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**PRELIMINARY AIRWORTHINESS EVALUATION  
OV-1D AIRPLANE WITH AN/ALQ-147  
XE-1 AND XE-2 SYSTEMS INSTALLED**

**FINAL REPORT**

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**February 1978**

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**UNITED STATES ARMY AVIATION ENGINEERING FLIGHT ACTIVITY  
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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br><br>The United States Army Aviation Engineering Flight Activity conducted a Preliminary Airworthiness Evaluation of an OV-1D aircraft with various infrared countermeasures equipment installed from 15 September through 10 October 1977 at the Grumman flight test facility, Calverton, New York. Emphasis was placed on heavy weight, low speed handling qualities. During the |   |   |

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20. Abstract

test 27.4 hours of flight time were recorded in 18 flights. One deficiency was identified: inconsistent stall warning characteristics of the OV-1D/RV-1D airplane. Five shortcomings were noted: (1) inability to jettison the AN/ALQ-133 (Quick Look) antenna pods in the RV-1D configuration; (2) high rudder pedal force required during single-engine flight; (3) inconvenient location of the pilot intercom system control box; (4) annoying airframe buffet at load factors greater than 1.4 with the louvered scarfed shroud suppressor installed and; (5) inaccessible location of the remote circuit breaker panel. Four specification noncompliances were also noted during the evaluation. The installation of an angle-of-attack instrument and stall warning device in the OV-1D aircraft is recommended. Flight testing should be conducted to verify or correct the takeoff data published in the operator's manual for all altitudes and temperatures.

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DEPARTMENT OF THE ARMY  
HQ, US ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND  
P O BOX 209, ST. LOUIS, MO 63166

19 MAY 1979

DRDAV-EQ

SUBJECT: Preliminary Airworthiness Evaluation, OV-1D Airplane With  
AN/ALQ 147 XE-1 and XE-2 Systems Installed, Final Report,  
USAAEFA Project No. 77-22

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1. The purpose of this letter is to establish the Directorate for Development and Engineering's position on the subject report.

2. Specific comments by paragraph are:

a. Paragraph 31 - The inconsistent aerodynamic stall warning characteristics of the OV-1D/RV-1D airplane are recognized. Artificial angle of attack (AOA)/stall warning devices are available to correct the problem. This Directorate sent a letter to the Project Manager, Special Electronics Mission Aircraft on 27 April 1979 strongly urging the PM to establish a Product Improvement Program to incorporate an AOA/stall warning system. An AOA/stall warning system tested by USAAEFA, Project No. 78-19, is virtually qualified. Only component qualification efforts are required with qualification by similarity a likely possibility.

b. Paragraph 32a - Do not concur that the inability to jettison the Quick Look antenna pods is a shortcoming. The ability to jettison the AN/ALQ-133 pods was not a design requirement. Electronic alignment requirements are too stringent to allow attachment by the relatively flexible requirement for jettison capability.

c. Paragraph 32b - High rudder pedal forces during single engine flight are a transient situation occurring immediately following an engine failure. After normal engine failure "clean up" procedures are completed, rudder pedal forces can be reduced to zero for continued flight. This problem is thus considered only a nuisance problem that would require either a major redesign of the rudder system or incorporation of a rudder boost system. Neither of these alternatives are considered cost effective.

19 MAY 1979

DRDAV-EQ

SUBJECT: Preliminary Airworthiness Evaluation, OV-1D Airplane With  
AN/ALQ 147 XE-1 and XE-2 Systems Installed, Final Report,  
USAAEFA Project No. 77-22

d. Paragraph 32c and e - Locations of specific pieces of equipment are a function of space available. It is recognized that all equipment cannot be located in primary cockpit areas thus compromises are required. Since neither of these reported shortcomings have been reported as field problems, no corrective action is anticipated.

e. Paragraph 32d - Airframe buffet with the Louvered Scarfed Shroud Suppressor is considered a nuisance problem for which there is no easy solution. Incorporation of an AOA/stall warning system discussed above will eliminate any confusion between this buffet and aerodynamic pre-stall warning buffet.

f. Paragraph 37 - Take-off performance testing was conducted by AEFA which confirmed the operator's manual data (USAAEFA Report No. 78-07).

g. Paragraph 38 and 39 - Incorporation of normal accelerometer and speed brake-extended advisory light is being accomplished by an already approved Engineering Change Proposal.

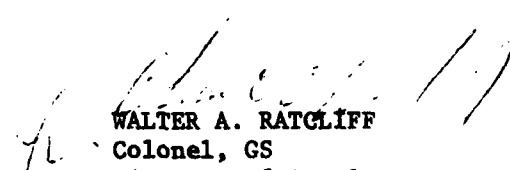
h. Paragraph 40 - Expansion of the RV-1D flight envelope to match the OV-1D envelope has been considered and has been determined not cost effective. Correction of aileron flutter with the AN/ALQ-133 pods above 300 knots would require an extensive evaluation, redesign and flight test program.

i. Paragraph 41 - Extensive field use of the OV-1 series aircraft has not uncovered a requirement for an external intercom station.

j. Paragraph 42 - No known requirement exists for 10,000 feet pressure altitude  $V_{MC}$  data.

k. Paragraph 43 and 44 - Action has been taken to incorporate the intent of these recommendations.

FOR THE COMMANDER:

  
WALTER A. RATCLIFF  
Colonel, GS  
Director of Development  
and Engineering

## **PREFACE**

Throughout the testing phase, the utmost cooperation and assistance were rendered by the personnel of Grumman Aerospace Corporation (GAC). The test vehicle was maintained and the test instrumentation supplied, calibrated and maintained by GAC. Special acknowledgement is given to the data reduction and photographic personnel of GAC for their timely and professional assistance.



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# INTRODUCTION

## BACKGROUND

1. The current production AN/ALQ-147 (HOT BRICK III) was developed as an infrared (IR) jammer for the OV-1D aircraft. A product improvement program resulted in the AN/ALQ-147 XE-1 version for the OV-1D and the AN/ALQ-147 XE-2 version to be utilized on the RV-1D, with eventual modification of the existing HOT BRICK III units to the AN/ALQ-147 XE-2 configuration. The AN/ALQ-147 XE-1 is carried on wing store stations 1 or 6 of the OV-1D, depending on the other external stores installed. The AN/ALQ-147 XE-2 is carried on station 4 of the RV-1D. On 8 July 1977 the United States Army Aviation Engineering Flight Activity (USAAEFA) was directed by the United States Army Aviation Research and Development Command (AVRADCOM) to conduct a Preliminary Airworthiness Evaluation (PAE) of the OV-1D with the AN/ALQ-147 XE-1 and XE-2 installed (ref 1, app A).

