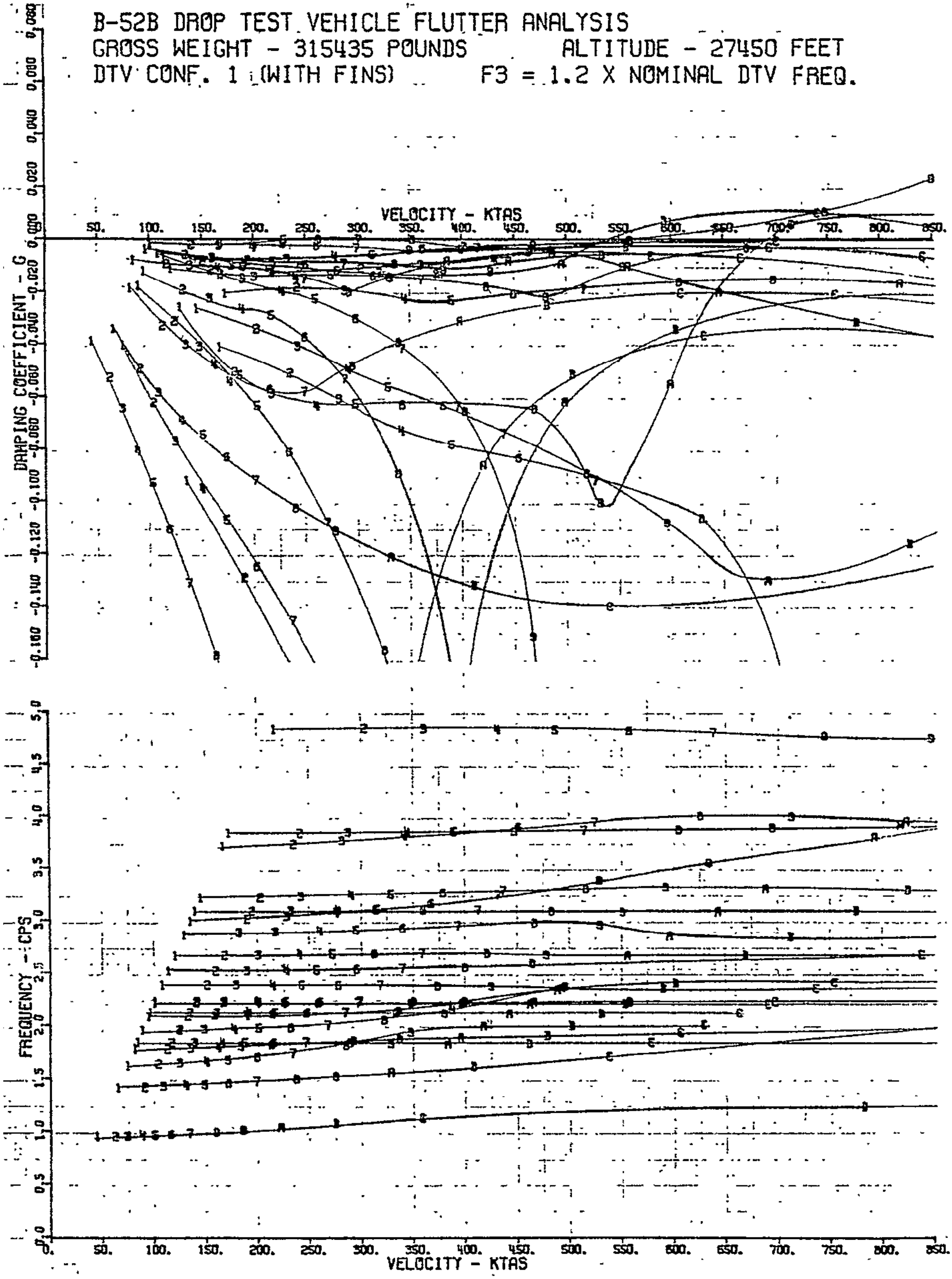

FIGURE 12
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APPROVED BY DAR DATE 2-28-78

B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) NOMINAL DTV FREQUENCIES

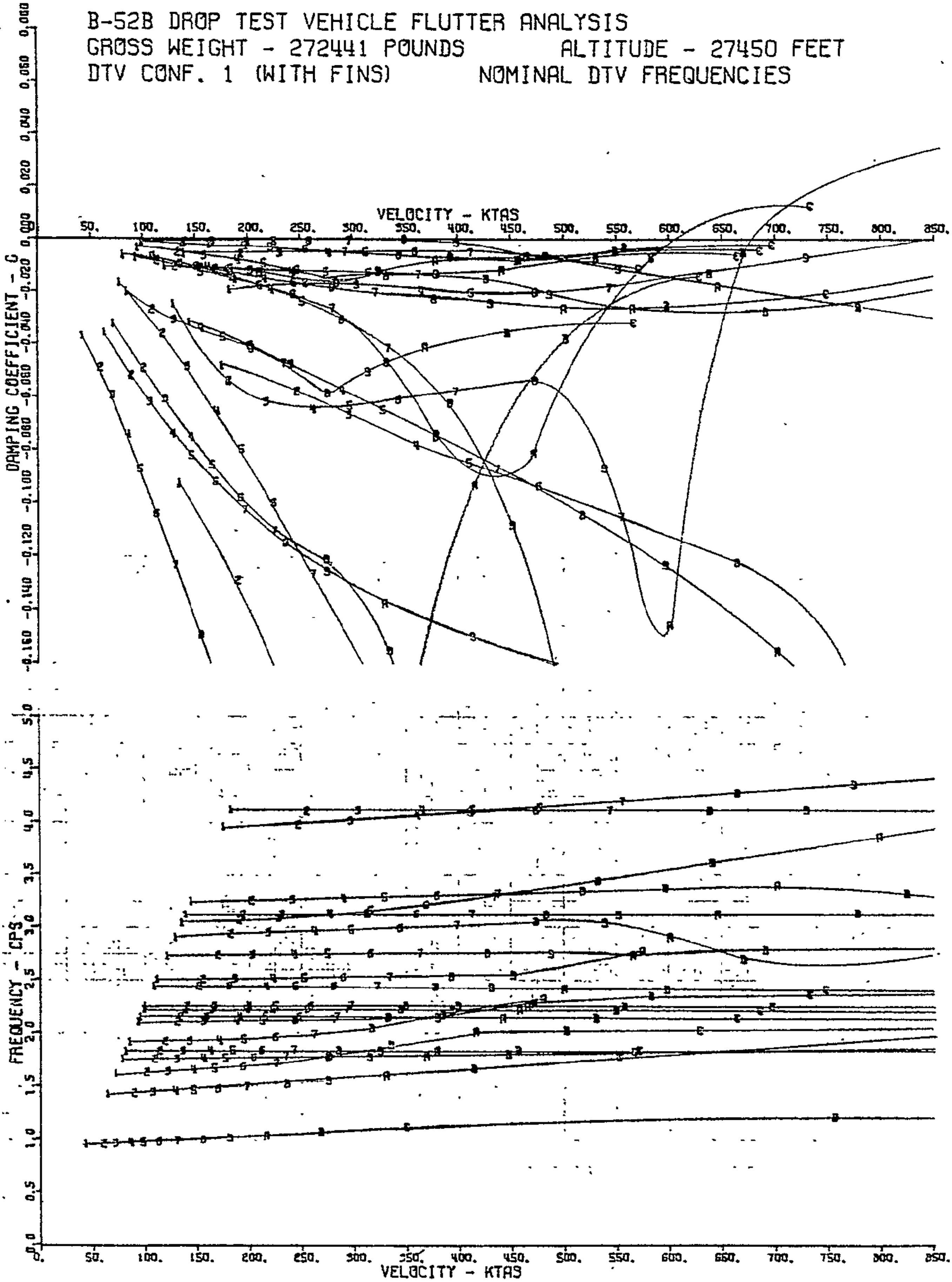

FIGURE 13
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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F1 = 0.9 X NOMINAL DTV FREQ.

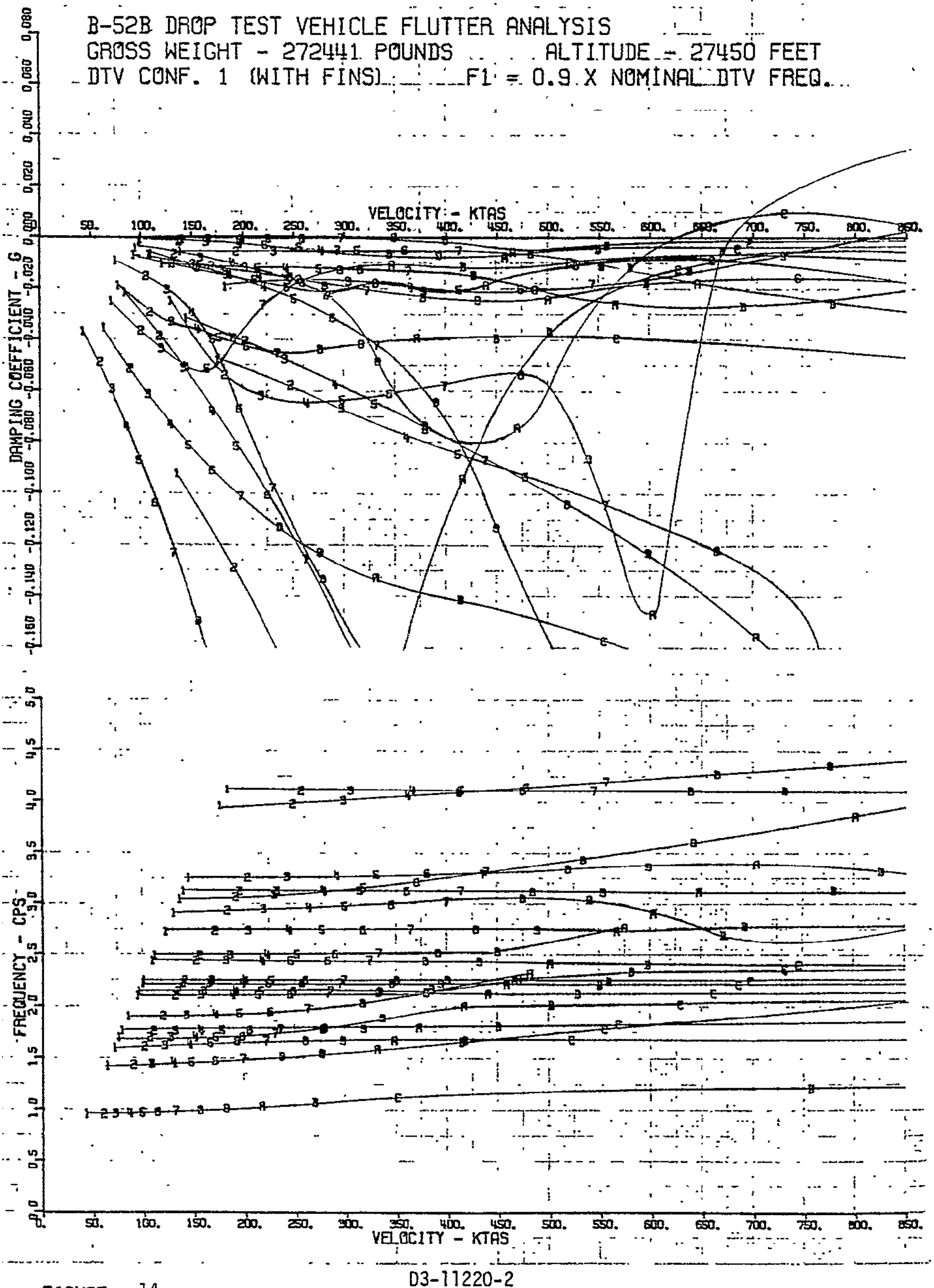

FIGURE 14
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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F1 = 1.1 X NOMINAL DTV FREQ.

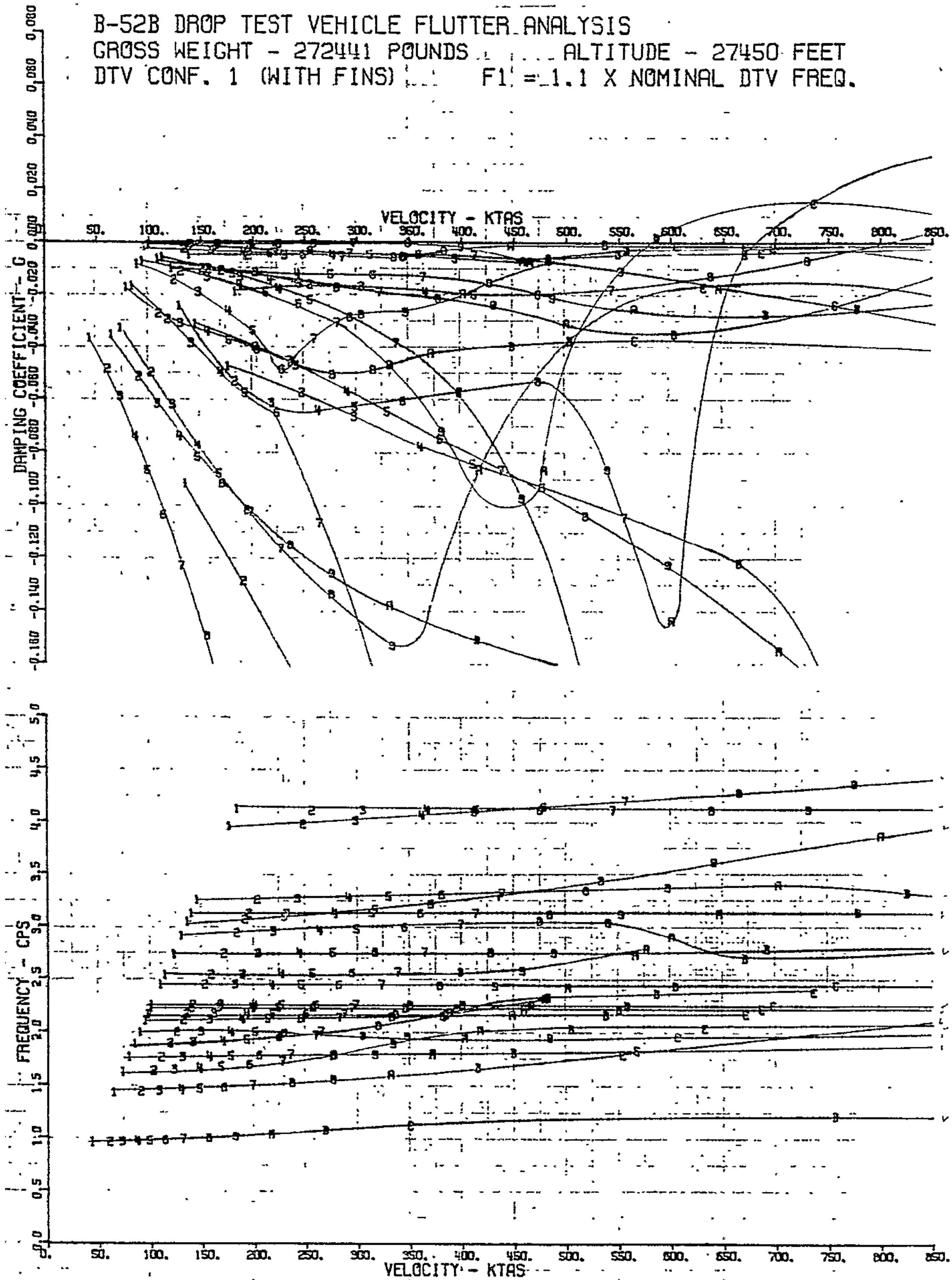

FIGURE 15

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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F2 = 0.9 X NOMINAL DTV FREQ.

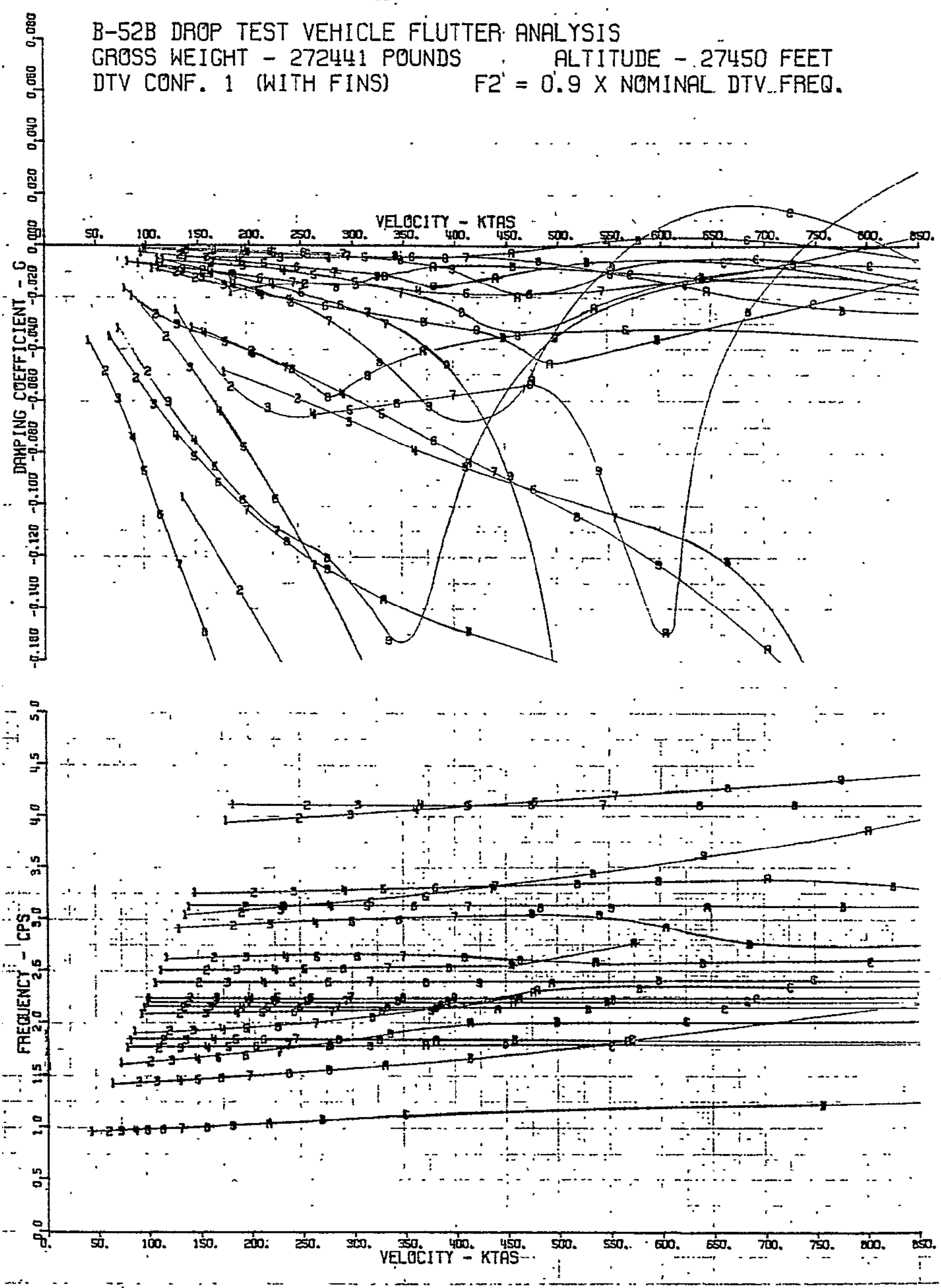

FIGURE 16
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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F2 = 1.1 X NOMINAL DTV FREQ.

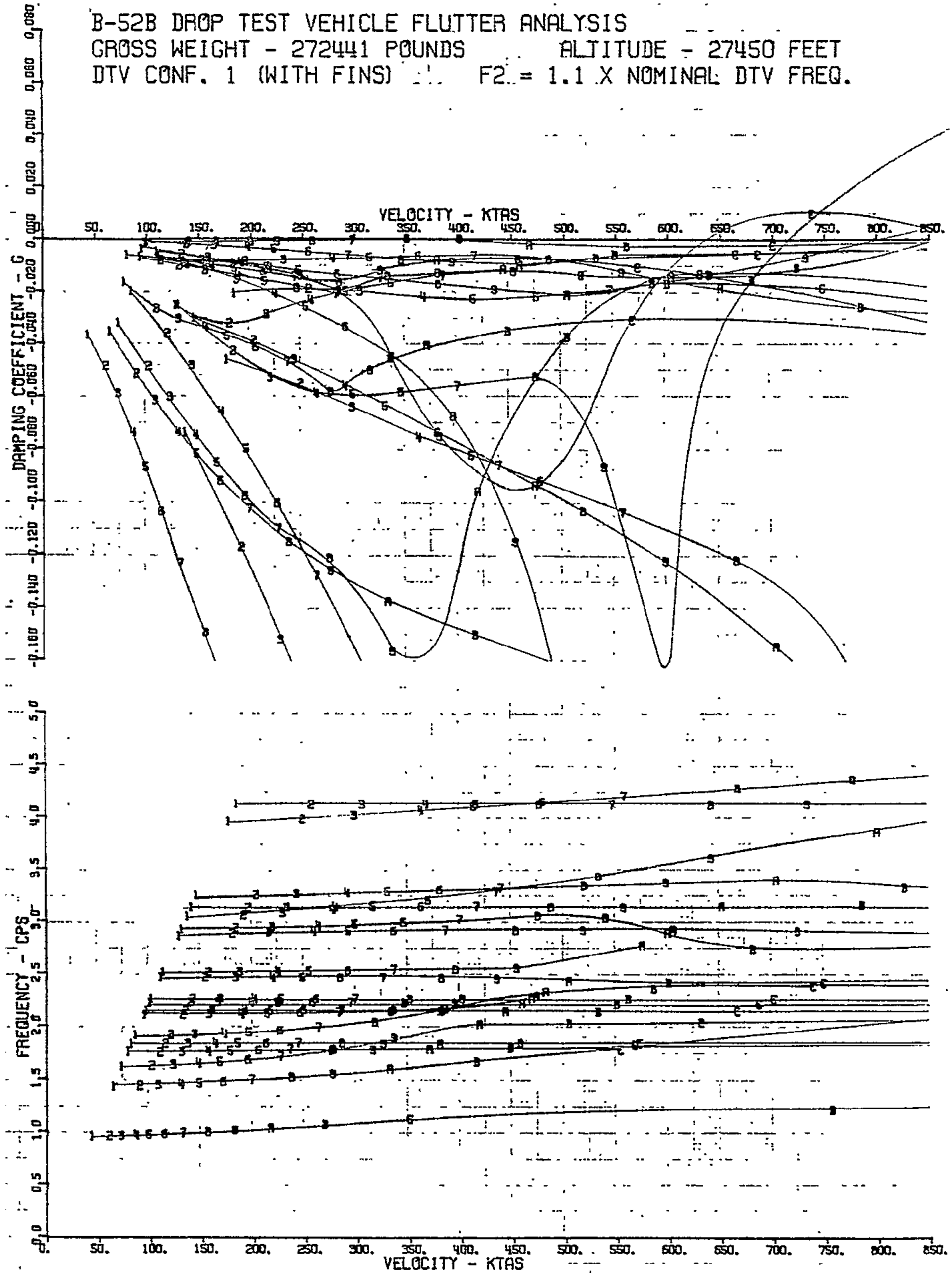

FIGURE 17
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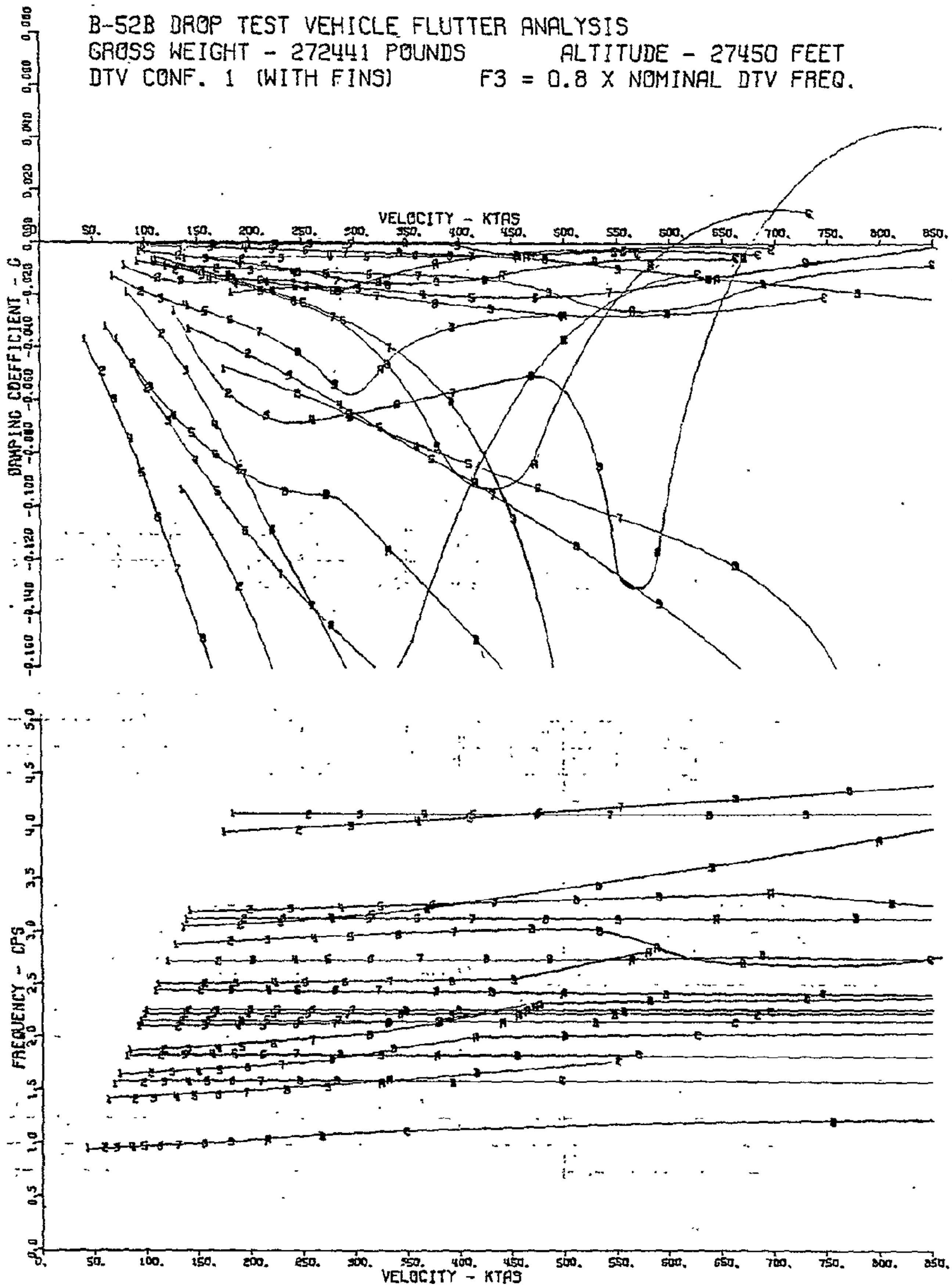

FIGURE 18

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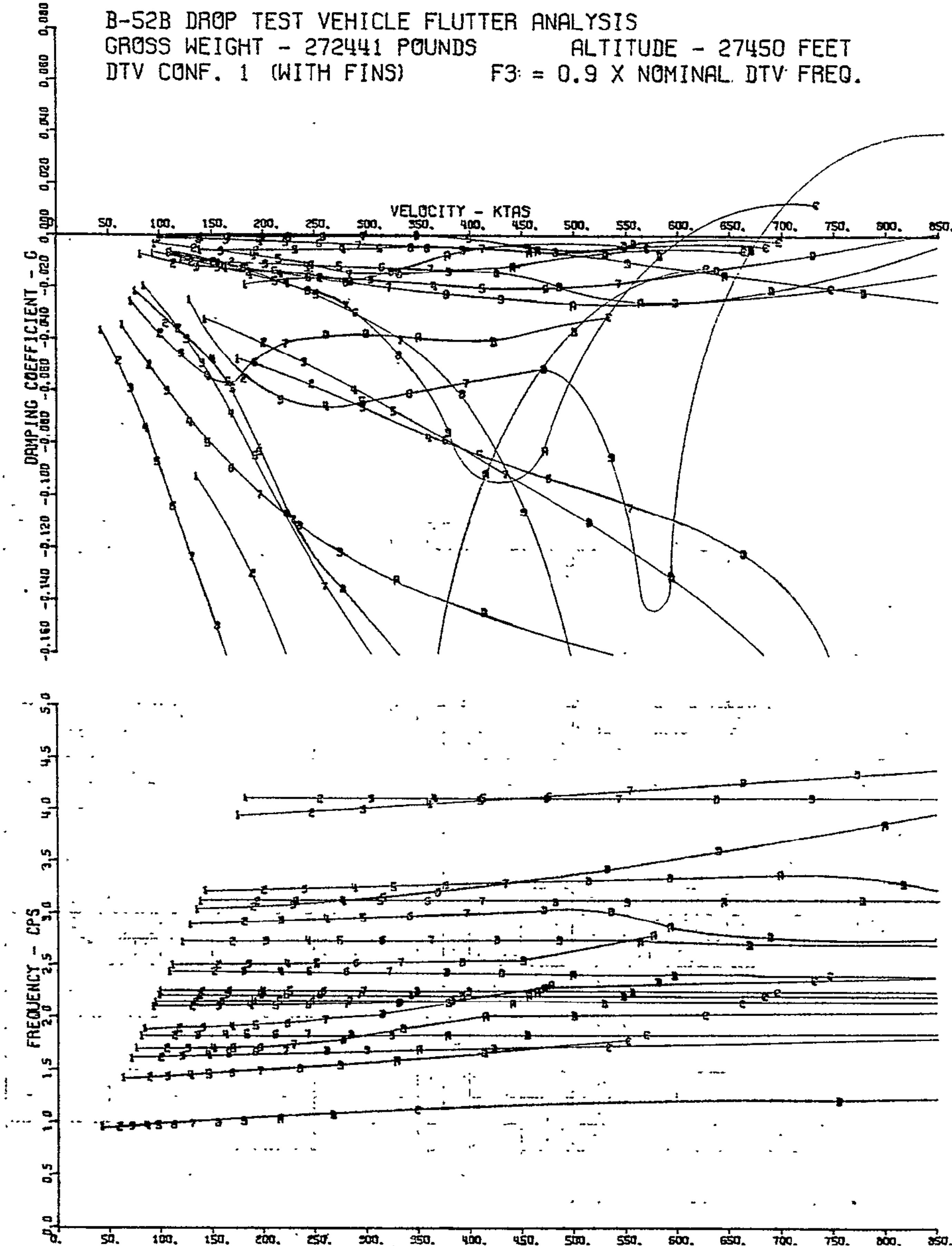

FIGURE 19

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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F3 = 1.1 X NOMINAL DTV FREQ.

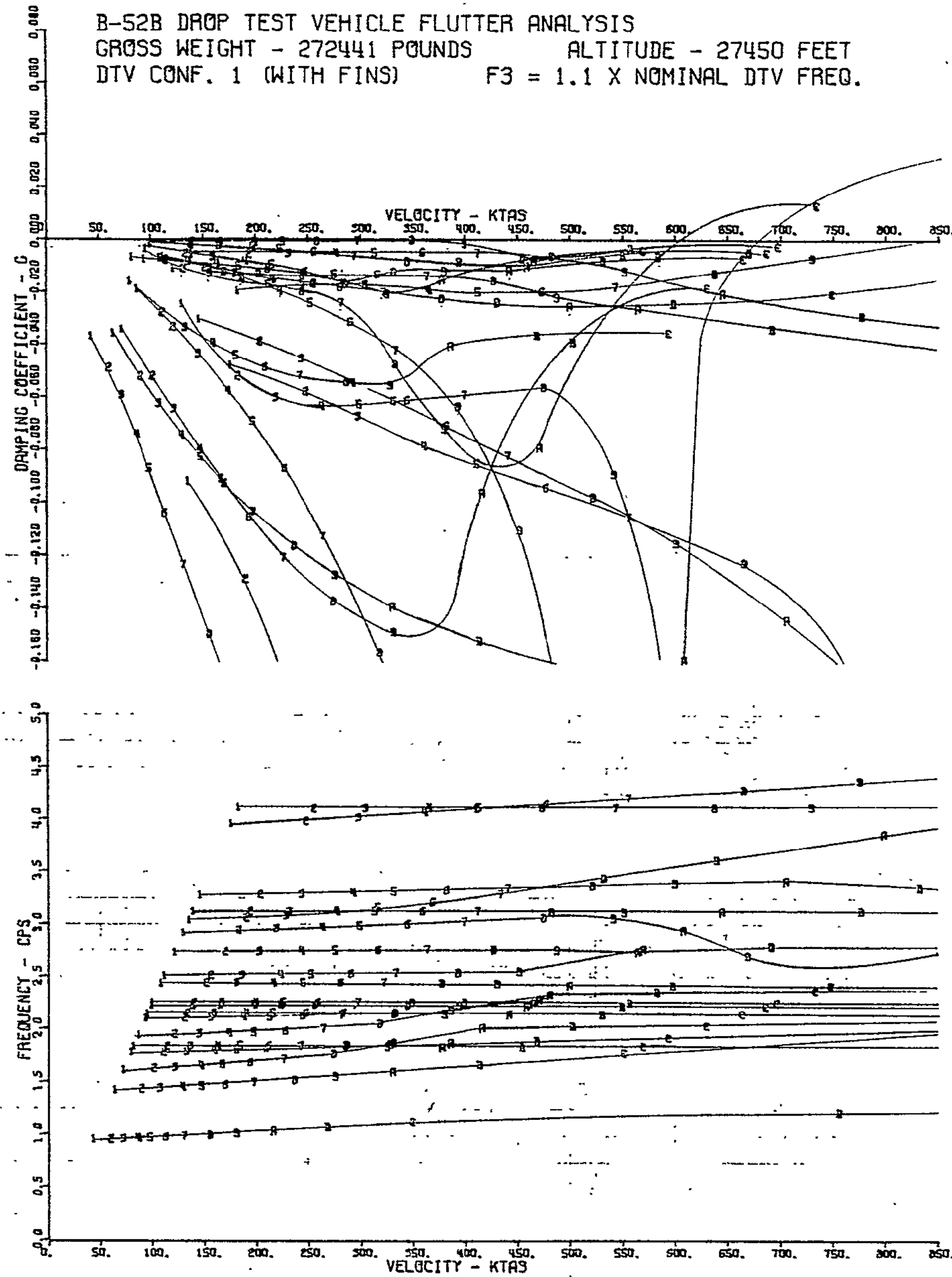

FIGURE 20
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B-52B DROP TEST VEHICLE FLUTTER ANALYSIS
GROSS WEIGHT - 272441 POUNDS ALTITUDE - 27450 FEET
DTV CONF. 1 (WITH FINS) F3 = 1.2 X NOMINAL DTV FREQ.

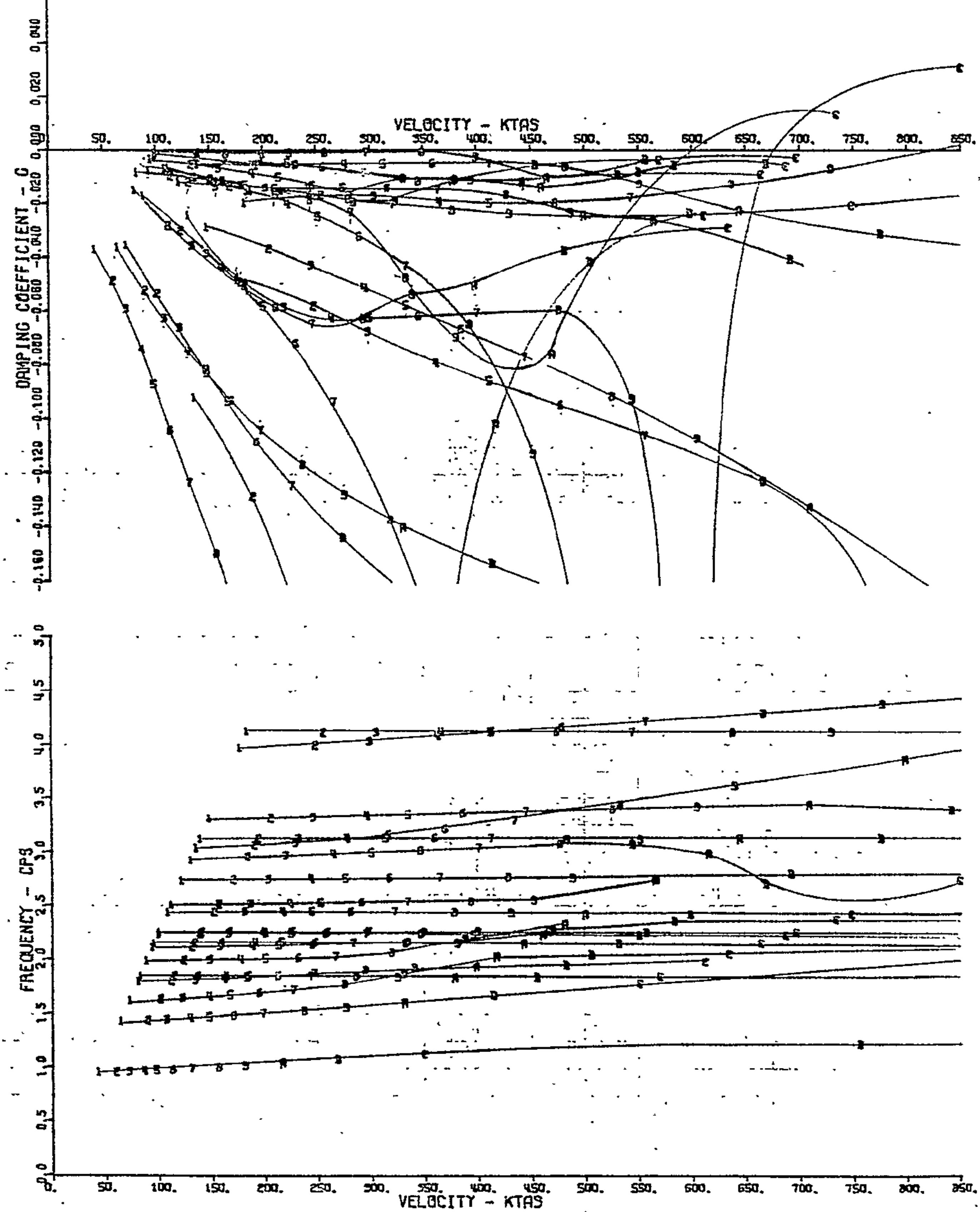

FIGURE 21
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4.0 FLIGHT AND GROUND LOAD ANALYSIS RESULTS

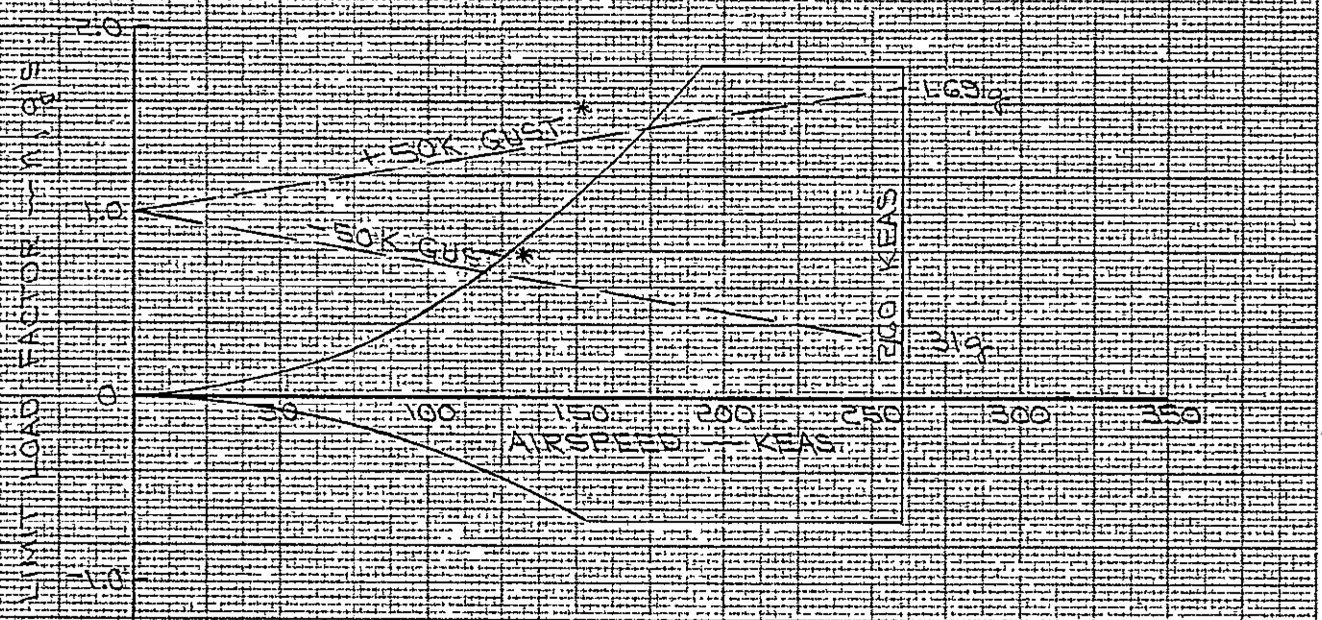
Results of the flight and ground load analyses conducted for B-52B-008 with and without DTV Configuration 1 suspended from the right hand wing pylon are presented. The analyses were made using the fuel sequence given in Section 3.0, Volume I of this document. The criteria for the load analyses were:

- Maximum B-52B/DTV gross weight of 336,344 pounds.
- Maximum airspeed of 260 KCAS or Mach .75, whichever is less.
- Maneuver flight load factor restrictions:
  - Positive limit load factor of 1.8 g's for weights in excess of 306,000 pounds and 2.0 g's for weights at or below 306,000 pounds.
  - Negative limit load factor of -.67 g's for all gross weight configurations.
- Ground handling load factor restrictions:
  - Positive ultimate load factor of 3.0 g's for taxi-takeoff conditions.
  - Positive vertical limit load factor of 1.0 g and side limit load factor of .27 g's for the ground turn conditions.
- Gust load factors per Reference 1, page 7.
- Ultimate loads are 1.5 times limit loads.