## TEST OBJECTIVES

2. The test objectives were to evaluate the handling qualities of the OV-1D in the following operational configurations:
- a. AN/ALQ-147 XE-1 installed on wing station 1 or 6.
  - b. AN/ALQ-147 XE-2 installed on wing station 4, and AN/ALQ-133 (Quick Look) antenna pods installed on wing stations 1 and 6.
  - c. AN/ALQ-147 XE-1 installed on wing station 6 with and without the louvered scarfed shroud suppressor (LSSS) installed on both engines.

## DESCRIPTION

3. The test aircraft was an OV-1D(C), SN 68-15932, which is a converted OV-1C. The OV-1D is a two-place mid wing observation aircraft equipped with two T53-L-701 Lycoming gas turbine engines. The RV-1D is similar to the OV-1D except that the airplane is equipped to carry the Quick Look antenna pods on wing stations 1 and 6. The AN/ALQ-147 XE-1 and XE-2 are IR countermeasures (IRCM) devices to be installed on the OV-1D or RV-1D, respectively. The LSSS is a passive IRCM device designed to reduce engine signatures. Appendix B gives a description of the AN/ALQ-147 XE-1 and XE-2 and describes the aircraft, wing station locations, and loading configurations. A more detailed description of the aircraft is contained in appendix B and the operator's manual (ref 2, app A).

### TEST SCOPE

4. The PAE consisted of a limited flying qualities evaluation of the OV-1D with and without the AN/ALQ-147 XE-1 and XE-2 installed. The flight tests were conducted at the Grumman Aerospace Corporation (GAC) facility at Calverton, New York, from 15 September through 10 October 1977. Eighteen test flights were conducted during 27.4 flight hours. GAC supplied aircraft maintenance on the chase and test OV-1 aircraft, instrumentation maintenance, fuel, test facility operation, data reduction, and plotting.

5. All flight testing was conducted under visual flight conditions and within the limits of the airworthiness release (ref 3, app A) and the operator's manual. The tests were conducted in the airplane configurations defined in table 1, at the conditions listed in table 2. Results of the test were compared with information in the operator's manual and were evaluated against the applicable requirements of military specification MIL-F-8785B(ASG) (ref 4).

Table 1. Airplane Configurations.

| Configuration  | Symbol | Landing Gear Position | Flap Setting (deg) | Power Setting <sup>1</sup> |
|----------------|--------|-----------------------|--------------------|----------------------------|
| Takeoff        | TO     | Down                  | 15                 | Note <sup>2</sup>          |
| Cruise         | CR     | Up                    | Zero               | PLF                        |
| Power approach | PA     | Down                  | 45                 | Note <sup>3</sup>          |
| Land           | L      | Down                  | 45                 | Flight-idle                |

<sup>1</sup> Propeller speed was as specified by the operator's manual.

<sup>2</sup> Military rated power for minimum-control airspeed ( $V_{MC}$ ) test, power for level flight (PLF) for other tests.

<sup>3</sup> Power for level flight at 1.2 landing stall speed ( $V_{SL}$ ) or normal approach airspeed, whichever is less.

Table 2. Test Conditions.<sup>1</sup>

| Wing Store Config No. | Test                                 | Airplane Configuration | Takeoff Gross Weight (lb) | Lateral Moment <sup>2</sup> (in.-lb) | Initial Trim Airspeed (KCAS) <sup>3</sup> | Remarks   |
|-----------------------|--------------------------------------|------------------------|---------------------------|--------------------------------------|---|---|
| 1                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 15,100                    | 15,300                               | 1.2V <sub>S</sub> <sup>5</sup>            | Clean airframe  |
|                       | V <sub>MC</sub> , both engines       | CR, TO, PA             |                           |                                      | Note <sup>6</sup>                         |   |
| 2                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 15,800                    | 19,600                               | 1.2V <sub>S</sub>                         | Airframe with AN/ALQ-133 on stations 1 and 6  |
| 3                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 18,300                    | 65,800                               | 1.2V <sub>S</sub>                         | Airframe with drop tank on station 3, XE-2 on station 4, AN/ALQ-133 on stations 1 and 6         |
|                       | V <sub>MC</sub> , both engines       | CR, TO, PA             |                           |                                      | Note <sup>6</sup>                         |   |
|                       | Control margins                      | CR                     | 17,300                    | 280,400                              | 190                                       |   |
|                       |                                      | TO, PA                 |                           |                                      | 150                                       |   |
|                       | Static lateral-directional stability | CR                     | 18,300                    | 65,800                               | 140 and 110                               |   |
| TO                    |                                      | 120 and 90             |                           |                                      |   |   |
| PA                    |                                      | 110 and 85             |                           |                                      |   |   |
| 4                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 18,200                    | -31,400                              | 1.2V <sub>S</sub>                         | Airframe with drop tanks on stations 3 and 4, XE-1 on station 1, SLAR <sup>7</sup> boom         |
|                       | V <sub>MC</sub> , both engines       | CR, TO, PA             |                           |                                      | Note <sup>6</sup>                         |   |
|                       | Control margins                      | CR                     | 17,200                    | -220,100                             | 190                                       |   |
|                       |                                      | TO, PA                 |                           |                                      | 150                                       |   |
|                       |                                      | CR                     |                           |                                      | 140 and 110                               |   |
|                       | Static lateral-directional stability | TO                     | 18,200                    | -31,400                              | 120 and 90                                |   |
| PA                    |                                      | 110 and 85             |                           |                                      |   |   |
| 5                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 18,300                    | 135,000                              | 1.2V <sub>S</sub>                         | Airframe with drop tanks on stations 3 and 4, SLAR boom, LS-59A on station 5, XE-1 on station 6 |
|                       | V <sub>MC</sub> , both engines       | CR, TO, PA             |                           |                                      | Note <sup>6</sup>                         |   |
|                       | Static lateral-directional stability | CR                     |                           |                                      | 140 and 110                               |   |
|                       |                                      | TO                     |                           |                                      | 120 and 90                                |   |
| PA                    |                                      | 110 and 85             |                           |                                      |   |   |
| 6                     | Stall characteristics <sup>4</sup>   | CR, TO, PA, L          | 18,300                    | 135,000                              | 1.2V <sub>S</sub>                         | Same as configuration 5 but with LSSS installed on both engines                                 |
|                       | Control margins                      | CR                     | 17,300                    | 301,500                              | 190                                       |   |
|                       |                                      | TO, PA                 |                           |                                      | 150                                       |   |

<sup>1</sup>All tests performed at aft center of gravity (cg) and approximately 10,000 feet pressure altitude.

<sup>2</sup>Right wing heavy is positive lateral moment; variable lateral moments for same configuration are due to fuel load.