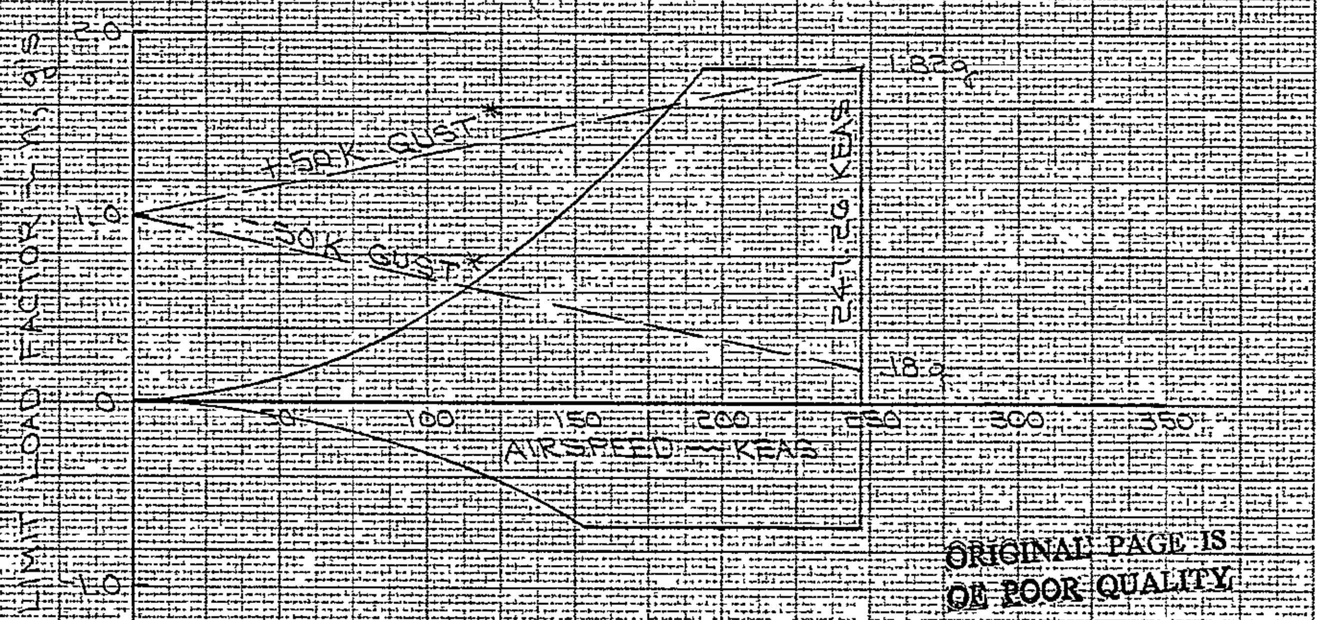
4.1 Maneuver - Gust Load Factor Criteria

The limit maneuver and gust load factor criteria used in the steady-state load analyses are defined in the airspeed-load factor (V-n) diagrams shown in Figures 22 through 30 of this volume and Figures 52 through 57 of Reference 2 for the airplane gross weight configuration and airspeed-altitude conditions evaluated. These maneuver-gust criteria reflect airplane weight, airspeed and load factor restrictions established for the drop test mission. A detailed mathematical description of the gust criteria is given in Paragraph 2.2 of this volume.

ALTITUDE — SEA LEVEL



ALTITUDE — 33900 FEET



* REF. R-1803-2B PAGE 7

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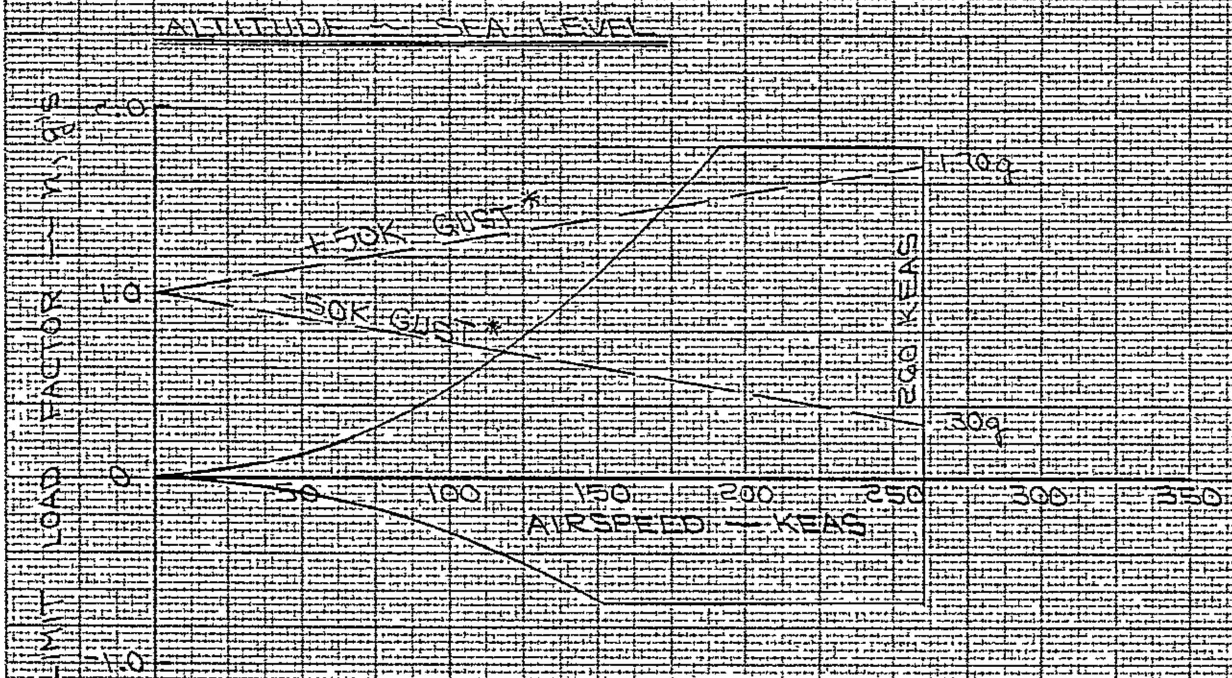
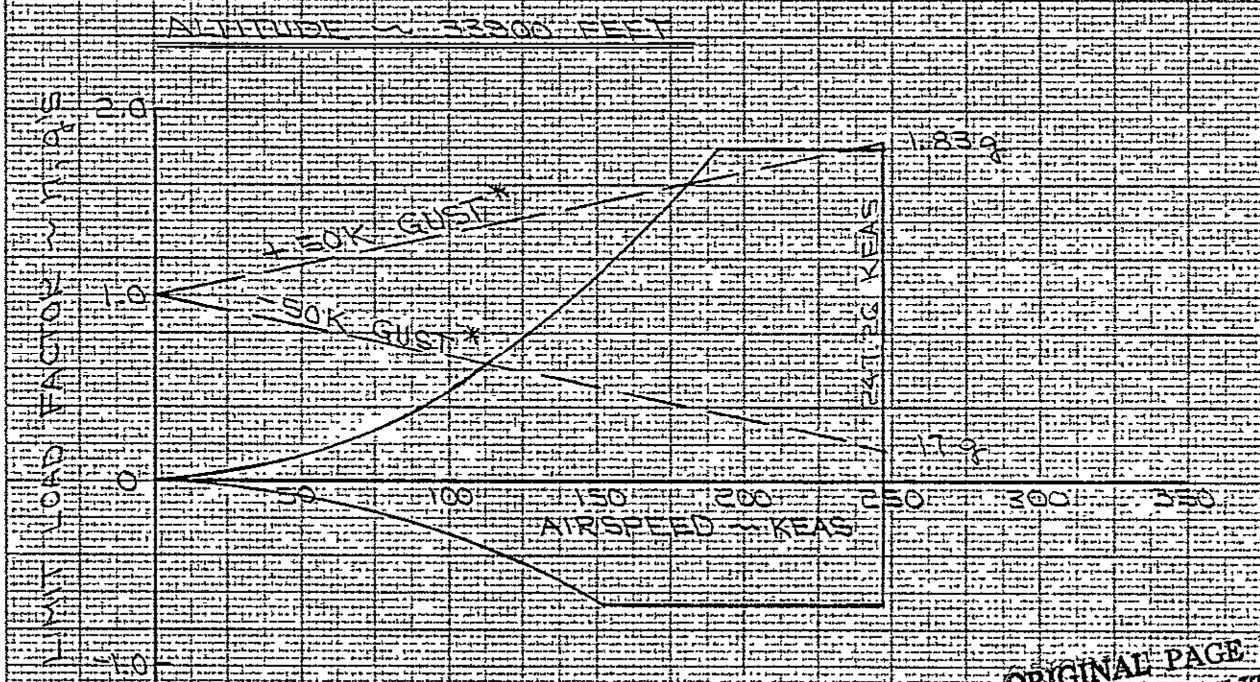
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 336344 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 22





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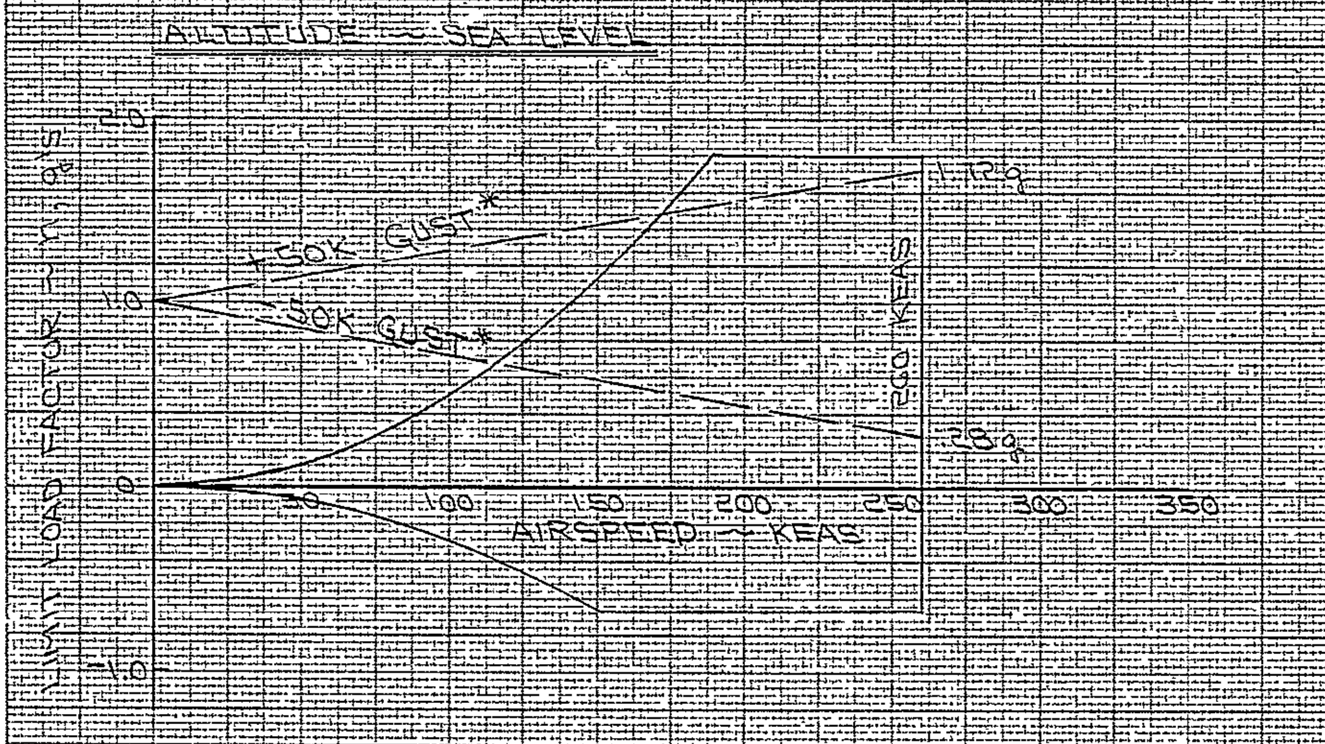
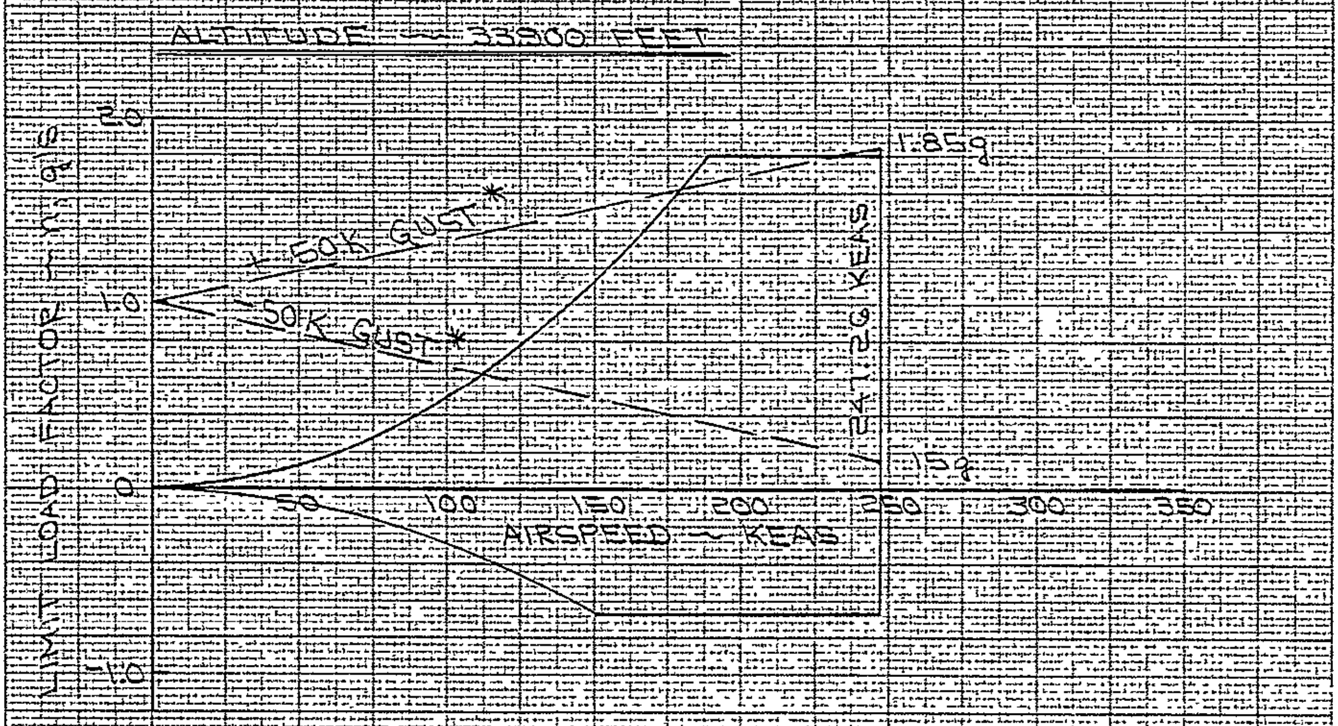
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 328532 LBS.
CONFIGURATION I (WITH FINS)

FIGURE 23





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LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 323532 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 24

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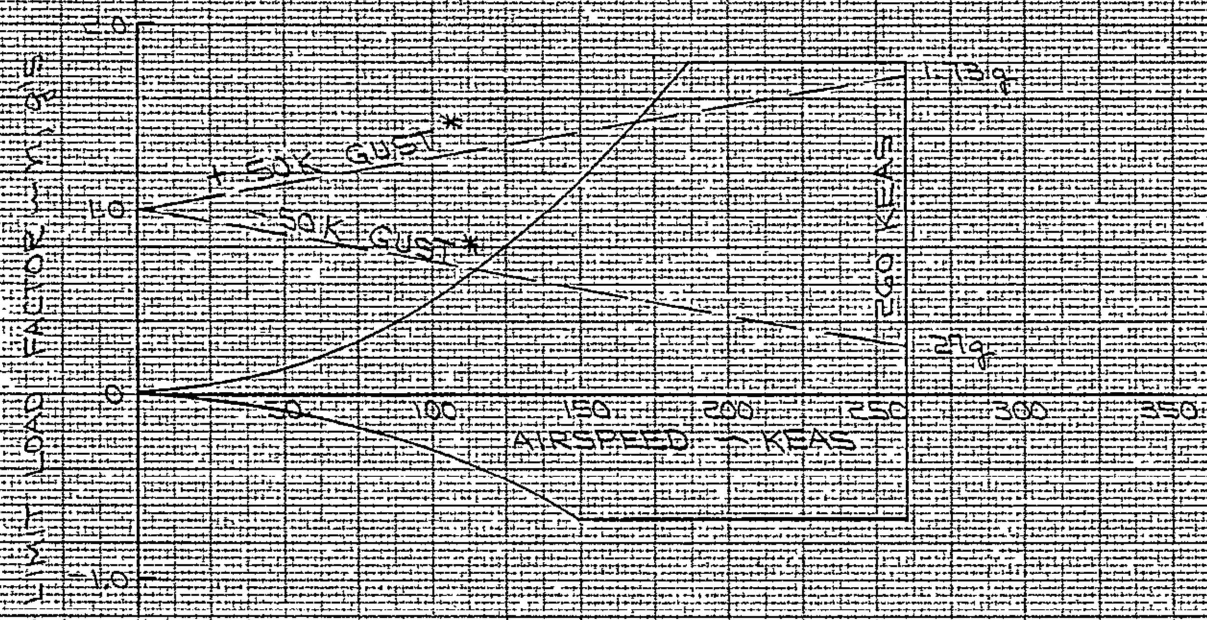
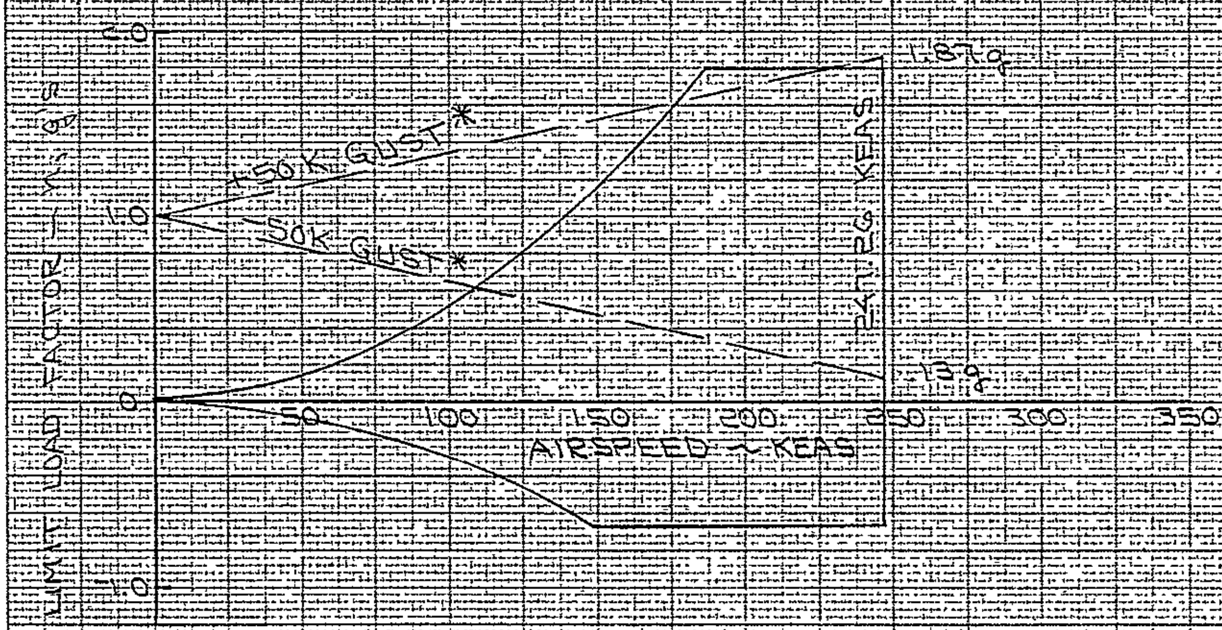
ALTITUDE ~ SEA LEVEL



ALTITUDE ~ 33900 FEET



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LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 315532 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 25