<sup>3</sup>KCAS: Knots calibrated airspeed.

<sup>4</sup>Accelerated stalls were conducted at 2g in CR and 1.4g in TO and PA configurations with a trim airspeed of 140 KCAS for CR and 120 KCAS for TO and PA.

<sup>5</sup>V<sub>S</sub>: Stall airspeed obtained from operator's manual.

<sup>6</sup>Recommended takeoff trim settings for TO configuration. Trim settings for single-engine minimum trim airspeed with one engine at idle and propeller feathered for CR and PA configurations.

<sup>7</sup>SLAR: Sidelooking airborne radar.

## TEST METHODOLOGY

6. Engineering flight test techniques used during this evaluation are discussed in the Results and Discussion section and appendix D of this report. A Handling Qualities Rating Scale (HQRS) (app D) was used to augment pilot comments. Appendix C contains listings of the test instrumentation, the parameters recorded on magnetic tape, and those displayed on the pilot panel. The airspeed calibration and fuel cell calibration were supplied by GAC. The aircraft was weighed at the GAC weight and balance facility and witnessed by a USAAEFA representative.

## RESULTS AND DISCUSSION

### GENERAL

7. The handling qualities of the OV-1D/RV-1D aircraft were evaluated in various configurations and with different IRCM equipment installed. Emphasis was placed on the low speed, high gross weight regime. Test configurations and conditions are defined in tables 1 and 2. Handling qualities tests included static lateral-directional stability, control margins and trimmability with high asymmetric wing loads, stall characteristics, and single-engine airspeed for minimum control (VMC). The handling qualities of the OV-1D/RV-1D as tested with either the AN/ALQ-147 XE-1 or XE-2 carriage are similar to the OV-1D as described in previous reports (refs 5, 6, and 7, app A) and the operator's manual. One deficiency was identified during the test: inconsistent stall warning characteristics of the OV-1D/RV-1D airplane. Five shortcomings were identified: (1) inability to jettison the Quick Look antenna pods in the RV-1D configuration; (2) high rudder pedal force required during single-engine flight; (3) inconvenient location of the pilot intercom system control box; (4) annoying airframe buffet at load factors greater than 1.4 with the LSSS installed; and (5) inaccessible location of the remote circuit breaker panel. Four specification noncompliances were also noted. The most significant recommendation is the installation in the cockpit of an angle-of-attack instrument and a stall warning device capable of cueing the pilot of impending stall even while the pilot's attention is focused outside the cockpit.

### HANDLING QUALITIES

#### Control Margins and Trimmability

8. Control margins and trimmability were evaluated at the conditions listed in table 2 to determine the minimum trim airspeed and lateral control margin for maximum asymmetry in the different configurations. The test was conducted by trimming the aircraft in ball-centered level flight at various airspeeds and noting trim and control positions. The asymmetric load was induced by wing store configuration and transferring fuel in flight from one drop tank into the main fuel tank to create the maximum unbalanced condition.

9. Control position and trim wheel position data are presented in figures 1 through 6, appendix E. The data for the maximum lateral moment are presented in figures 5 and 6 and were obtained with the AN/ALQ-147 XE-1 on wing station 6, the LS-59 on wing station 5, full fuel in the drop tank on wing station 4, the SLAR boom on the fuselage, and an empty fuel tank on wing station 3. The load imbalance was approximately 1500 pounds, generating a lateral moment of almost 302,000 in.-lb. Minimum trim airspeed in the CR configuration for this wing loading was 160 KCAS (fig 5) which is slightly higher than previous USAAEFA data (ref 5, app A). In the TO configuration full lateral trim was

inadequate at all airspeeds tested (fig. 6, app E). In the PA configuration minimum trim airspeed was 135 KCAS, which agrees with previous USAAEFA data (ref 5).

10. After determining the minimum trim airspeed, airspeed was reduced until reaching a control limit or until reaching operator's manual  $V_S$  plus 5 knots. In the CR configuration the flight envelope was limited by lateral control authority at approximately 100 KCAS, which was approximately 17 KCAS above operator's manual  $V_S$ . Approximately 12 percent lateral control margin was available at 80 KCAS in the TO configuration.

11. With high asymmetric wing loads the lack of lateral trim authority defined the minimum trim airspeed. Lateral control authority was adequate at airspeeds above 100 KCAS in the CR configuration and at airspeeds above 80 KCAS in the TO and PA configurations. Within the scope of this test, the control margins and trimmability of the OV-1D/RV-1D were satisfactory.

#### Static Lateral-Directional Stability

12. Static lateral-directional stability tests were performed in the wing store configurations and airplane configurations listed in table 2. The tests were conducted by trimming the aircraft (zero sideslip) at the airspeeds defined in table 2. Steady-heading sideslips of 5, 10, and 15 degrees to the left and right were conducted. Test results are presented in figures 7 through 18, appendix E, and are essentially unchanged from previous evaluations (refs, 5, 6, and 7, app A). Dihedral effect and side-force characteristics were positive and essentially linear, and provided good cues to the pilot of out-of-trim flight conditions. Pedal forces were approximately linear from 5 degrees left to 10 degrees right sideslip. However, beyond 10 degrees sideslip in either direction considerable pedal force lightening was observed, especially when the drop tanks and the Quick Look antenna pods were installed (fig. 9, app E). This rudder lightening increased the pilot effort required to establish and maintain a steady-heading sideslip (HORS 4). Within the scope of this test, the static lateral-directional stability of the OV-1D/RV-1D aircraft is satisfactory.

#### Stall Characteristics

13. Stall characteristics were evaluated in the wing store configurations and airplane configurations indicated in table 2. The aircraft was trimmed in ball-centered level flight at approximately  $1.2V_S$  for the 1g stalls, 140 KCAS for the 60-degree bank (2g) stalls, and 120 KCAS for the 45-degree bank (1.4g) stalls. Airspeed was then slowly decreased at approximately 1 knot per second or less until achieving a stall. Stall warning was defined by airframe buffet, aileron feedback, and/or roll oscillations. Stalls were characterized by a nose-down pitching motion, a left or right wing roll-off, or a combination of the two. Control effectiveness about all three axes during approach to the stall was good.



14. Stall test conditions and characteristics in the CR, TO, PA, and L configurations are summarized in tables 3, 4, 5, and 6, respectively. Time history data are presented in figures 19 through 49, appendix E. Stall warning margin in the CR configuration varied from 3 to 33 knots, and in the TO configuration it varied from zero to 7 knots. Stall warning margin varied from zero to 9 knots in the PA configuration, and zero to 5 knots in the L configuration. These inconsistent stall warning margins were confusing to the pilot and reduced his confidence in the aircraft in the low-speed flight regime. Stall warning with the LSSS installed was characterized by the rapid onset of a moderate buffet from 15 to 30 knots above  $V_S$  during a 1g stall. This buffet masked whatever inconsistent stall warning the OV-1D/RV-1D had. The inconsistent stall warning characteristics of the OV-1D/RV-1D airplane are a deficiency.