BOEING

NO. D3-11220-2

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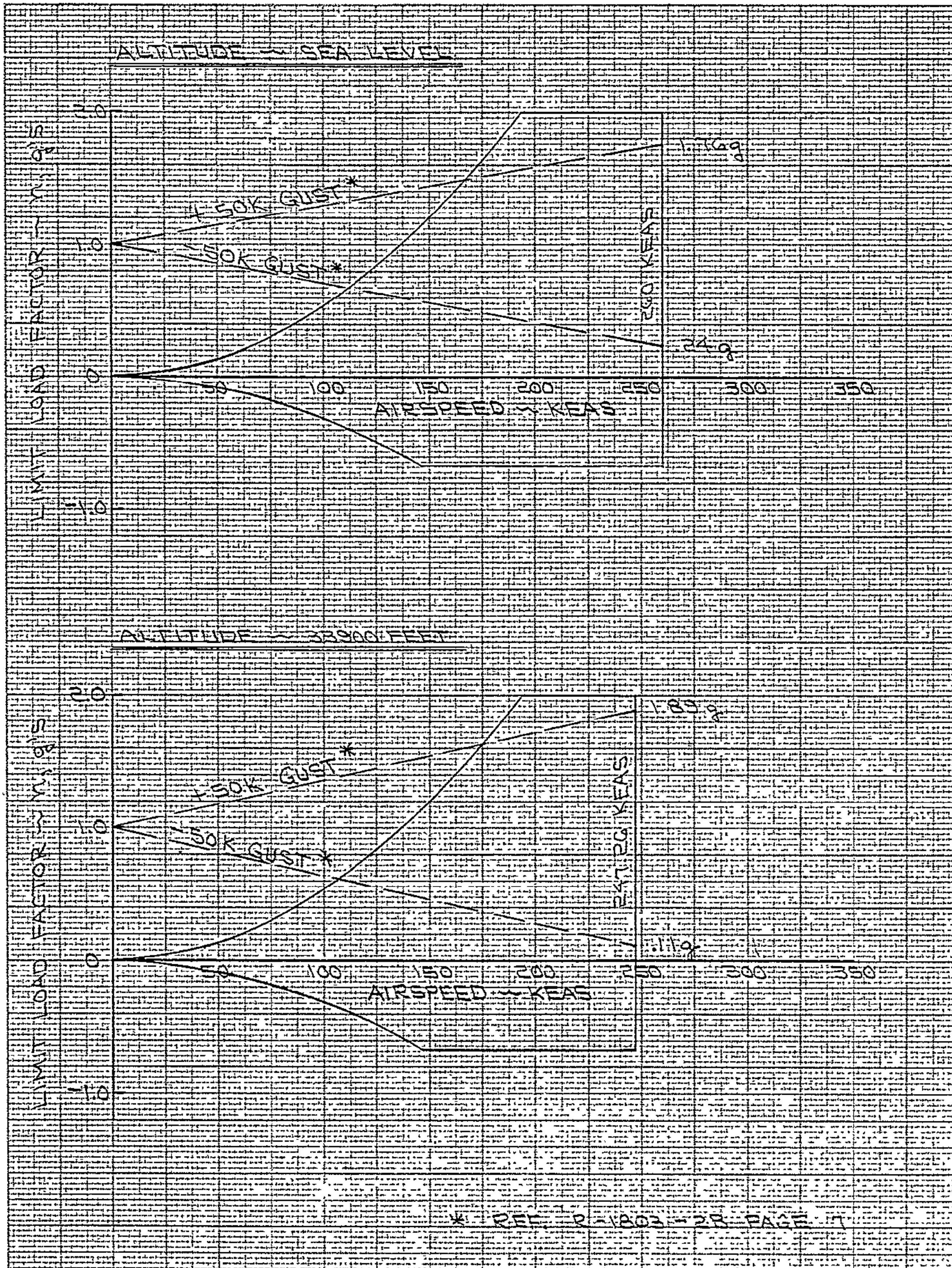

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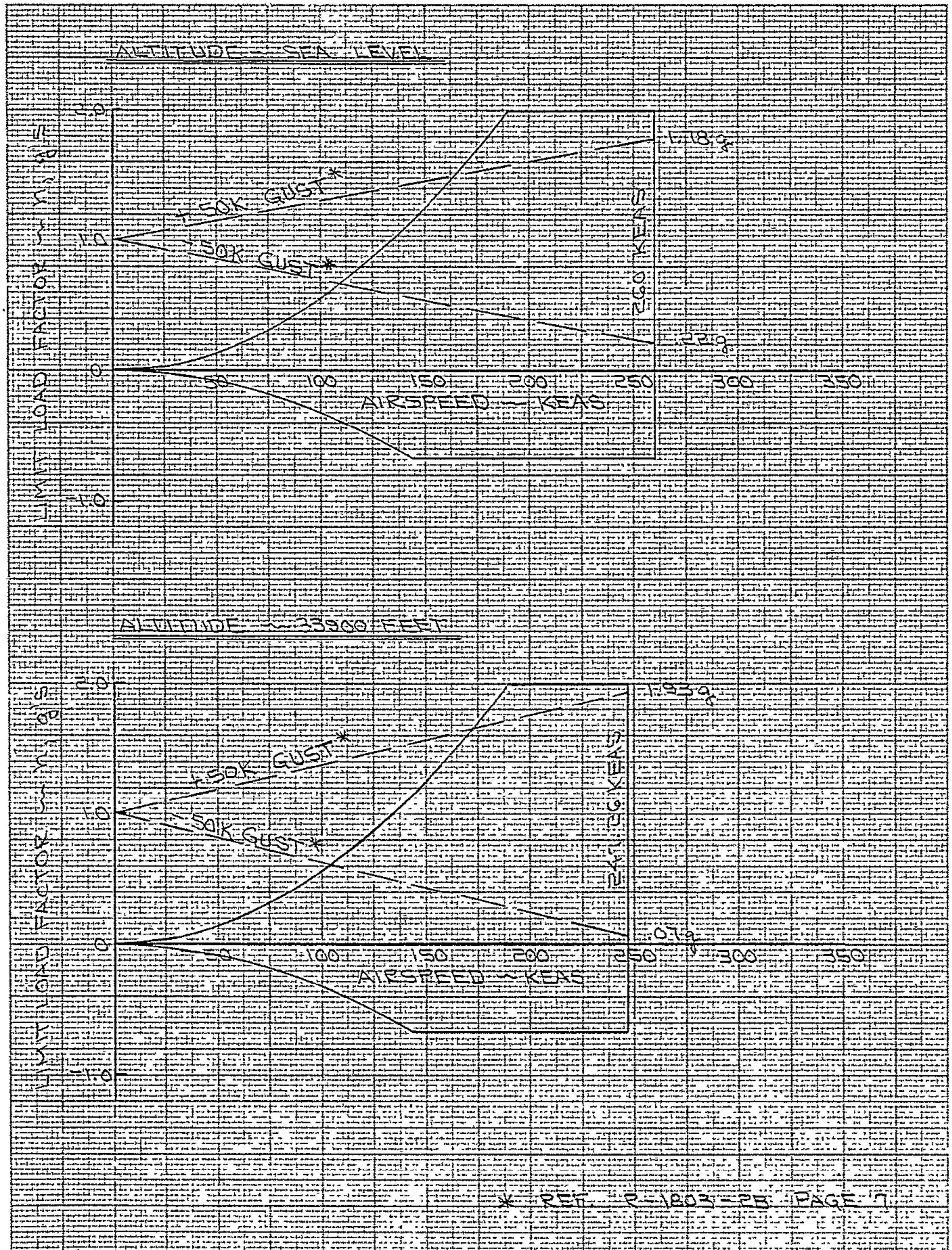
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 305532 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 26



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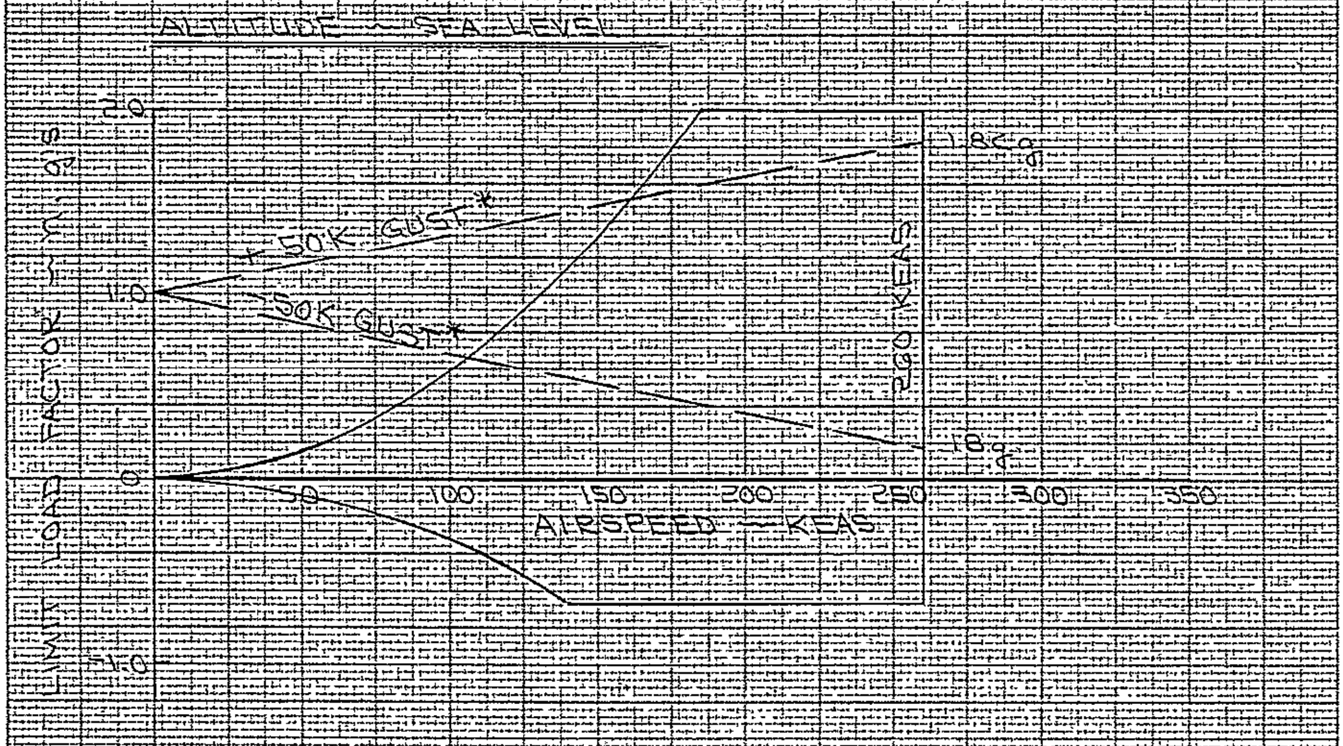
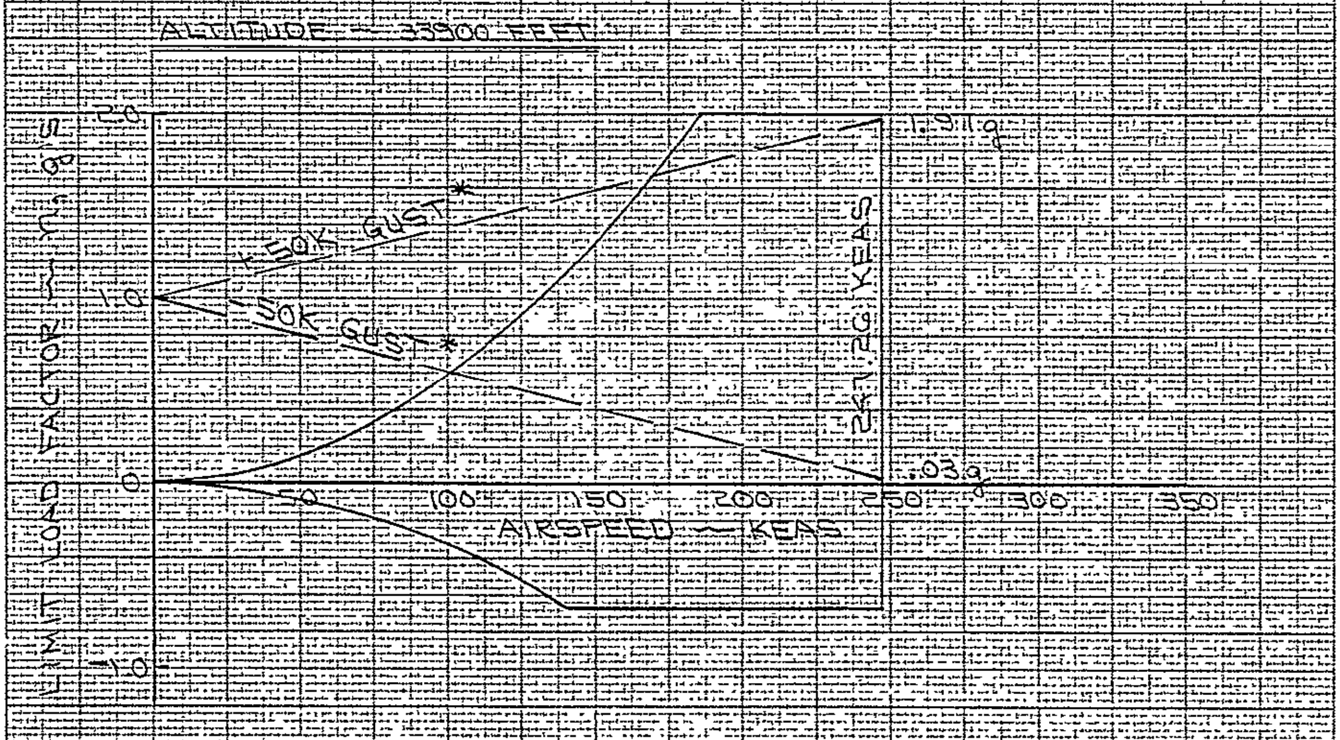
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 293532 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 27





* REF. R 1802-23 PAGE 7

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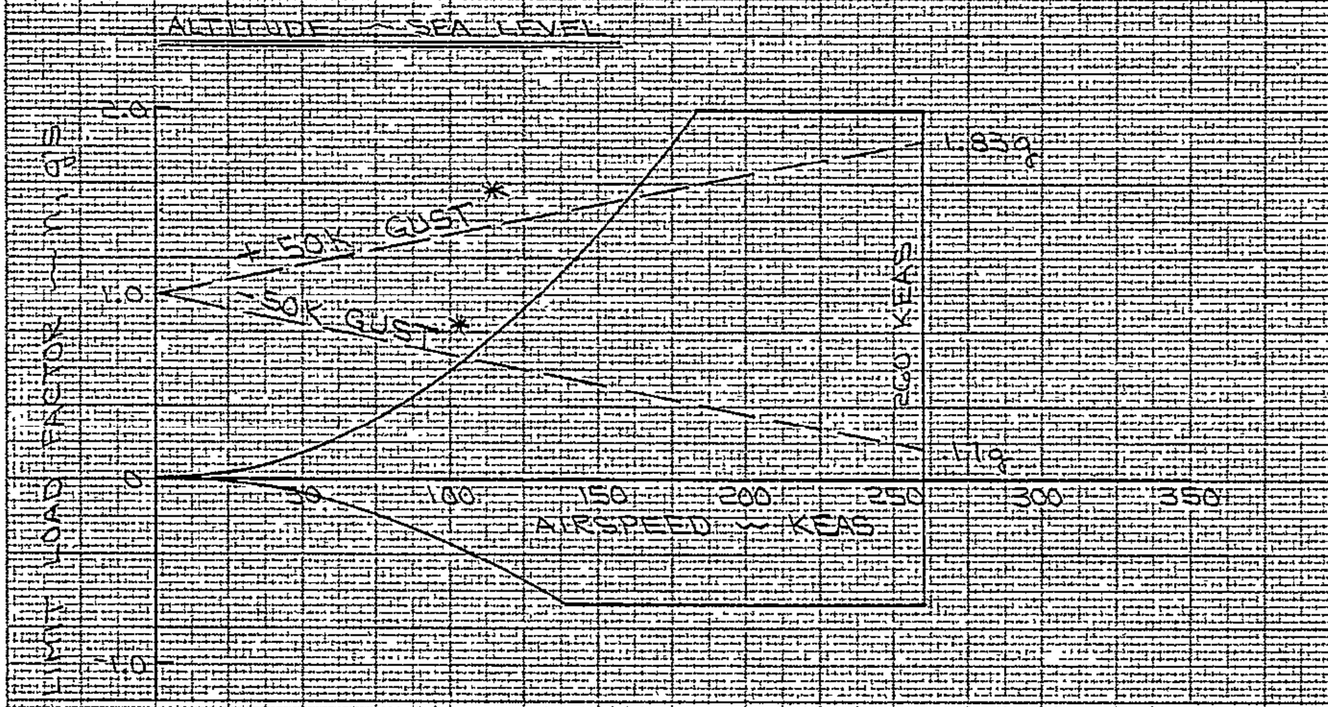
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 279858 LBS.
CONFIGURATION 1 (WITH FINS)

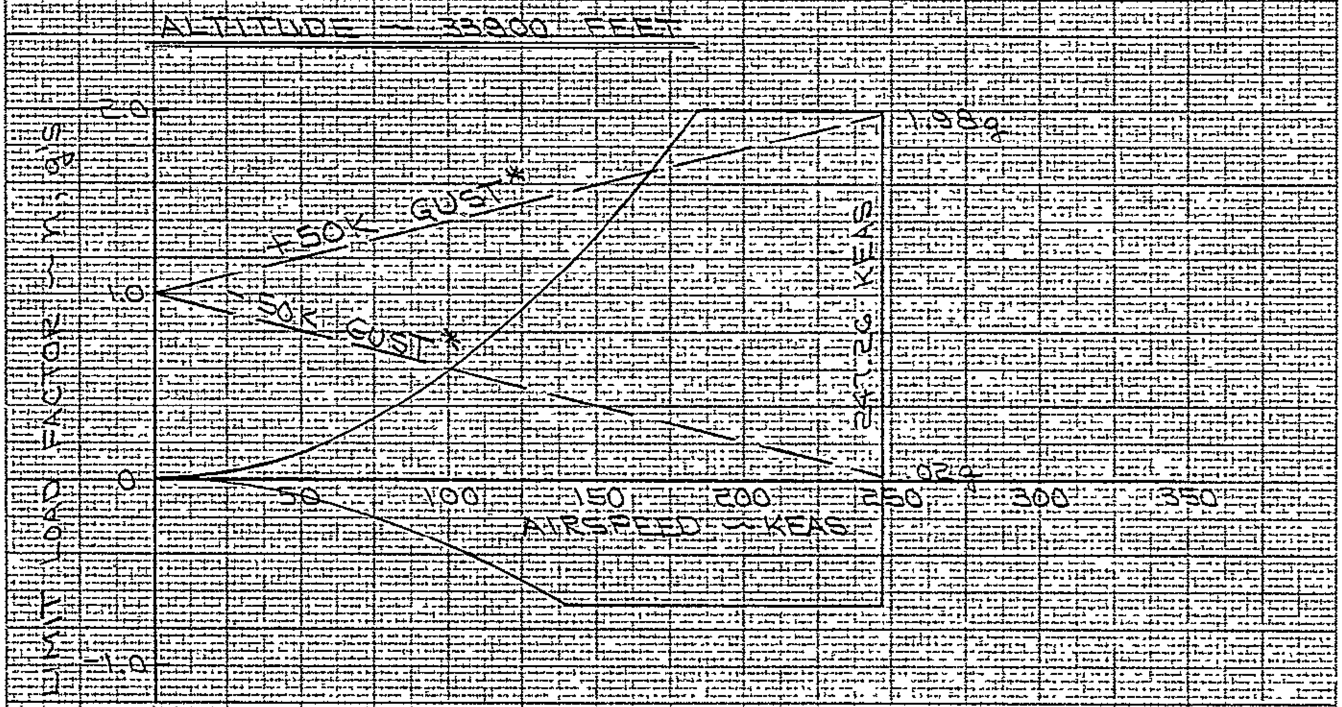
REV LTR:

FIGURE 28

BOEING

E-3909





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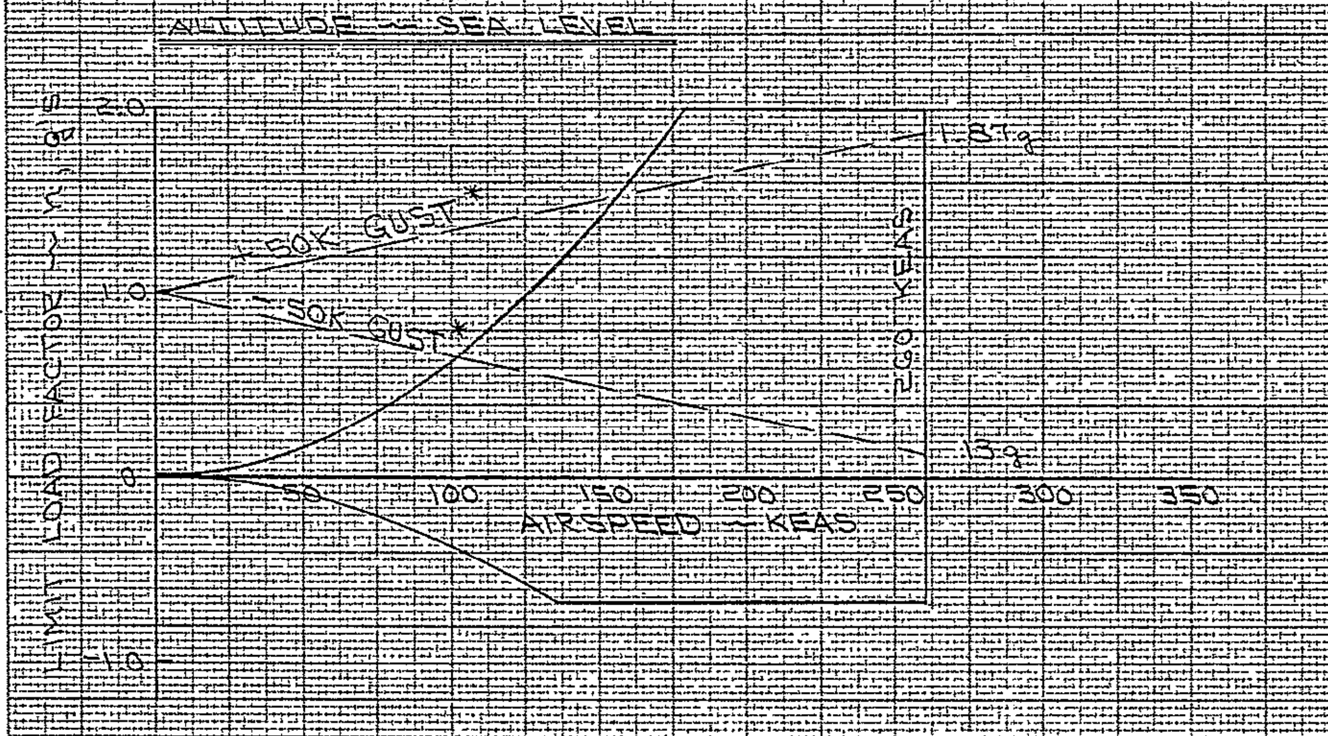
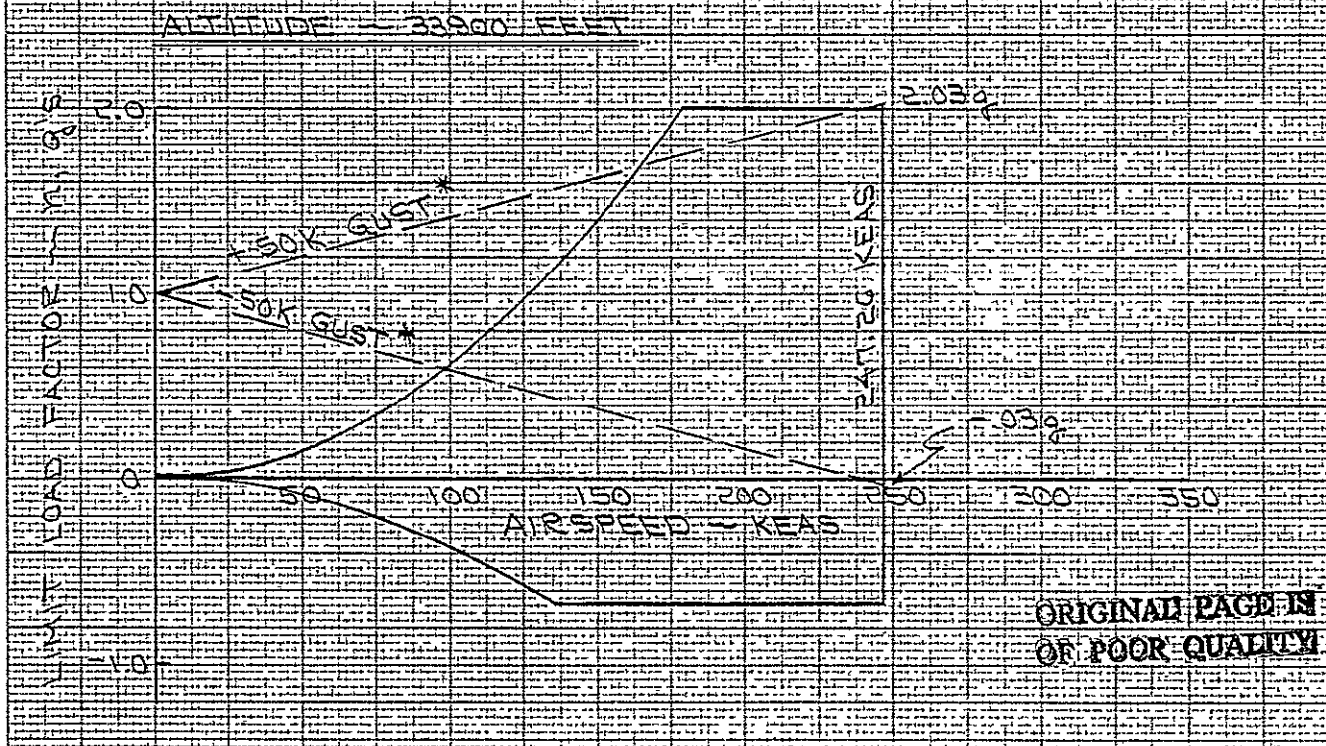
LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 275858 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 29





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LIMIT V-n DIAGRAMS -
A/P GROSS WEIGHT = 260094 LBS.
CONFIGURATION 1 (WITH FINS)

FIGURE 30

4.2 Wing Loads

Wing positive and negative design load shears, moments and torsions were determined using the maneuver-gust load factor criteria defined in Paragraph 4.1 of this volume. These loads were calculated using the "limit" and "ultimate" load factor concept. The limit loads, with one exception, can be obtained directly from the ultimate loads as presented through division by the factor of safety, 1.5. The exception is that wing loading for the taxi-takeoff condition is calculated at a 3.0 g ultimate load factor with a safety factor of 1.0. Due to the nonlinearity of the tip protection gear load - stroke curve, the net loading is correct only for the load factor at which the tip protection gear reaction was calculated.

The loads were determined based on the fuel sequence as defined in Section 3.0, Volume I of this document. The fuel sequence is based on 6.4 pound per gallon fuel density and a maximum drop test vehicle weight of 52,000 pounds. All airplane load analyses clear the airplane for a maximum drop test vehicle weight of 52,000 pounds. The pylon loadings as presented in Volumes III and IV of this document are based on a drop test vehicle weight of 49,000 pounds.

The right hand wing design load shear, moment and torsion envelopes for B-52B-008/DTV Configuration 1 (with fins) are presented in Figures 31 through 48. The left hand wing design load shear, moment and torsion envelopes for B-52B-008/DTV Configuration 1 (with fins) are unchanged from those defined in Figures 58 through 75 of Reference 2.

The abbreviations used to identify the loading conditions are defined as follows:

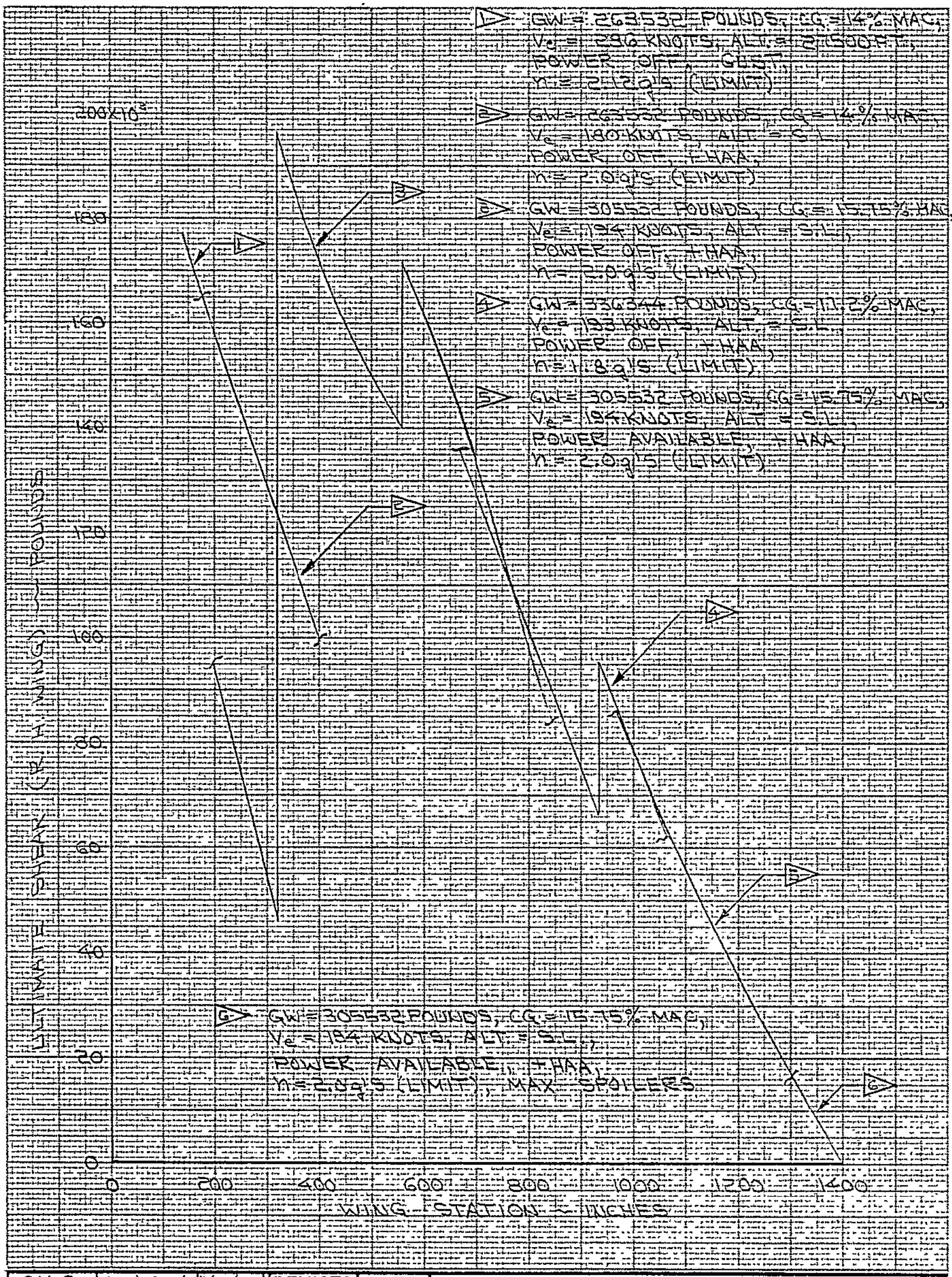
- GW - Gross Weight
- CG - Center of Gravity
- Alt. - Altitude
- S.L. - Sea Level
- MAC - Mean Aerodynamic Chord
- + HAA - Plus High Angle of Attack
- - HAA - Minus High Angle of Attack
- + LAA - Plus Low Angle of Attack
- - LAA - Minus Low Angle of Attack

4.3 Wing Center Section Loads

Critical wing center section shear (V_Z), moment (M_X) and Torsion (T) loading at the left and right hand side of body are given in Table III for B-52B-008/DTV Configuration 1 (with fins). A comparison of these loadings to the critical X-15A-2 center section loading is given in Paragraph 5.2.2, Volume I of this document.

4.4 Gear Loads

Ultimate gear loads for taxi-takeoff and ground turn conditions are given in Tables IV and V. These analyses evaluated the gear loading for the 336,344 pound airplane at a forward, nominal and aft CG location. Ground turn analyses were made with the airplane turning to the right and to the left. Comparison of this loading to gear strength is presented in Paragraph 5.2.3, Volume I of this document.



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ULTIMATE WING SHEAR FOR POSITIVE SHEAR ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 31

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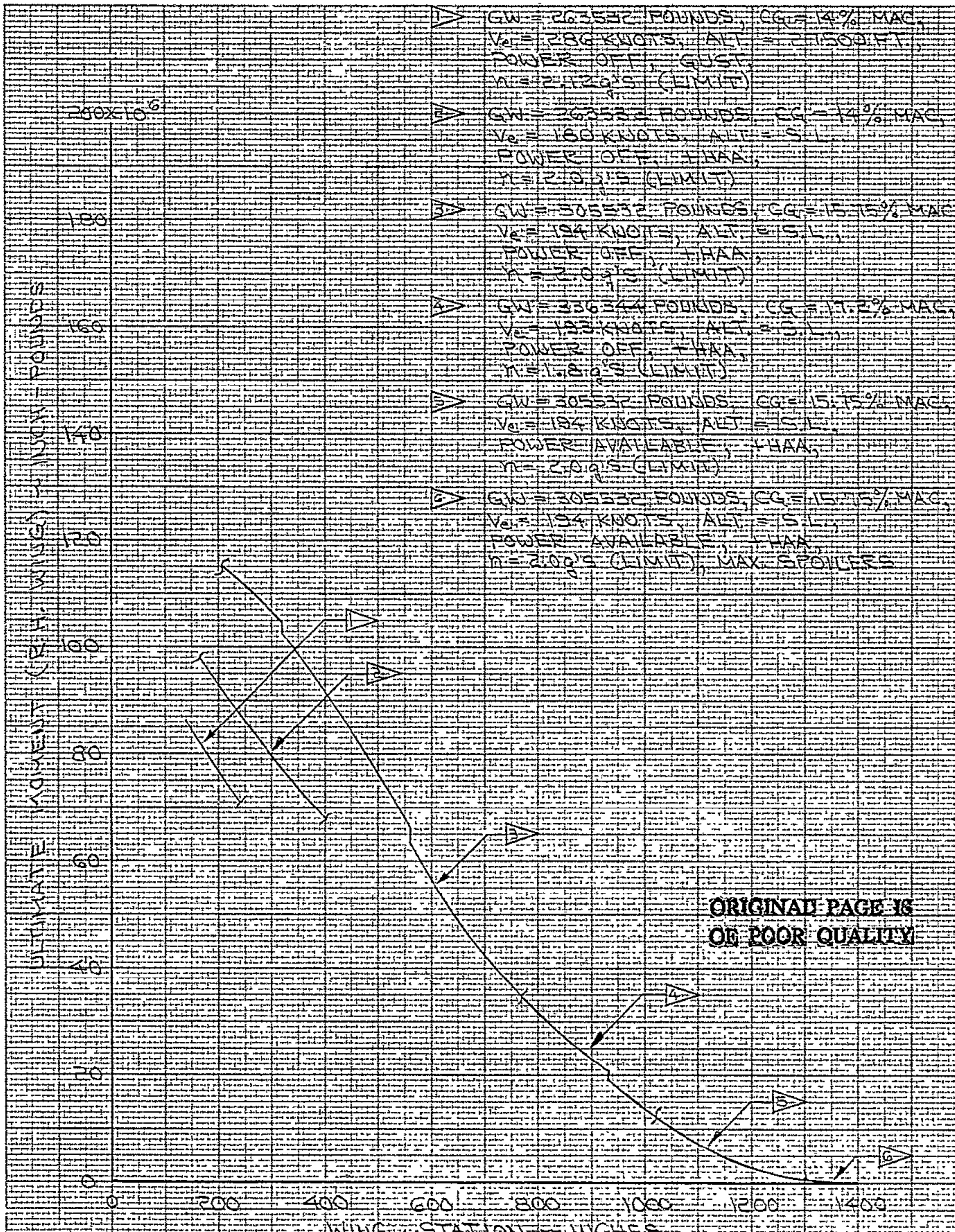

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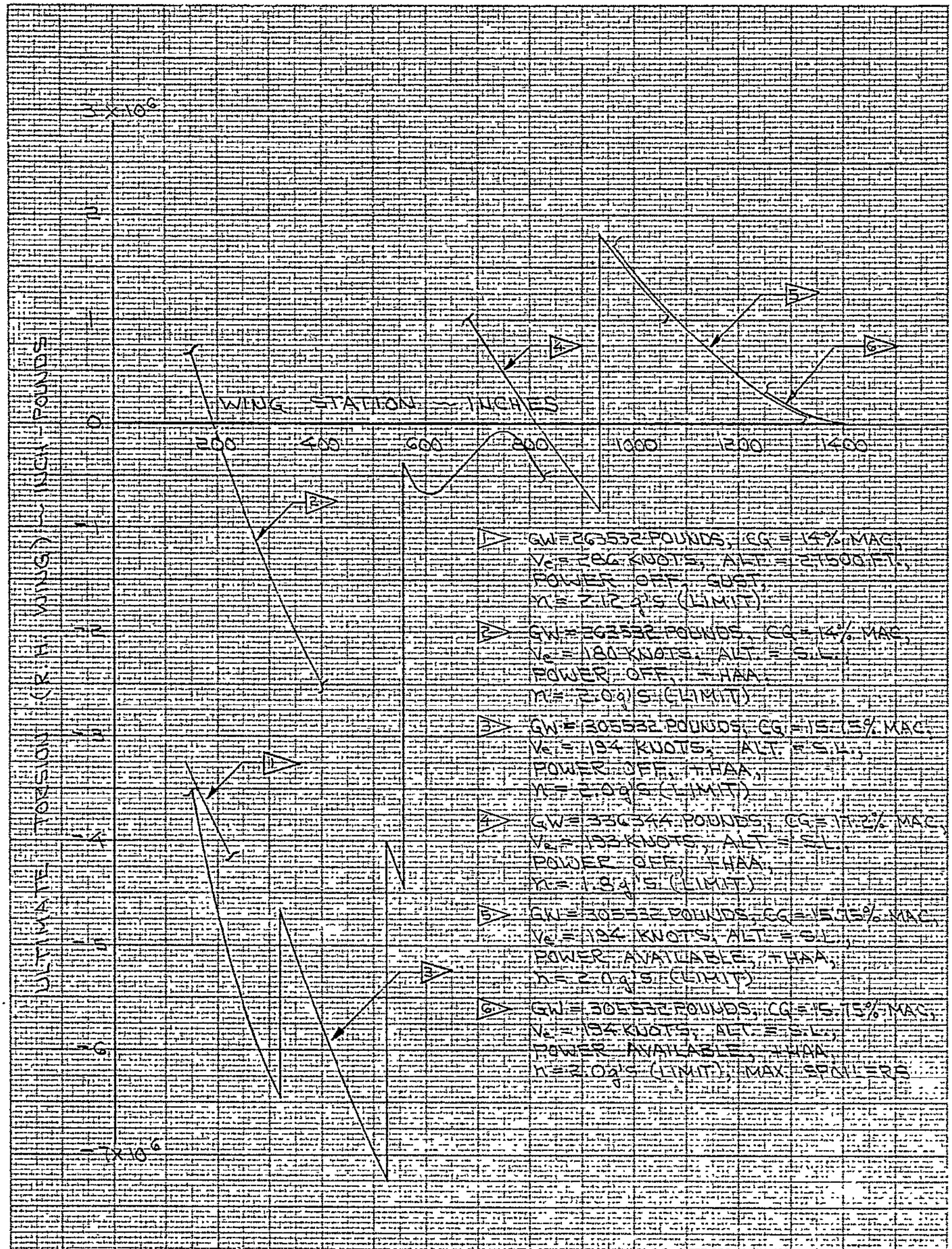
ULTIMATE WING MOMENT FOR POSITIVE SHEAR ENVELOPE - R. H. WING DTV CONFIGURATION I (WITH FINS)