15. Stall characteristics and recoveries were essentially comparable to previous evaluations, except for the post-stall activity and on the RV-1D, some lateral control activity which occasionally occurred just prior to stall. Several moderate to rapid right wing roll-offs were observed, regardless of the aircraft wing store configuration (figs. 21 and 25, app E). These right wing roll-offs were probably due, at least in part, to some amount of inherent left sideslip in ball-centered flight.

16. In the CR configuration, stall airspeeds varied greatly from approximately 79 to 134 KCAS; however, angle of attack only varied from 20.0 to 24.0 degrees, regardless of the type of stall (table 3). In the TO configuration, stall airspeeds varied from 72 to 97 KCAS, although angle of attack only varied 3.5 degrees, from 20.5 to 24.0 degrees (table 4). PA configuration (table 5) stall airspeeds varied from 65 to 88 KCAS; however, the angle of attack at stall only varied 2.5 degrees, from 21.5 to 24.0 degrees. Although less than a dozen L configuration stalls were conducted, stall airspeeds varied from 74 to 82 KCAS, but the angle of attack at stall only varied 1 degree, from 22.5 to 23.5 degrees (table 6). In summary, stall airspeeds ranged from 65 to 134 KCAS, but stall angle of attack only varied by  $\pm 2$  degrees, from 20 to 24 degrees, regardless of the airplane or wing store configuration, gross weight, load factor, pilot technique, or mission equipment installed.

17. The OV-1D/RV-1D airplane failed to meet the requirements of the following paragraphs of MIL-F-8785B (ASG):

a. Paragraph 3.4.1.1 - The OV-1D/RV-1D did not have a clear and unambiguous warning of approach to a dangerous condition.

b. Paragraph 3.4.2.1.1 - The OV-1D/RV-1D did not have an easily perceptible warning of approaching stall.

c. Paragraph 3.4.2.1.1.1 - The OV-1D/RV-1D did not have the required stall warning margin.

To improve the operational capability and safety of the OV-1D/RV-1D airplane, the inconsistent stall warning characteristics should be corrected immediately. An

Table 3. Stall Test Conditions and Characteristics<sup>1</sup>

Cruise Configuration

| Config No. | Gross Weight (lb) | Bank Angle (deg) | Stall Warning Margin Calibrated Airspeed (kt) | Stall Calibrated Airspeed (kt) | Indicated Angle of Attack (deg) |
|------------|-------------------|------------------|---|--------------------------------|---------------------------------|
| 1          | 14,840            | Zero             | 17  | 79                             | 22.0                            |
| 1          | 14,540            | 60 left          | 26  | 112                            | 22.0                            |
| 1          | 14,500            | 60 right         | 33  | 107                            | 22.0                            |
| 2          | 15,600            | Zero             | 3   | 82                             | 22.0                            |
| 2          | 15,170            | 60 left          | 18  | 120                            | 20.0                            |
| 3          | 18,200            | Zero             | 19  | 87                             | 22.0                            |
| 3          | 17,810            | 60 left          | 19  | 122                            | 20.0                            |
| 3          | 17,590            | 60 right         | 3   | 127                            | 24.0                            |
| 4          | 18,090            | Zero             | 30  | 86                             | 22.0                            |
| 4          | 17,990            | Zero             | 17  | 85                             | 23.0                            |
| 4          | 17,130            | 60 left          | 4   | 127                            | 20.0                            |
| 4          | 17,060            | 60 right         | 6   | 126                            | 22.0                            |
| 5          | 18,110            | Zero             | 8   | 85                             | 24.0                            |
| 5          | 17,880            | 60 left          | 16  | 112                            | 23.0                            |
| 5          | 17,810            | 60 right         | 5   | 134                            | 21.0                            |
| 6          | 18,100            | Zero             | 23  | 83                             | 23.0                            |
| 6          | 17,430            | 60 left          | 22  | 120                            | 23.0                            |

<sup>1</sup>60-degree bank angle: approximately 2.0g.

Table 4. Stall Test Conditions and Characteristics<sup>1</sup>

Takeoff Configuration

| Config No. | Gross Weight (lb) | Bank Angle (deg) | Stall Warning Margin Calibrated Airspeed (kt) | Stall Calibrated Airspeed (kt) | Indicated Angle of Attack (deg) |
|------------|-------------------|------------------|---|--------------------------------|---------------------------------|
| 1          | 14,750            | Zero             | 5   | 72                             | 22.0                            |
| 1          | 14,420            | 45 left          | 3   | 90                             | 21.0                            |
| 1          | 14,360            | 45 right         | 7   | 81                             | 21.0                            |
| 2          | 15,540            | Zero             | 3   | 74                             | 21.5                            |
| 2          | 15,010            | 45 right         | 1   | 83                             | 21.5                            |
| 3          | 18,170            | Zero             | 6   | 81                             | 20.5                            |
| 3          | 17,380            | 45 left          | 2   | 97                             | 21.5                            |
| 3          | 17,240            | 45 right         | 2   | 92                             | 22.0                            |
| 4          | 17,880            | Zero             | 1   | 79                             | 23.0                            |
| 4          | 17,780            | Zero             | 1   | 79                             | 23.5                            |
| 4          | 16,900            | 45 left          | 3   | 89                             | 23.5                            |
| 4          | 16,710            | 45 right         | 7   | 88                             | 22.0                            |
| 5          | 18,040            | Zero             | 1   | 77                             | 23.0                            |
| 5          | 17,720            | 45 left          | 7   | 88                             | 24.0                            |
| 5          | 17,610            | 45 right         | 5   | 91                             | 22.5                            |
| 6          | 18,010            | Zero             | 0   | 78                             | 24.0                            |
| 6          | 17,080            | 45 left          | 0   | 92                             | 22.0                            |
| 6          | 16,740            | 45 right         | 0   | 89                             | 23.0                            |

<sup>1</sup>45-degree bank angle: approximately 1.4g.