FIGURE 32



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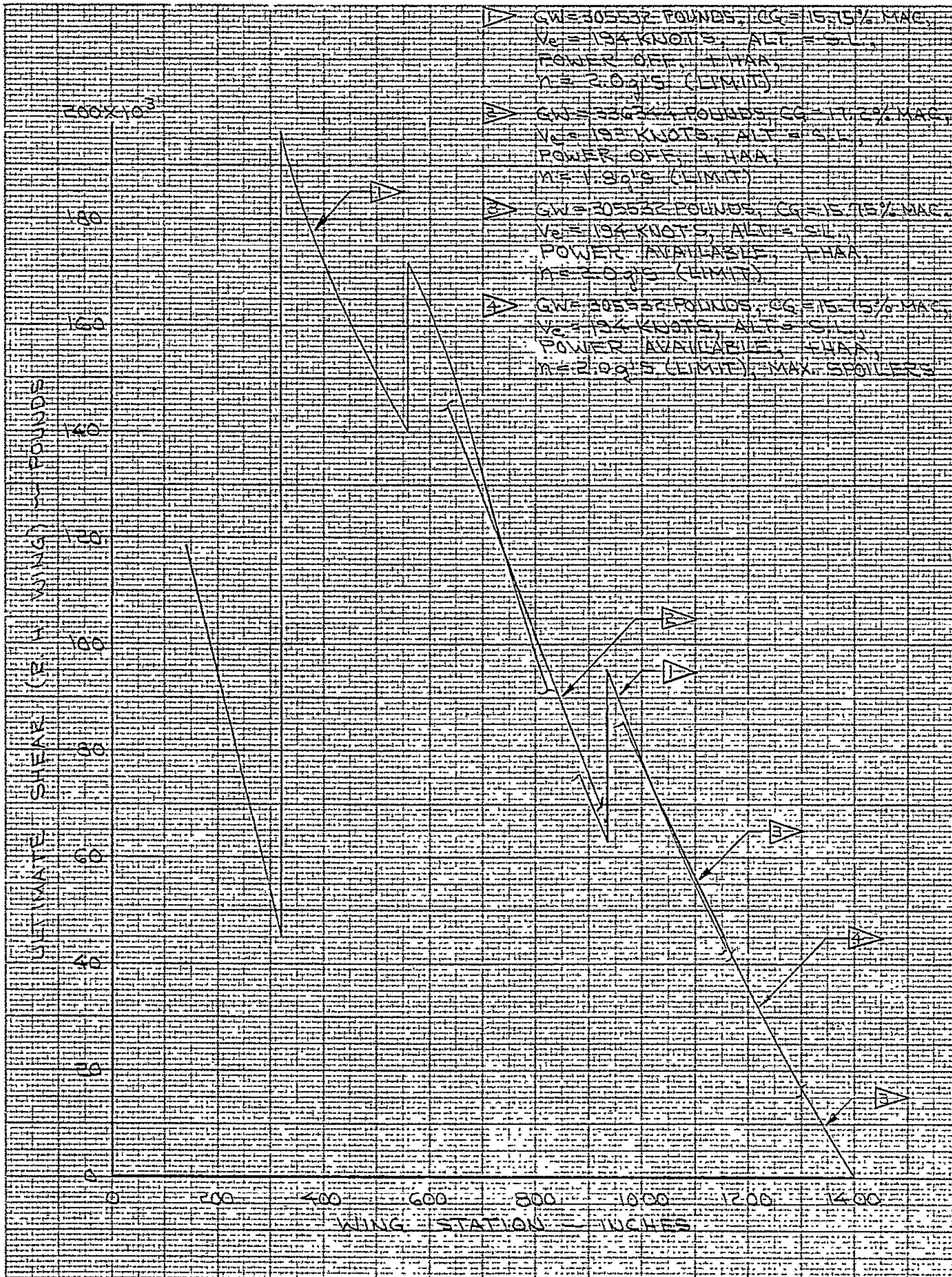
ULTIMATE WING TORSION FOR POSITIVE SHEAR ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 33



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ULTIMATE WING SHEAR FOR POSITIVE MOMENT ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 34

REV LTR:

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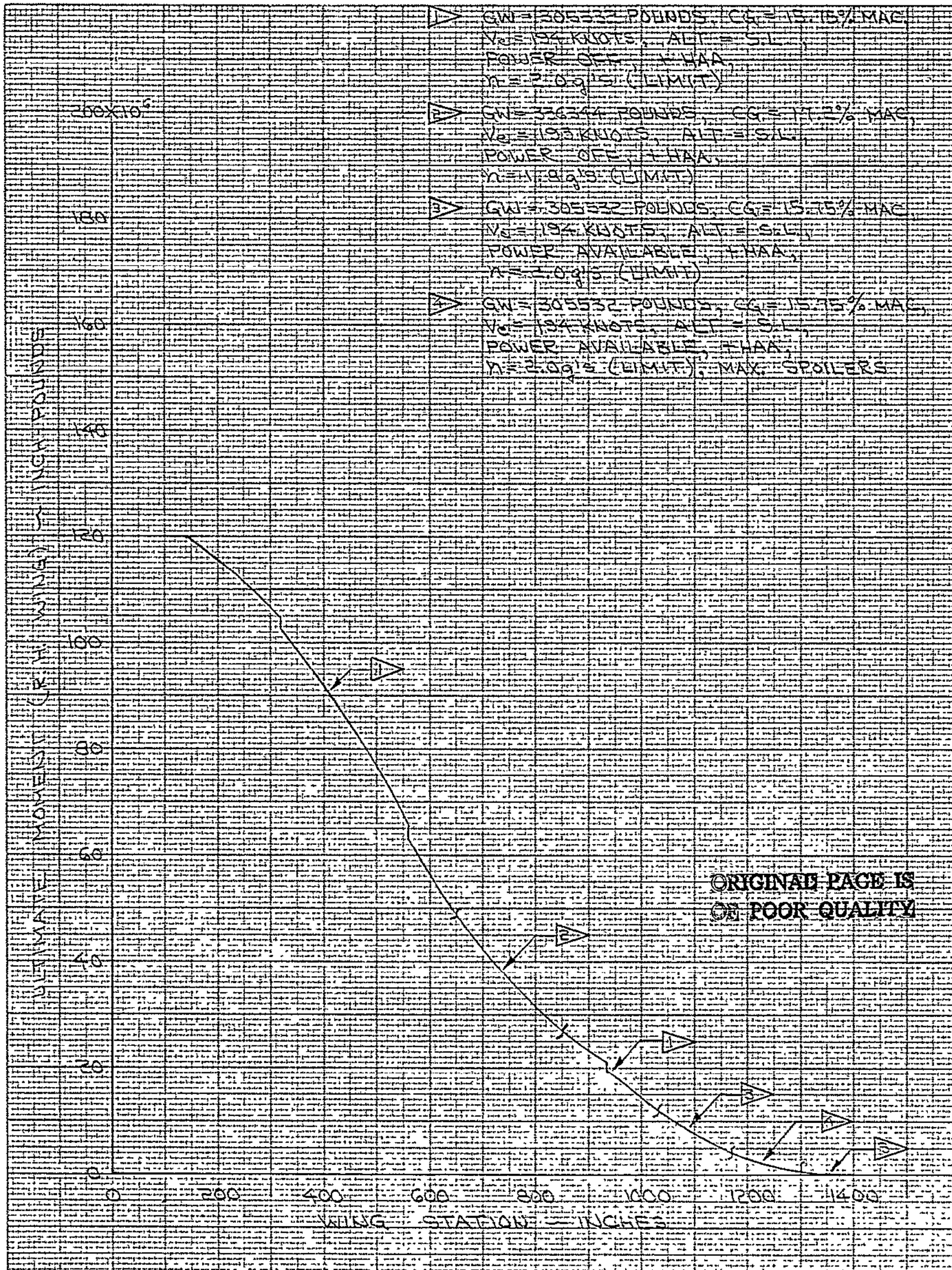

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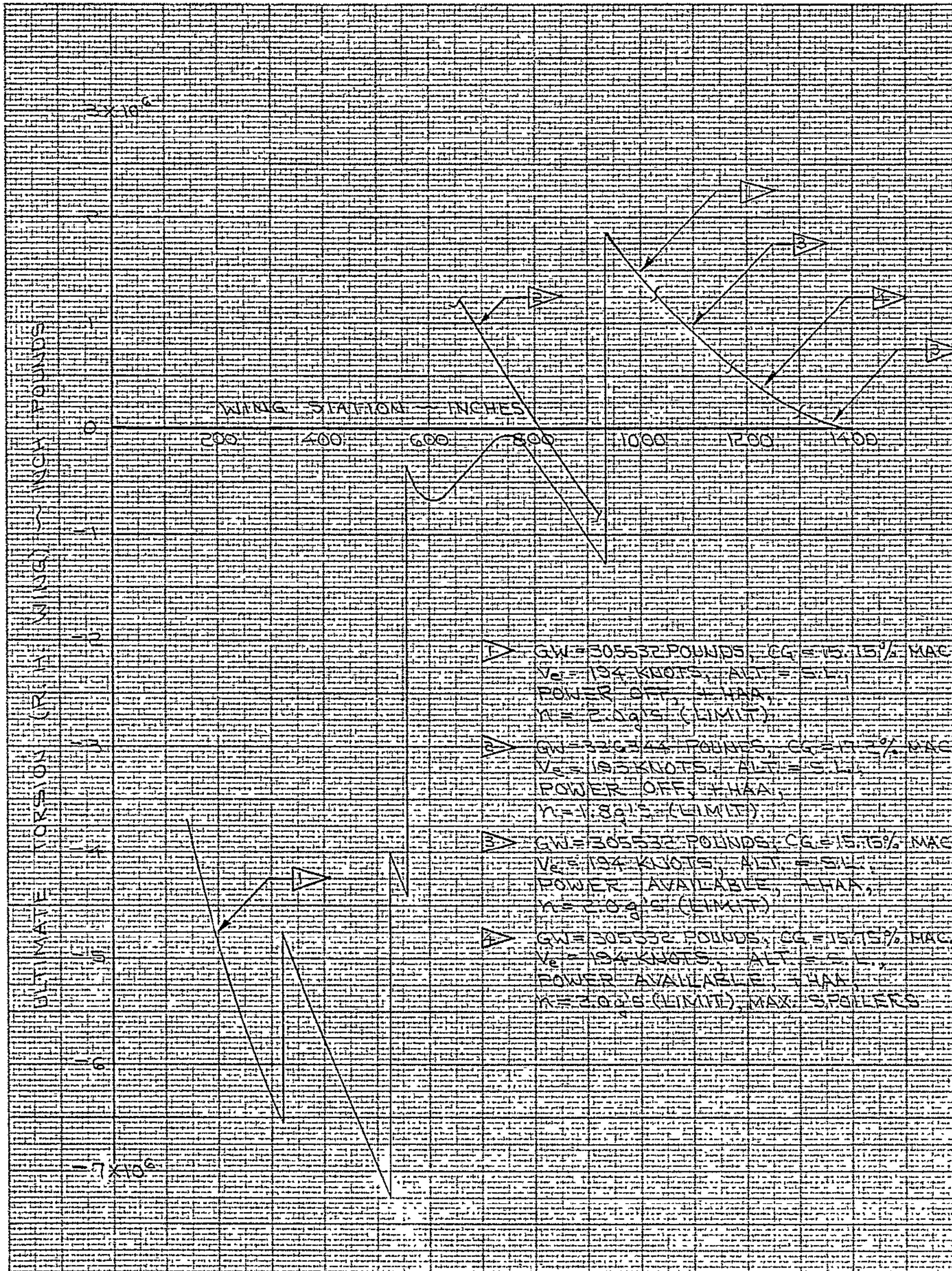
ULTIMATE WING MOMENT FOR POSITIVE MOMENT ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 35



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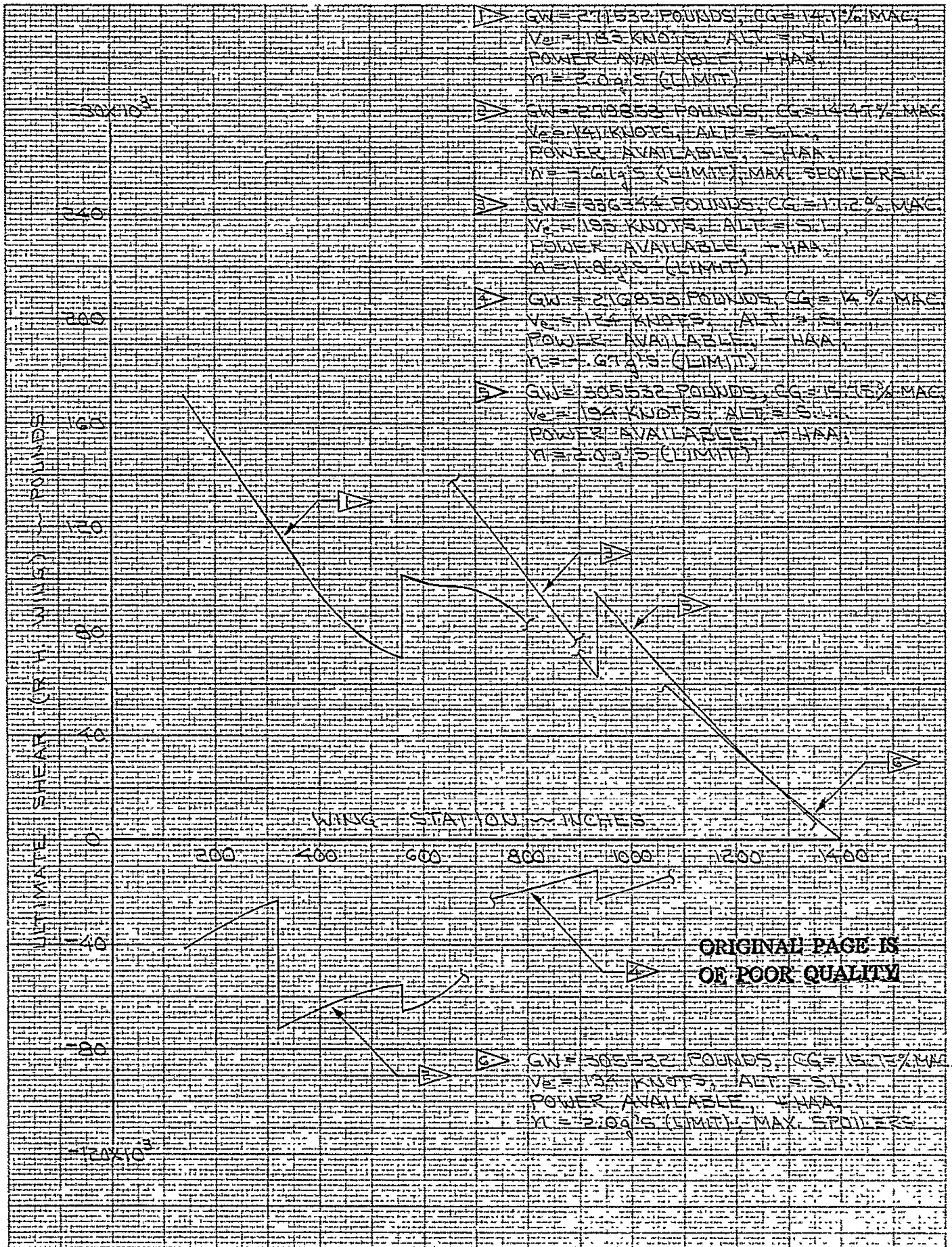
ULTIMATE WING TORSION FOR POSITIVE MOMENT ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 36



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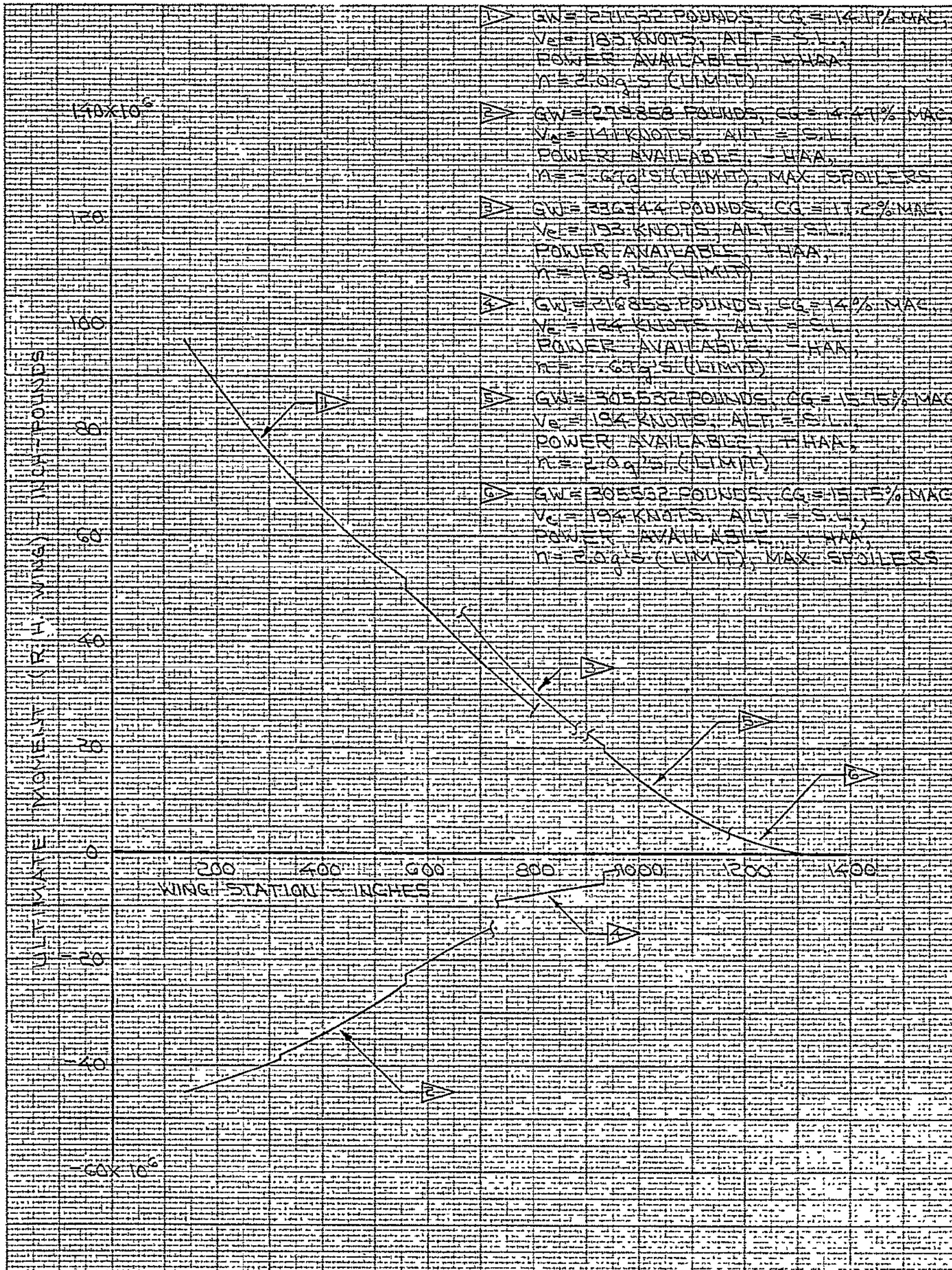
ULTIMATE WING SHEAR FOR POSITIVE TORSION ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 37



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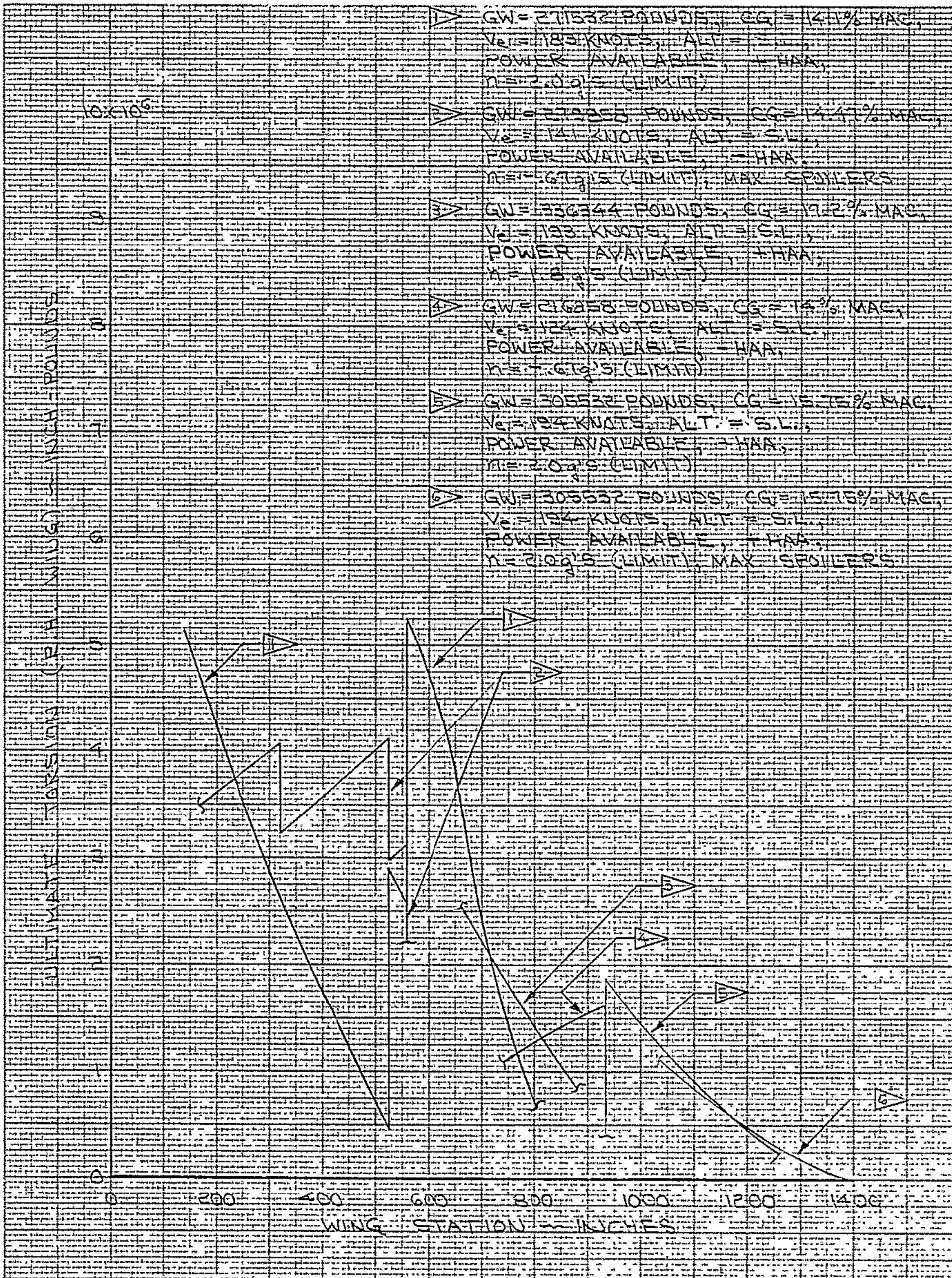
ULTIMATE WING MOMENT FOR POSITIVE
TORSION ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 38