Table 5. Stall Test Conditions and Characteristics<sup>1</sup>

Power Approach Configuration

| Config No. | Gross Weight (lb) | Bank Angle (deg) | Stall Warning Margin Calibrated Airspeed (kt) | Stall Calibrated Airspeed (kt) | Indicated Angle of Attack (deg) |
|------------|-------------------|------------------|---|--------------------------------|---------------------------------|
| 1          | 14,700            | Zero             | 0   | 65                             | 23.0                            |
| 1          | 14,310            | 45 left          | 0   | 79                             | 22.0                            |
| 1          | 14,220            | 45 right         | 0   | 74                             | 23.0                            |
| 2          | 15,450            | Zero             | 3   | 67                             | 22.5                            |
| 2          | 14,940            | 45 left          | 6   | 81                             | 22.0                            |
| 2          | 14,830            | 45 right         | 3   | 80                             | 21.5                            |
| 3          | 18,040            | Zero             | 3   | 75                             | 23.0                            |
| 3          | 17,160            | 45 left          | 0   | 88                             | 22.0                            |
| 3          | 16,730            | 45 right         | 9   | 79                             | 22.0                            |
| 4          | 17,740            | Zero             | 3   | 72                             | 24.0                            |
| 4          | 17,690            | Zero             | 4   | 72                             | 24.0                            |
| 4          | 16,680            | 45 left          | 7   | 85                             | 23.0                            |
| 4          | 16,620            | 45 right         | 9   | 82                             | 22.0                            |
| 5          | 17,970            | Zero             | 3   | 73                             | 23.0                            |
| 5          | 17,510            | 45 left          | 7   | 87                             | 22.5                            |
| 5          | 17,410            | 45 right         | 7   | 87                             | 22.0                            |
| 6          | 17,940            | Zero             | 7   | 71                             | 23.5                            |
| 6          | 16,590            | 45 left          | 0   | 88                             | 22.0                            |
| 6          | 16,540            | 45 right         | 0   | 82                             | 23.0                            |

<sup>1</sup>45-degree bank angle: approximately 1.4g.

Table 6. Stall Test Conditions and Characteristics

Landing Configuration

| Config No. | Gross Weight (lb) | Bank Angle (deg) | Stall Warning Margin Calibrated Airspeed (kt) | Stall Calibrated Airspeed (kt) | Indicated Angle of Attack (deg) |
|------------|-------------------|------------------|---|--------------------------------|---------------------------------|
| 1          | 14,600            | Zero             | 0   | 75                             | 23.0                            |
| 2          | 15,360            | Zero             | 0   | 74                             | 23.0                            |
| 3          | 17,820            | Zero             | 3   | 82                             | 23.5                            |
| 4          | 17,480            | Zero             | 4   | 81                             | 23.5                            |
| 4          | 17,420            | Zero             | 5   | 79                             | 23.5                            |
| 5          | 17,880            | Zero             | 3   | 82                             | 22.5                            |
| 6          | 17,550            | Zero             | 4   | 82                             | 23.0                            |

angle of attack instrument and a stall warning device, capable of cueing the pilot of impending stall even while the pilot's attention is focused outside the cockpit, should be installed.

#### Single-Engine Minimum-Control Airspeed

18. VMC was evaluated in the wing store configurations and airplane configurations indicated in table 2. This test was conducted by placing the appropriate engine power lever in ground-idle and then using the auto-feather system to feather the propeller. The aircraft was then trimmed at the minimum trim airspeed. After trimming, airspeed was decreased while maintaining a constant heading and bank angle until loss of control or stall limited further decrease. This procedure allowed the sideslip angle to vary during the VMC test. When conducting the VMC test in the TO configuration, the aircraft was retrimmed to the trim settings recommended for takeoff in the operator's manual before the VMC test was performed.

19. Single-engine VMC data are presented in figures 50 through 61, appendix E. Limited lateral control authority defined VMC except for two cases. Occasionally, VMC in the PA configuration was defined by stall, and in wing store configuration 5 with the flaps extended and the left propeller feathered, VMC was defined by limited pedal authority (fig. 60). The limited pedal VMC occurred with the right-wing-heavy loading configuration. The critical engine (engine which causes the highest VMC) was the left engine, except in wing store configuration 5. In this configuration with the heavy right wing, the right engine became the critical engine. In all heavy-weight, flaps-down configurations the aircraft was very near the stall angle of attack at VMC.

20. High pedal forces were observed in the single-engine flight regime. In the TO configuration, with recommended TO trim, pedal forces up to approximately 275 pounds (fig. 55, app E) were experienced. High rudder pedal force required during single-engine flight is a shortcoming, and fails to meet the requirements of paragraph 3.3.9.2 of MIL-F-8785B(ASG).

21. The VMC data generated during this test agreed with or showed GAC data to be conservative. Data published in the operator's manual do not include 10,000-foot pressure altitude information and therefore it was not possible to compare test data with published data in the operator's manual. Within the scope of this evaluation the data generated by GAC for 10,000 feet pressure altitude appear to be reliable and conservative, and should be incorporated in the operator's manual.

#### Takeoff Characteristics

22. Takeoffs and landings were performed with high asymmetric wing loads. The maximum out-of-balance condition evaluated was with the SLAR boom installed plus 400 pounds more fuel in the right drop tank than the left, plus a 243-pound

LS-59 flasher on wing station 5, and a 242-pound AN/ALQ-147 XE-1 on wing station 6, plus the aircraft's inherent lateral moment. This loading produced approximately 198,400 in.-lb of lateral moment. Landings and takeoffs were conducted in light wind conditions and the pilot reported little difficulty in controlling the aircraft (HQRS 3). The crosswind limit defined in the operator's manual for takeoff with other than drop tanks is 15 knots. With a high asymmetric load the 15-knot limit would be conservative if the crosswind was from the heavy wing side but very optimistic if from the light wing side. The following NOTE should be added to Figure 14-10 of the operator's manual (app F):

#### NOTE

When landing or taking off in a crosswind with asymmetric wing stores, it is recommended that, when feasible, the aircraft be positioned such that the heavy wing is upwind.

The recommended trim setting in the operator's manual (5 degrees right aileron, 5 degrees right rudder, and 1 degree down elevator) created high lateral control forces during takeoff with a high asymmetrical wing load. The recommended trim for takeoff should be retained for operations with symmetrical loads, but the following NOTE is recommended for inclusion in Chapter 3, "Before Takeoff Check," of the operator's manual (app F):

#### NOTE

With right-wing-heavy loading configurations, the recommended lateral trim for takeoff may vary from 5 degrees right aileron to 3 degrees left aileron, depending on the severity of the unbalanced condition.

23. During takeoff characteristics tests, the takeoff ground roll was estimated for near sea-level, standard-day conditions. High altitude and high temperature takeoff performance tests have not been conducted on the OV-1D. Flight testing should be conducted to verify or correct the takeoff data published in the operator's manual for all altitudes and temperatures.

#### MISCELLANEOUS

24. The OV-1 test aircraft was flown with the LSSS installed on the engines. The aircraft was trimmed in ball-centered level flight at 140 knots indicated airspeed (KIAS) in the CR configuration and 120 KIAS in the CR and TO configurations to evaluate maneuvering characteristics. Any level turn in excess of 45 degrees bank or g loading greater than 1.4 caused the aircraft to buffet. Annoying airframe buffet at load factors greater than 1.4 with the LSSS installed is a shortcoming.

25. The test program included flights in the RV-1D configuration (wing store configurations 2 and 3). With the Quick Look antennas installed on wing stations

1 and 6, the aircraft is restricted to 300 knots or 0.6 mach. Since this is a high-altitude mission configuration, this airspeed limitation severely restricts the aircraft's dive and evasive maneuver capability and therefore reduces its survivability in a hostile environment. Consideration should be given to expanding the flight envelope of the RV-1D to match the flight envelope of the OV-1D. The antenna pods mounted on wing stations 1 and 6 weigh approximately 350 pounds each and create considerable drag. These pods are nonjettisonable and reduce the single-engine performance and maneuver capability of the RV-1D. The inability to jettison the Quick Look antenna pods in the RV-1D configuration is a shortcoming.

26. A cockpit evaluation was conducted during the PAE. The pilot intercom control box was found to be in an inconvenient and vertigo-inducing location. The control box is located on the center radio console to the right rear of the pilot. The pilot must look down and under his raised right arm to see the panel and its control switches. The inconvenient location of the pilot intercom control box is a shortcoming. The remote circuit breaker panel located in the left aft equipment compartment contains circuit breakers which control interior and exterior lights, radios, and mission-related electrical equipment which may be required in flight. The inaccessible location of the remote circuit breaker panel is a shortcoming. It is possible for the pilot to have the speed brakes extended and not realize it. Twice during the program test points were almost flown with the speed brake extended. A radio call from the chase aircraft prevented this from happening. A speed brake-extended warning device should be installed in the cockpit. The flight envelope of the OV-1 is partially defined by acceleration limits, yet there is no accelerometer in the cockpit. An accelerometer should be installed in the cockpit of the OV-1D/RV-1D aircraft.

27. Checklist procedures call for starting engines with the ground power unit (GPU) connected to the aircraft and the aft equipment doors open. After starting engine(s) the GPU is disconnected and equipment doors are closed while engines are running and propellers turning. The flight crew does not have communication with the ground personnel working around the aircraft. Consideration should be given to installing an external communications panel on the aircraft to enable the ground crew to have direct verbal contact with the flight crew.

28. There are two aft cg limits for the OV-1D: 31 percent mean aerodynamic chord (MAC) without the SLAR; 29.3 percent MAC with the SLAR. These limits are defined in Chapter 7 of the operator's manual. However, nowhere in Chapter 12 (Weight and Balance Computation) is the reason for two aft cg limits explained. The following NOTE should be added to sheet 15, Chart E of Figure 12-2, Chapter 12 of the operator's manual (app F):

**NOTE**

Aft cg limit without SLAR is 31 percent MAC. Aft cg limit with SLAR is 29.3 percent MAC.



29. The procedure for engine failure presented in Chapter 4 of the operator's manual lists "power - as required" for Step 2. Operating the engine at less than full propeller speed reduces the power available. The following NOTE should be incorporated into Chapter 4 of the operator's manual to impress upon the pilot that if maximum power is required to maintain controlled flight the propeller control lever should be in the maximum rpm position (app. F):

**NOTE**

If maximum power available is required to maintain flight the operating propeller lever should be set at MAX RPM.

## **CONCLUSIONS**

### **GENERAL**

30. Within the scope of this test the handling qualities of the RV-1D/OV-1D with the AN/ALQ-147 XE-1 or XE-2 are essentially unchanged from those described in the operator's manual. With the LSSS installed an annoying buffet was experienced at airspeeds as much as 30 knots above stall airspeed. This buffet masks whatever inconsistent stall warning the OV-1D/RV-1D has. The handling qualities of the RV-1D are essentially the same as the OV-1D except for some lateral control activity occasionally observed just prior to stall. One deficiency and five shortcomings were identified.

### **DEFICIENCY AND SHORTCOMINGS**

31. The following deficiency was identified: inconsistent stall warning characteristics of the OV-1D/RV-1D airplane (para 14).

32. The following shortcomings were noted:

- a. Inability to jettison the Quick Look antenna pods in the RV-1D configuration (para 25).
- b. High rudder pedal force required during single-engine flight (para 20).
- c. Inconvenient location of the pilot intercom control box (para 26).
- d. Annoying airframe buffet at load factors greater than 1.4 with LSSS installed (para 24).
- e. Inaccessible location of the remote circuit breaker panel (para 26).

### **SPECIFICATION COMPLIANCE**

33. Within the scope of this test the OV-1D/RV-1D airplane failed to meet the requirements of the following paragraphs of MIL-F-8785B(ASG): 3.3.9.2 (para 20), 3.4.1.1 (para 17), 3.4.2.1.1 (para 17), and 3.4.2.1.1.1 (para 17).

## RECOMMENDATIONS

34. The inconsistent stall warning characteristics of the OV-1D should be corrected immediately (para 17).
35. Install in the cockpit an angle-of-attack instrument and a stall warning device capable of cueing the pilot of impending stall even while the pilot's attention is focused outside the cockpit (para 17).
36. Correct the shortcomings as soon as practical.
37. Conduct flight testing to verify or correct the takeoff data published in the operator's manual for all altitudes and temperatures (para 23).
38. Install a normal acceleration indicator in the cockpit (para 26).
39. Install a speed brake-extended warning device in the cockpit (para 26).
40. Consider expanding the RV-1D flight envelope to match the OV-1D flight envelope (para 25).
41. Consider installing an external communications panel to enable ground personnel to communicate with the flight crew (para 27).
42. Incorporate 10,000 feet pressure altitude  $V_{MC}$  data into the operator's manual (para 21).
43. The following NOTE should be added to Figure 14-10, "Crosswind Landing Chart," of the operator's manual (para 22):

### NOTE

When landing or taking off in a crosswind with asymmetric wing stores, it is recommended that when feasible, the aircraft be positioned such that the heavy wing is upwind.

44. The following NOTE should be added to the "before takeoff" check in Chapter 3 of the operator's manual (para 22):

### NOTE

With right-wing-heavy loading configurations, the recommended lateral trim for takeoff may vary from 5 degrees right aileron to 3 degrees left aileron, depending on the severity of the unbalanced condition.

45. The following NOTE should be added to Figure 12-2, Chart E, "Center of Gravity Table," of the operator's manual (para 28):

**NOTE**

Aft cg limit without SLAR is 31 percent MAC. Aft cg limit with SLAR is 29.3 percent MAC.