BOEING



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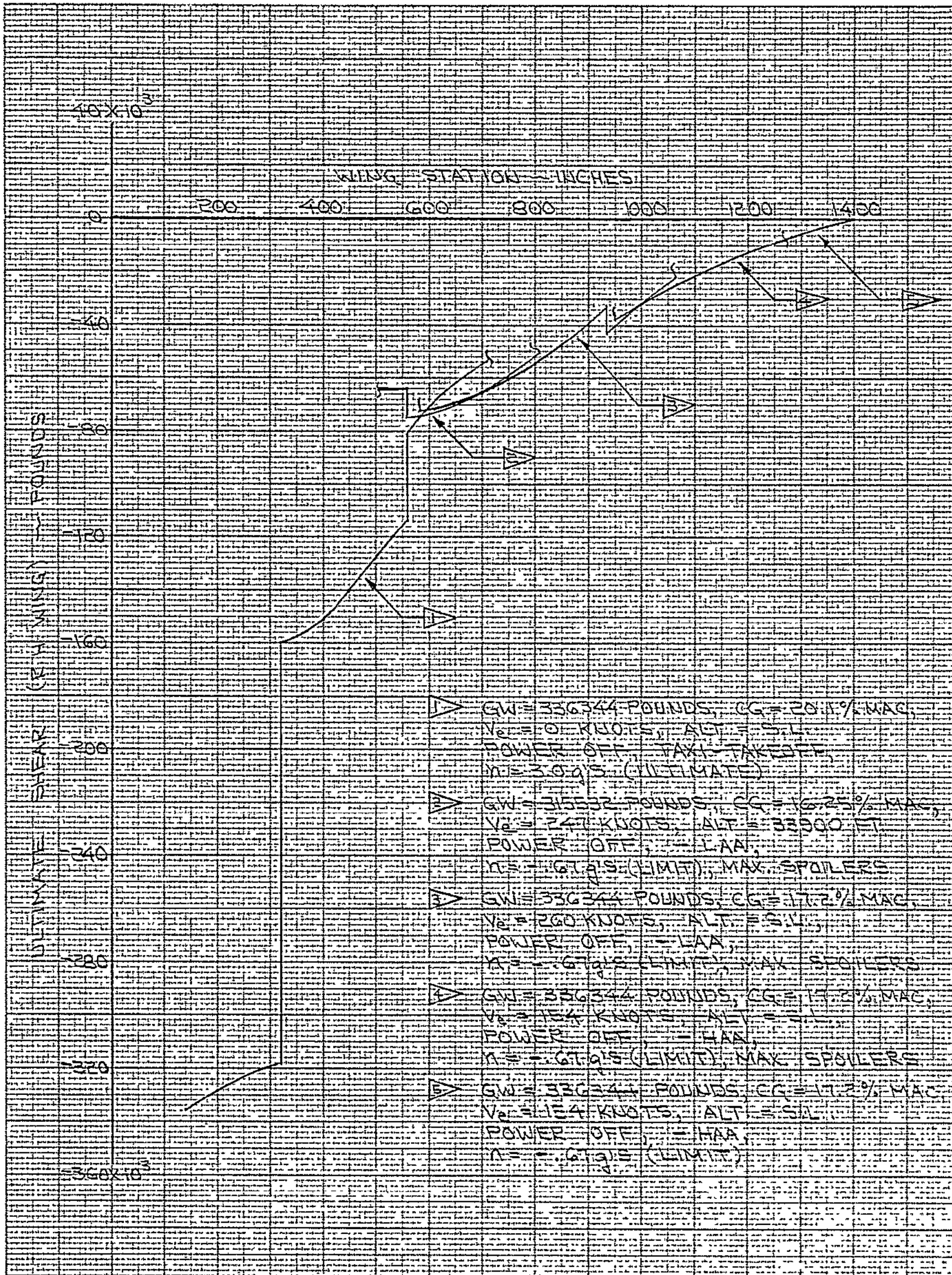
ULTIMATE WING TORSION FOR POSITIVE TORSION ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

REV LTR:

FIGURE 39



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ULTIMATE WING SHEAR FOR NEGATIVE
SHEAR ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 40

REV LTR:

BOEING

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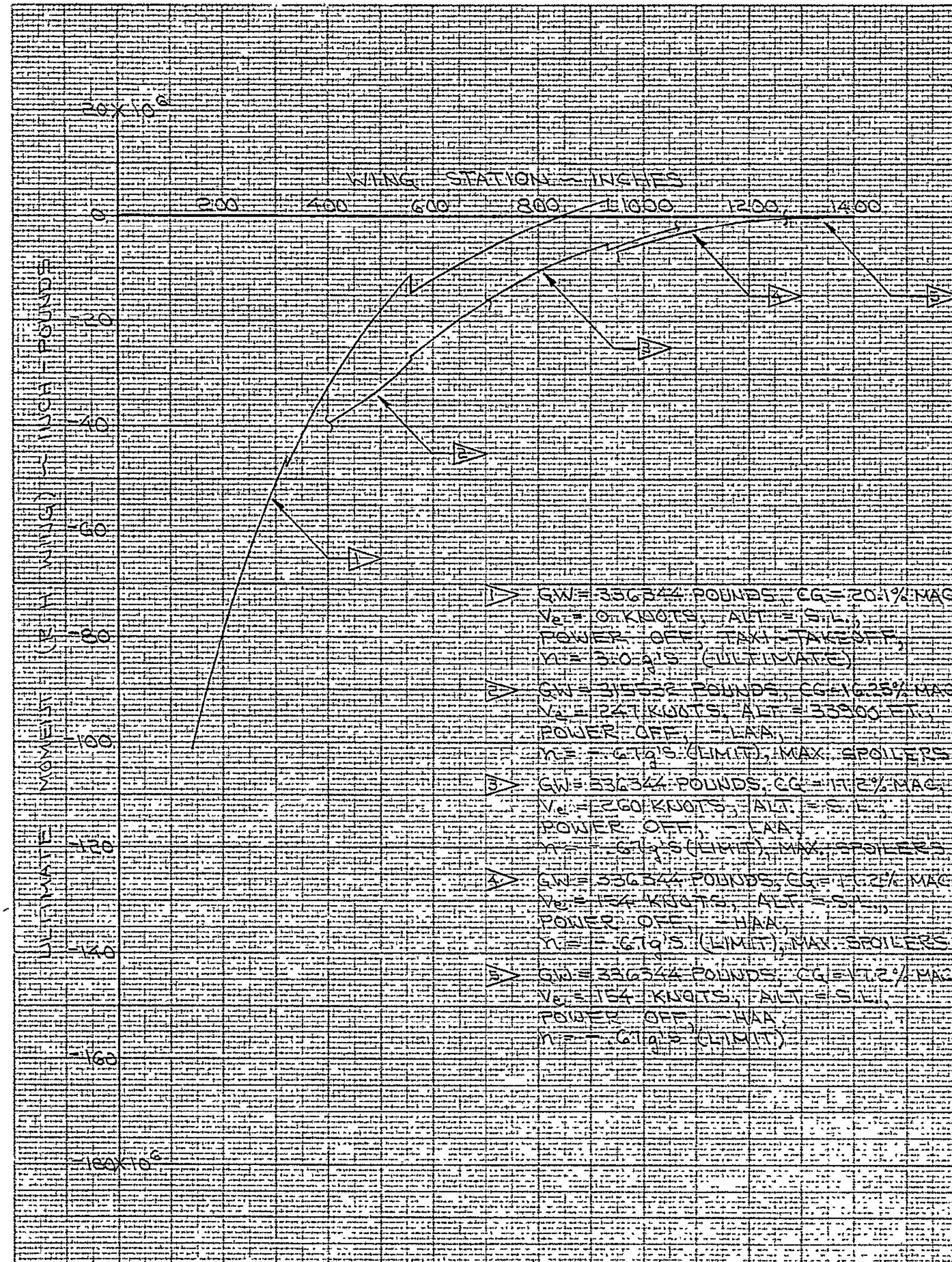

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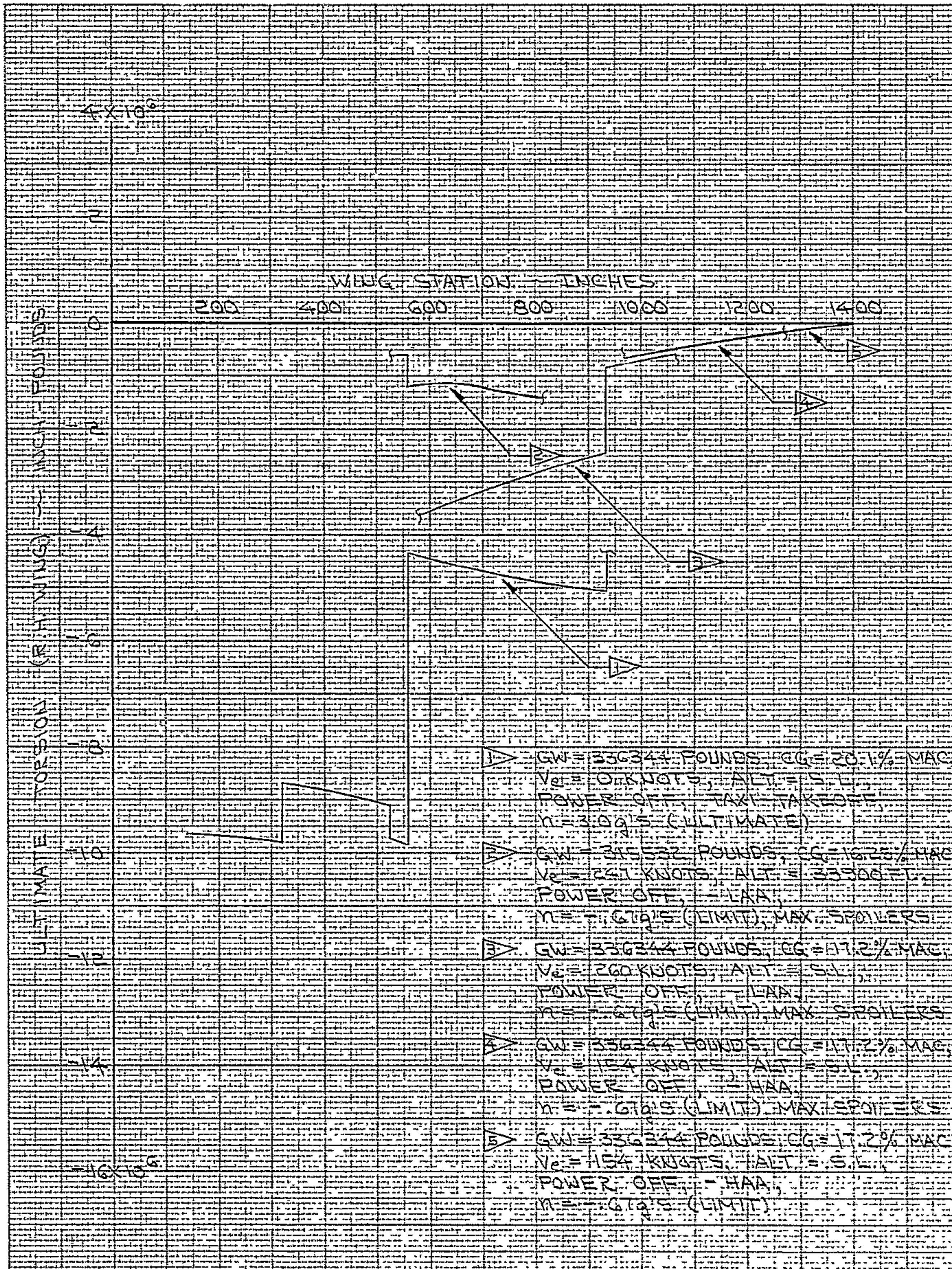
ULTIMATE WING MOMENT FOR NEGATIVE
SHEAR ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 41

REV LTR:



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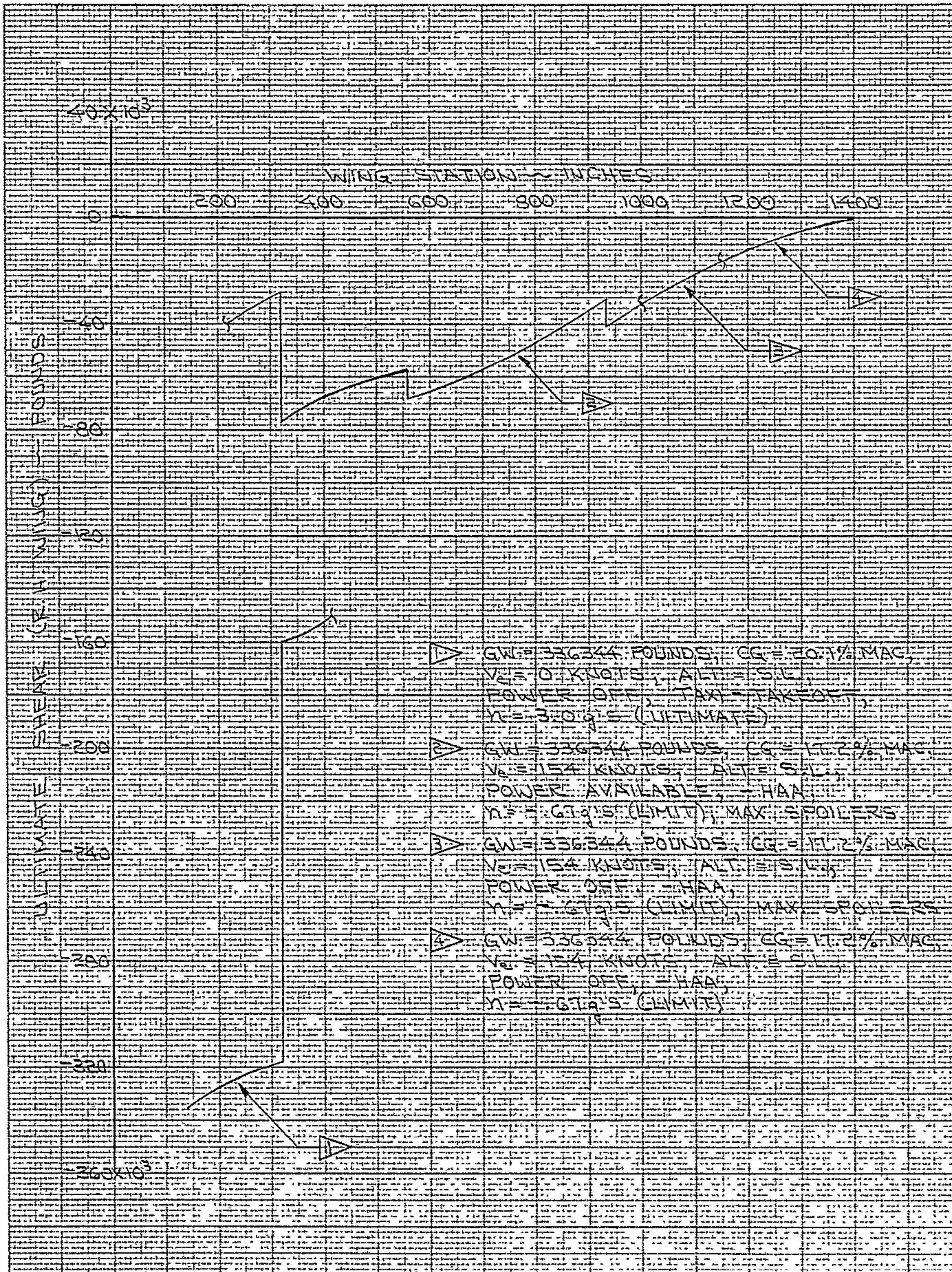
ULTIMATE WING TORSION FOR NEGATIVE SHEAR ENVELOPE - R. H. WING
DTV CONFIGURATION I (WITH FINS)

FIGURE 42



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ULTIMATE WING SHEAR FOR NEGATIVE MOMENT ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 43

BOEING

NO. D3-11220-2

REV LTR:

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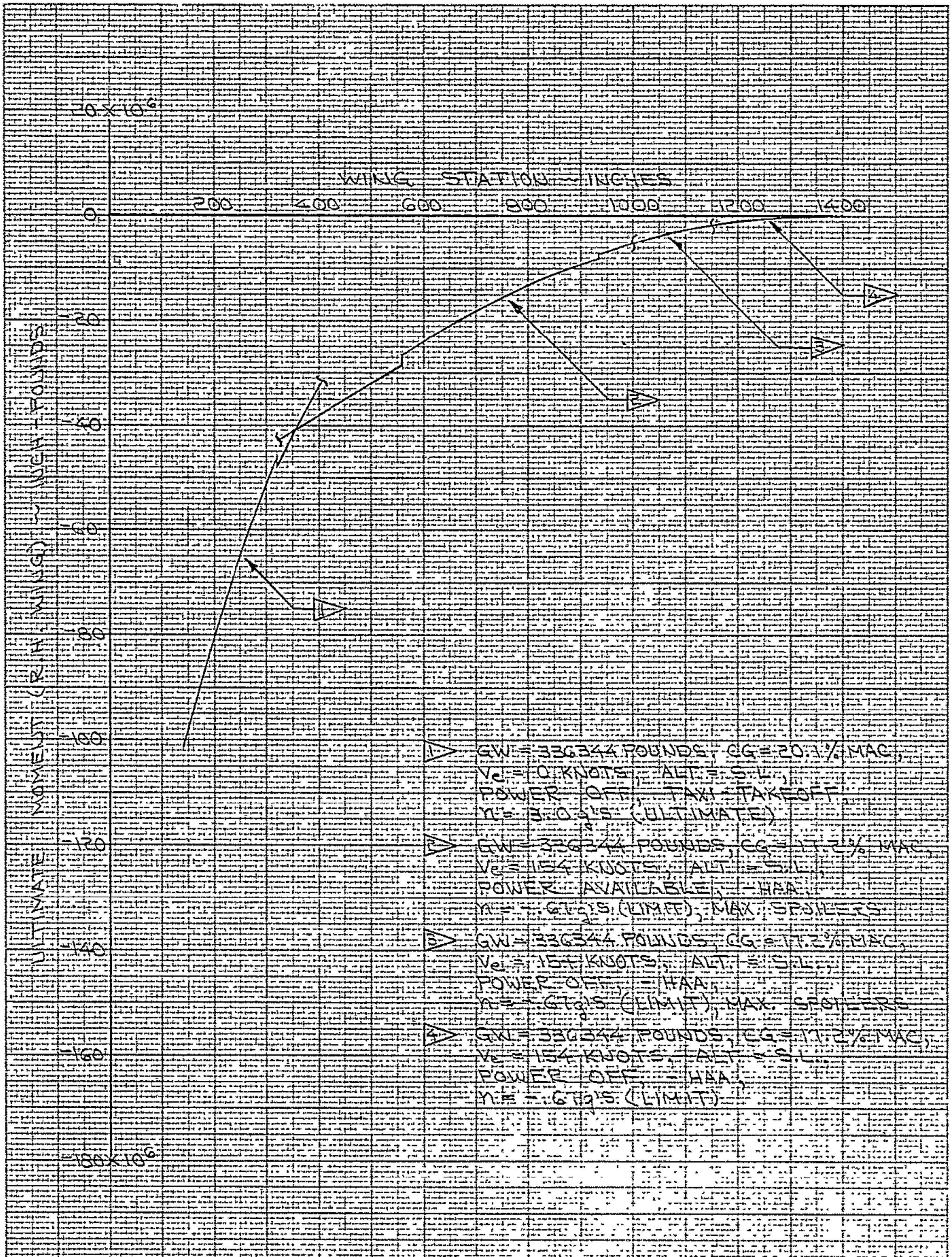
E-3909