46. The following NOTE should be added to single-engine emergency procedures in Chapter 4 of the operator's manual (para 29):

**NOTE**

If maximum power available is required to maintain flight the operating propeller lever should be set at MAX RPM.

## APPENDIX A. REFERENCES

1. Letter, AVRADCOM, DRDAV-EQI, 8 July 1977, subject: Test request for OV-1D/HOT BRICK XE-1 and XE-2 evaluation.
2. Technical Manual, TM 55-1510-204-10/5, *Operator's Manual, OV-1D Aircraft*, 29 August 1975.
3. Letter, AVRADCOM, DRDAV-EQI, 8 Sept 1977, subject: Airworthiness Release for USAARADCOM/USAAEFA Project No. 77-22.
4. Military Specification, MIL-F-8785B(ASG), *Flying Qualities of Piloted Airplanes*, 7 August 1969, with interim amendments.
5. Final Report, USAAEFA, Project No. 74-20, *HOT BRICK III Airworthiness Evaluation, OV-1D Airplane*, November 1974.
6. Final Report, US Army Aviation Systems Test Activity (USAASTA), Project No. 68-43, *Army Preliminary Evaluation, Preproduction OV-1D*, March 1970.
7. Final Report, USAASTA, Project No. 70-03, *Army Preliminary Evaluation II, Production OV-1D*, March 1971.

## APPENDIX B. DESCRIPTION

1. The test aircraft was an OV-1D(C) converted C model, SN 68-15932. The following modifications were made to the C model to convert it to a D model: improved main landing gear; electrical conduits and wiring in the wing panels; two additional equipment bay doors on the fuselage; new SLAR attachment fittings and shelves; belly pod for KA-60 camera; T53-L-701 engines in lieu of T53-L-15's; updated propeller controls; reinforced wing attachment fittings; and reinforced wing panels. In addition, this aircraft had the RV modification performed at the GAC Bethpage plant. This modification required the wing skin in the vicinity of wing store stations 1 and 6 to be peeled back and the attachment points for store stations 1 and 6 reinforced. The wing skin was then replaced. This modification provided for carriage of the AN/ALQ-133 (Quick Look) antennas on wing store stations 1 and 6. The stores carried during the flight test were not operational; however, they had the same weight distribution and aerodynamic characteristics as the operational items.

2. The OV-1D is designed to carry external wing stores at six locations, as shown in figure 1. The store locations are identified by numbers 1 to 6, starting at the aircraft's left wing tip.

3. The basic weight of the test aircraft, with trapped fuel, was 12,436 pounds. The longitudinal moment was 2,034,527 in.-lb and the lateral moment was 15,309 in.-lb. The aircraft had Aero 15 racks on stations 1, 5, and 6 and Aero 65A racks on stations 3 and 4.

4. Full control travel on the test aircraft was as follows: Elevator up 25 degrees, and down 14.6 degrees; center rudder left 23.5 degrees, and right 23.5 degrees; right aileron down 74.8 degrees, and up 25.5 degrees. Full trim limits were elevator nose-down 6.8 degrees, and nose-up 4.95 degrees; rudder trim right 16.5 degrees and left 15.0 degrees; aileron left 14.7 degrees and right 14.8 degrees.

5. The HOT BRICK system is an open loop infrared countermeasures (IRCM) set utilizing a mechanically-mounted IR source. The IR source consists of a ceramic radiating element heated by the combustion of JP-4 fuel. The IR transmitter assembly is coupled with a modulator assembly and is mounted on a modified 150-gallon jettisonable fuel tank in the present production version (fig. 2) and in the XE-2 version (fig. 3). The XE-1 version (fig. 4) is an independent pod designed to be mounted on wing stations 1 or 6, depending on other external stores carried. The XE-1 is to be used on the OV-1D and the XE-2 is to be used on the RV-1D.

6. The AN/ALQ-133 (Quick Look System) includes two large antenna pods carried on wing stations 1 and 6, plus various internal electrical packages. The antenna pods weigh 345 and 363 pounds left and right, respectively; both measure 20 inches high by 12 inches wide by 120 inches long (photo 1). These pods are not jettisonable.