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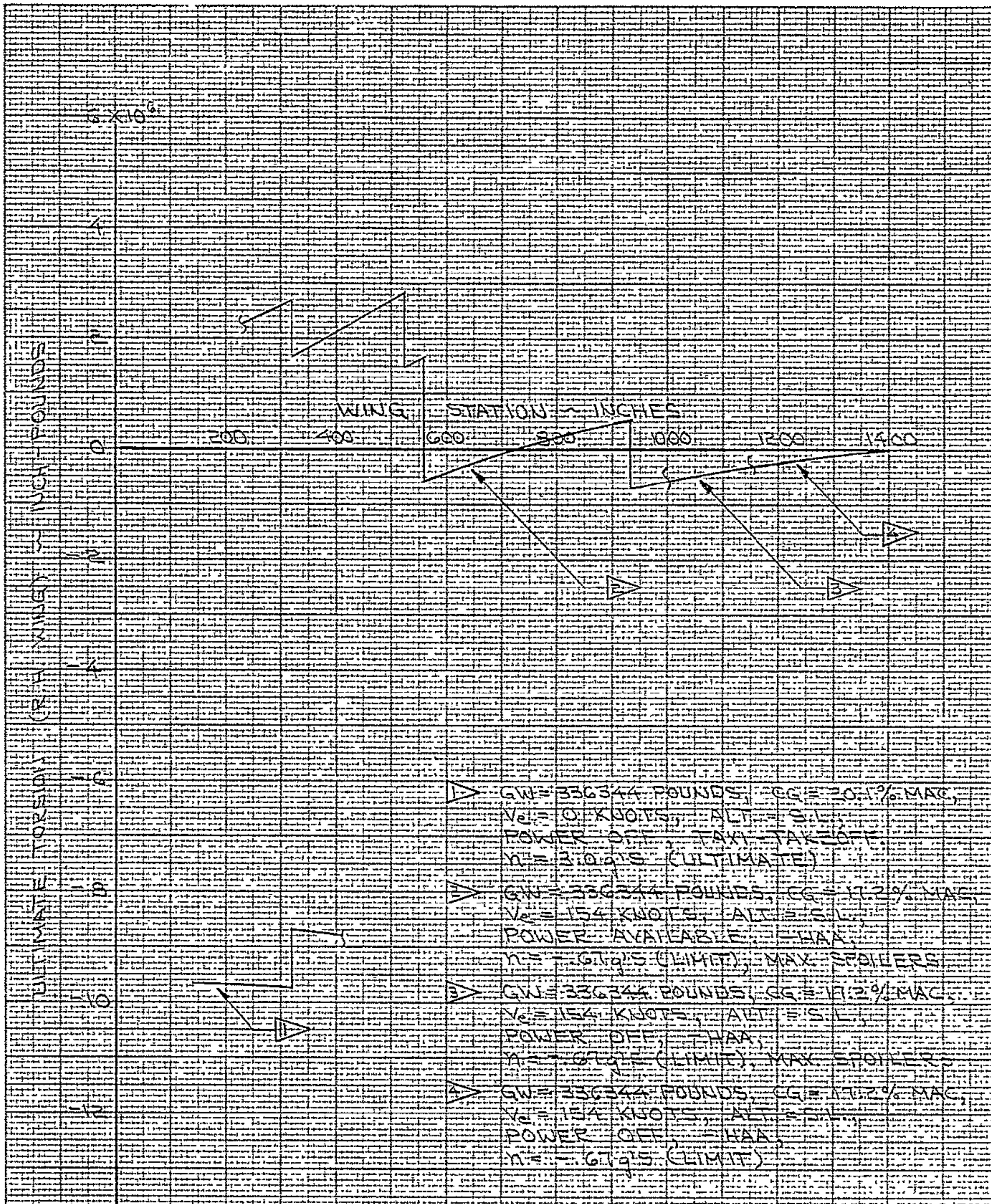
ULTIMATE WING MOMENT FOR NEGATIVE MOMENT ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 44



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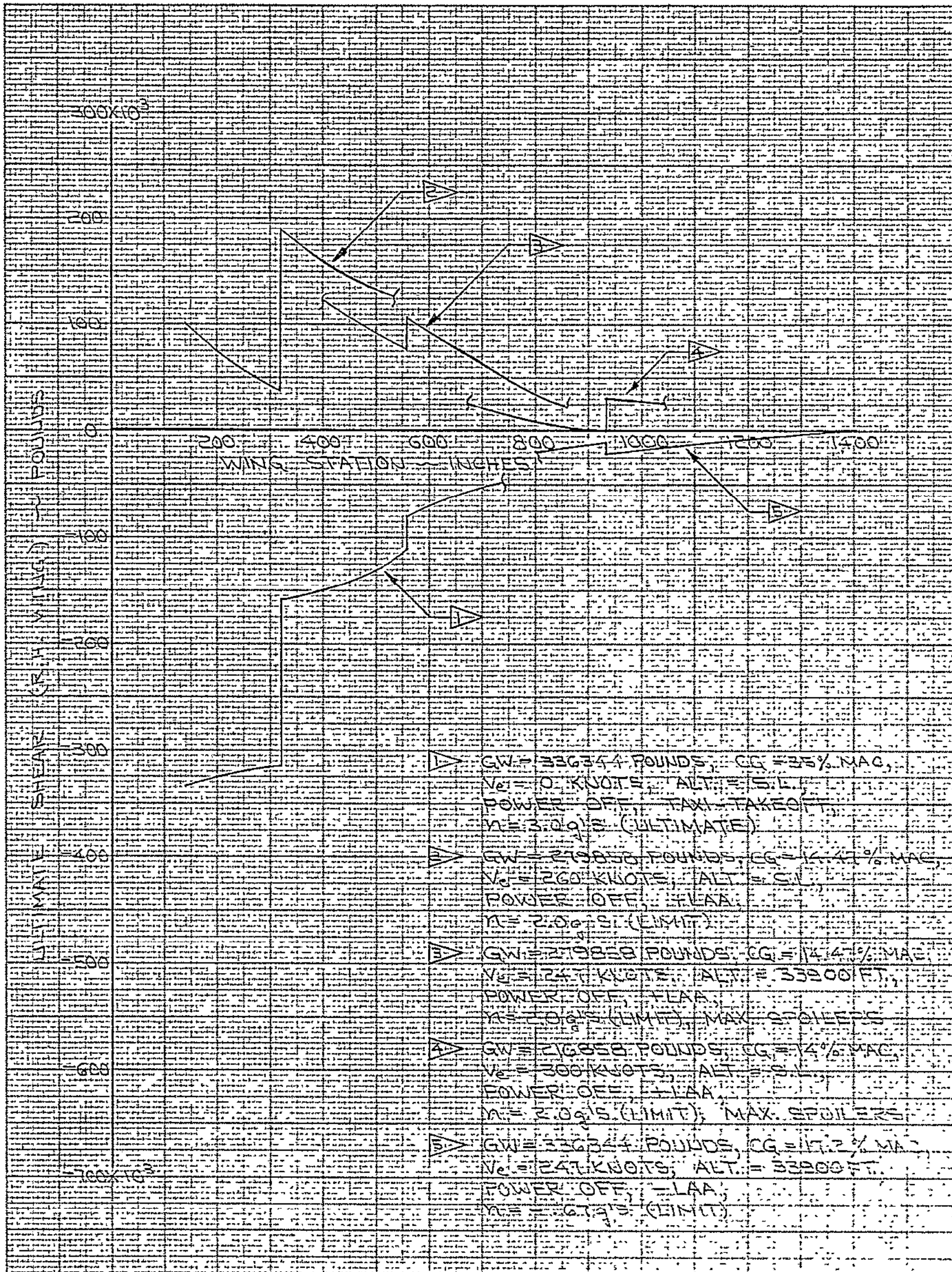
ULTIMATE WING TORSION FOR NEGATIVE
MOMENT ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 45



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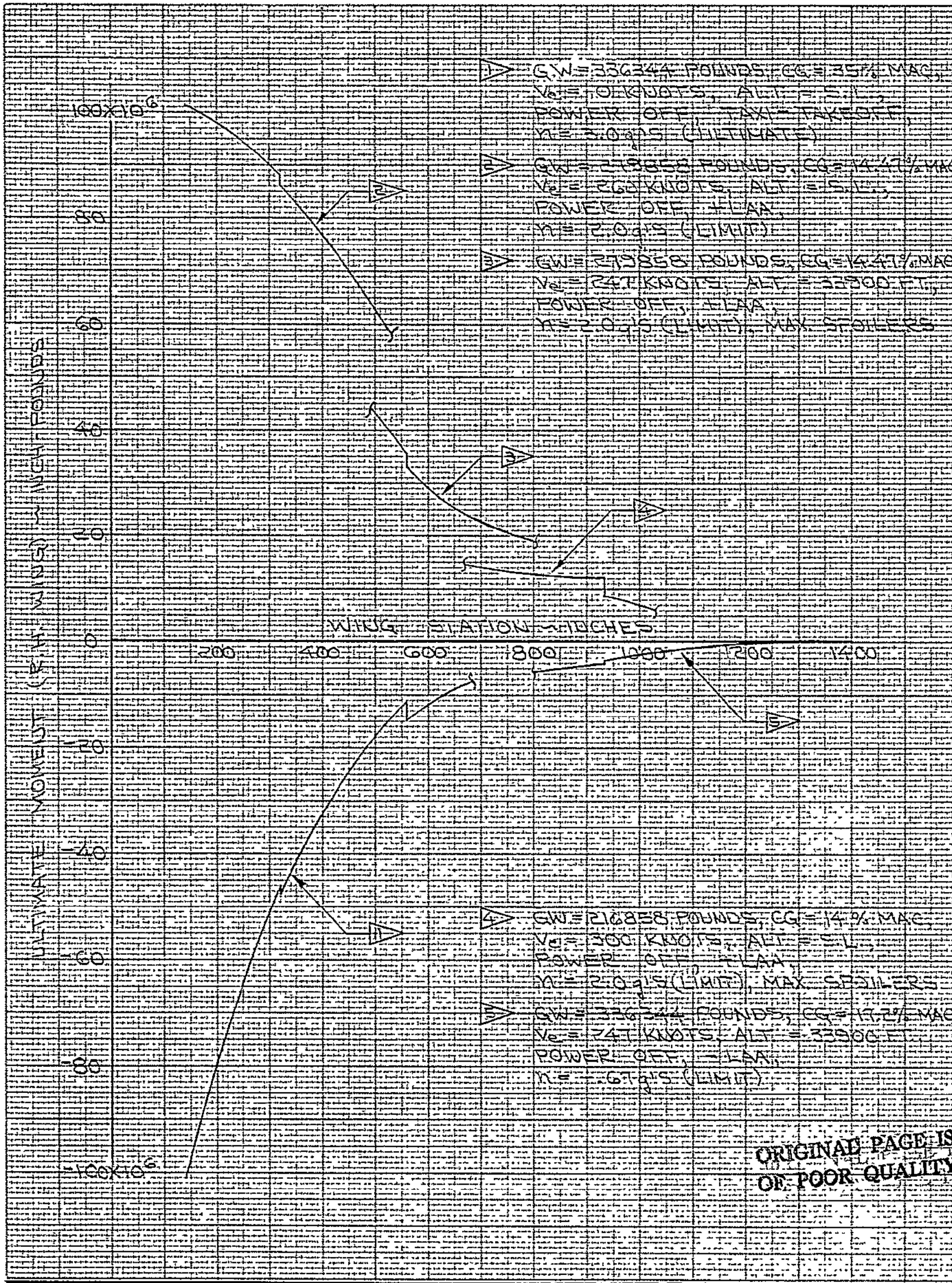
ULTIMATE WING SHEAR FOR NEGATIVE TORSION ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 46



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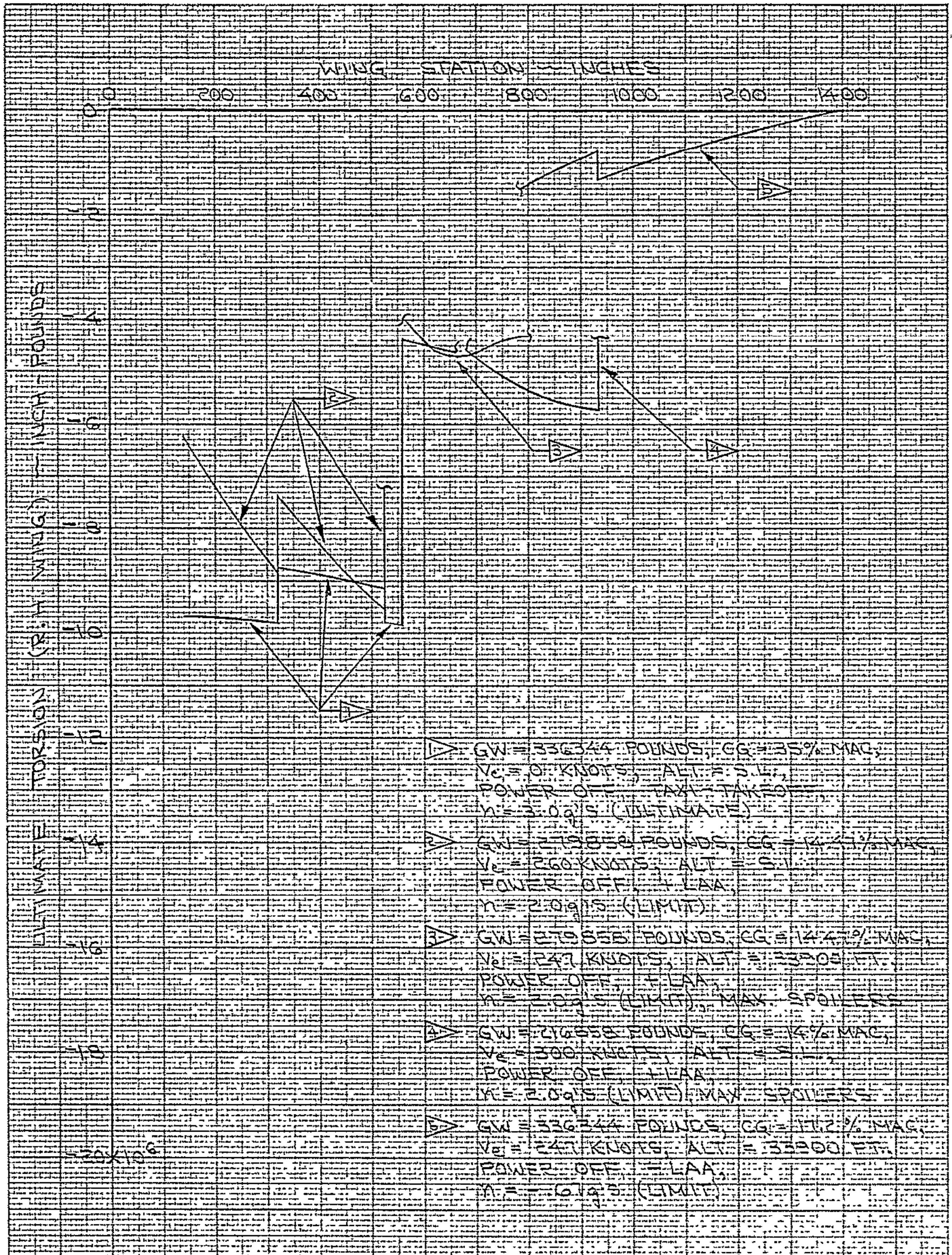
ULTIMATE WING MOMENT FOR NEGATIVE TORSION ENVELOPE - R. H. WING DTV CONFIGURATION 1 (WITH FINS)

FIGURE 47



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ULTIMATE WING TORSION FOR NEGATIVE
TORSION ENVELOPE - R. H. WING
DTV CONFIGURATION 1 (WITH FINS)

FIGURE 48

TABLE III

CRITICAL WING CENTER SECTION LOADS - ULTIMATE
(WING BUTTOCK LINE 55 - SIDE OF BODY)

CONDITION	$V_{Z_L} * 10^{-3}$ (POUNDS)	$M_{X_L} * 10^{-6}$ (INCH-LBS.)	$T_L * 10^{-6}$ (INCH-LBS.)	$V_{Z_R} * 10^{-3}$ (POUNDS)	$M_{X_R} * 10^{-6}$ (INCH-LBS.)	$T_R * 10^{-6}$ (INCH-LBS.)
B-52B/DTV CONFIGURATION 1 (WITH FINS)						
TAXI-TAKEOFF [1]	-262.712	-93.557	48.452	-335.835	-91.206	45.077
+HAA [2]	193.016	95.471	-55.434	118.229	100.065	-66.282
GUST [3]	187.589	69.450	-45.364	78.123	70.555	-50.226

[1] G.W. = 336,344 POUNDS, C.G. = 20.1% MAC, V_e = 0 KNOTS, ALT. = SEA LEVEL, POWER OFF, n = 3.0 g's (ULTIMATE)

[2] G.W. = 305,532 POUNDS, C.G. = 15.75% MAC, V_e = 194 KNOTS, ALT. = SEA LEVEL, POWER OFF, n = 2.0 g's (LIMIT)

[3] G.W. = 260,094 POUNDS, C.G. = 14% MAC, V_e = 247 KNOTS, ALT. = 33,900 FEET, POWER OFF, n = 2.03 g's (LIMIT)

TABLE IV

ULTIMATE GEAR LOADS
(3.0g TAXI-TAKEOFF)

		B-52B/DTV CONFIGURATION 1		
		POUNDS	POUNDS	POUNDS
AIRPLANE GROSS WEIGHT		336,344	336,344	336,344
CG IN PERCENT MAC		20.1	23	35
FRONT GEAR LOADS	F_L	232,818	226,597	201,738
	F_R	272,179	264,910	233,956
	D_L	0	0	0
	D_R	0	0	0
	S_L	0	0	0
	S_R	0	0	0
REAR GEAR LOADS	F_L	219,226	225,398	251,997
	F_R	256,289	263,507	292,241
	D_L	0	0	0
	D_R	0	0	0
	S_L	0	0	0
	S_R	0	0	0
TIP PROTECTION GEAR LOADS	F_L	16,100	16,150	16,280
	F_R	12,420	12,470	12,820
	D_L	0	0	0
	D_R	0	0	0
	S_L	0	0	0
	S_R	0	0	0

F - Vertical Force
D - Drag Force
S - Side Force

Sub L - Left
Sub R - Right

TABLE V

ULTIMATE GEAR LOADS

(GROUND TURN, n_z = 1.0 (LIMIT), n_y = .27 (LIMIT))

		B-52B/DTV CONFIGURATION 1 (WITH FINS)					
		GROUND TURN TO RIGHT			GROUND TURN TO LEFT		
		POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
AIRPLANE GROSS WEIGHT		336,344	336,344	336,344	336,344	336,344	336,344
CG IN PERCENT MAC		20.1	23	35	20.1	23	35
FRONT GEAR LOADS	F_L	173,250	168,000	146,250	74,037	72,089	66,658
	F_R	79,593	78,092	85,656	178,800	174,000	151,500
	D_L	0	0	0	0	0	0
	D_R	0	0	0	0	0	0
	S_L	46,361	44,945	39,077	-19,812	-19,285	-17,811
	S_R	21,298	20,892	19,216	-47,847	-46,551	-40,482
REAR GEAR LOADS	F_L	158,250	162,750	183,750	71,090	73,165	78,980
	F_R	76,589	78,840	71,918	163,800	168,450	190,500
	D_L	0	0	0	0	0	0
	D_R	0	0	0	0	0	0
	S_L	46,200	47,415	53,150	-20,750	-21,314	-22,839
	S_R	22,361	22,968	24,777	-47,811	-49,070	-55,088
TIP PROTECTION GEAR LOADS	F_L	16,834	16,834	16,942	0	0	0
	F_R	0	0	0	16,789	16,812	16,878
	D_L	0	0	0	0	0	0
	D_R	0	0	0	0	0	0
	S_L	3,367*	3,367*	3,388*	0	0	0
	S_R	0	0	0	-3,358*	-3,362*	-3,376*

*S_{TPG} = .2 F_{TPG} (REF. D-10754)

F - Vertical Force
D - Drag Force
S - Side Force

Sub L - Left
Sub R - Right

5.0 REFERENCES

1. No. R-1803-2B, "Basic Flight Criteria", Amendment No. 2, dated 17 June 1949.

2. Boeing Document D3-11220-1, "Load and Dynamic Assessment of B-52B-008 Carrier Aircraft for Configuration 1 and 2 Space Shuttle Solid Rocket Booster Decelerator Subsystem Drop Test Vehicles - Volume II, Airplane Flutter and Load Analysis Results", dated 24 October 1977.

3. NACA TN 3030, "A Method of Calculating the Subsonic Steady-State Load on an Airplane with a Wing of Arbitrary Plan Form and Stiffness", W.L. Gray and K.M. Schenk, dated December 1953.

4. Boeing Document D-10754, "External Loads Criteria, Volume I", dated 14 February 1951.