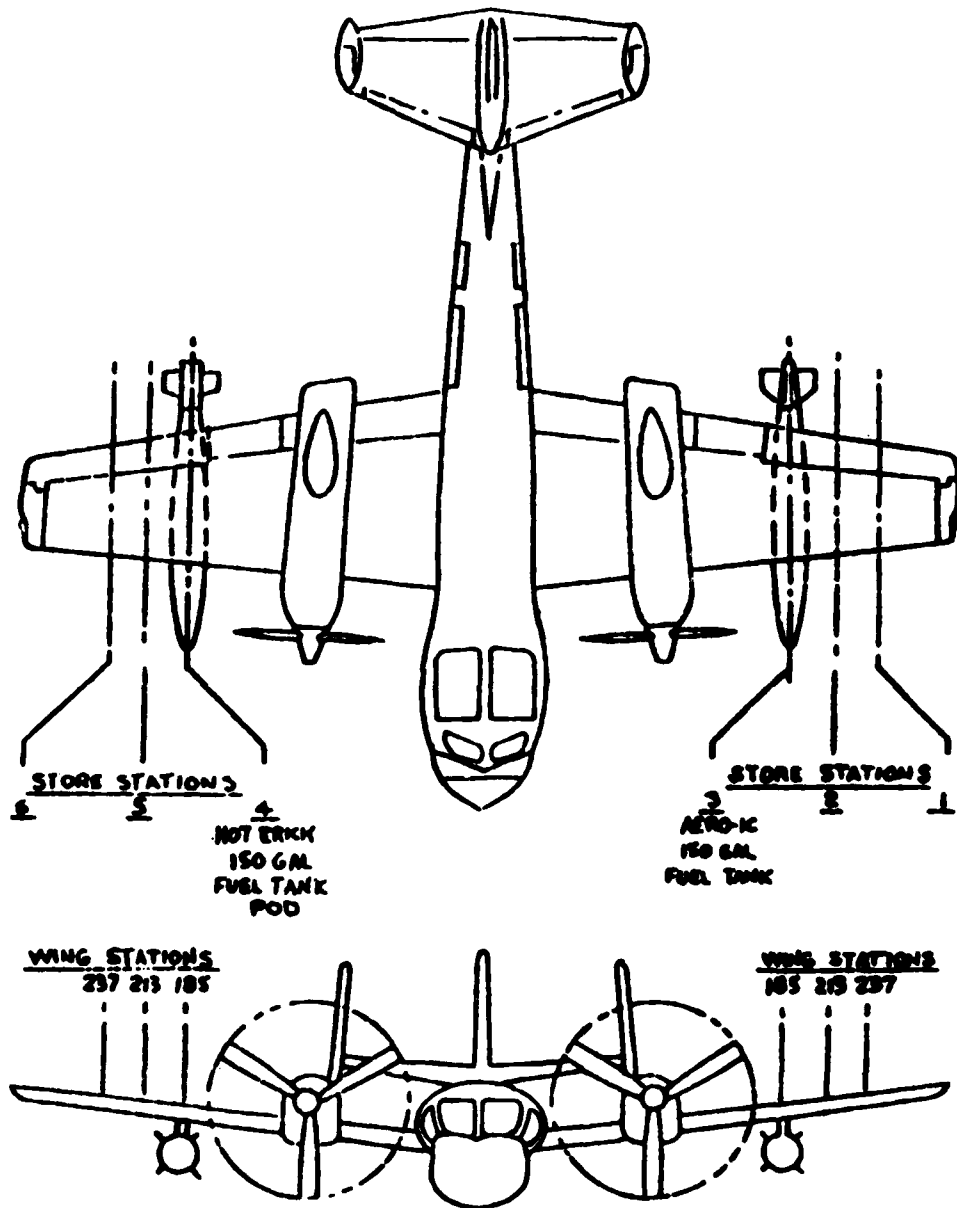


Figure 1. Wing Store Arrangement -  
OV-10A/Hot Brick.

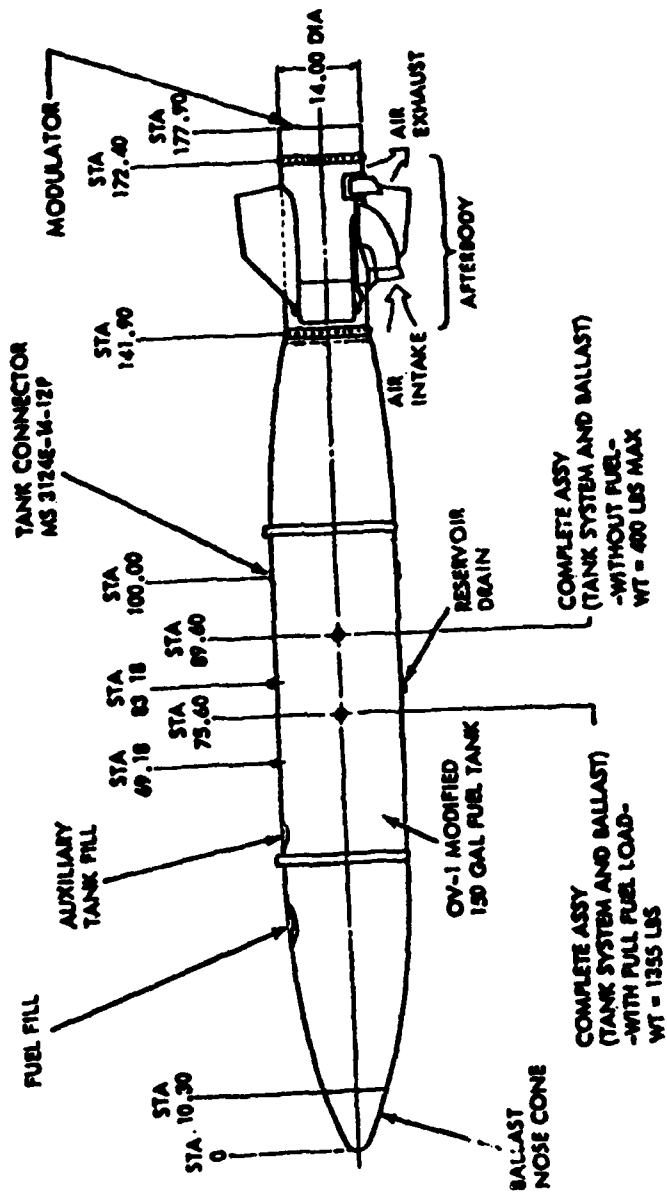


Figure 2. AN/ALQ-147 (HOT BRICK III) Present Modulator.



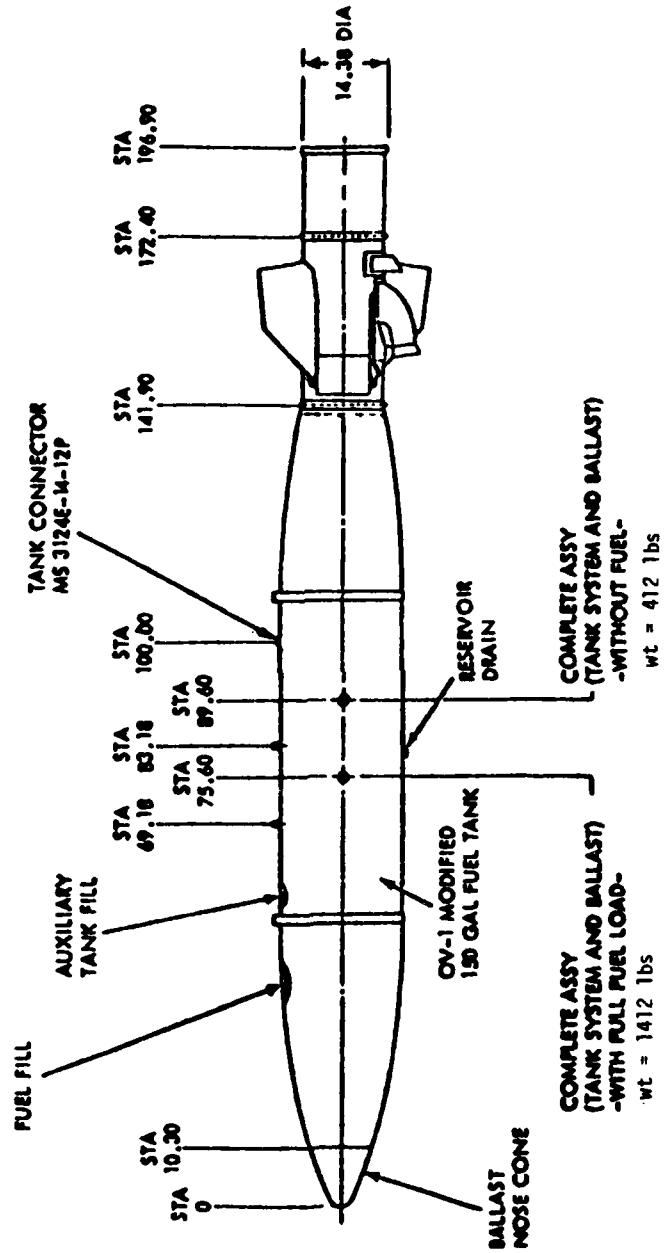


Figure 3. AN/ALQ-147 (XE-2) With Modified Modulator.

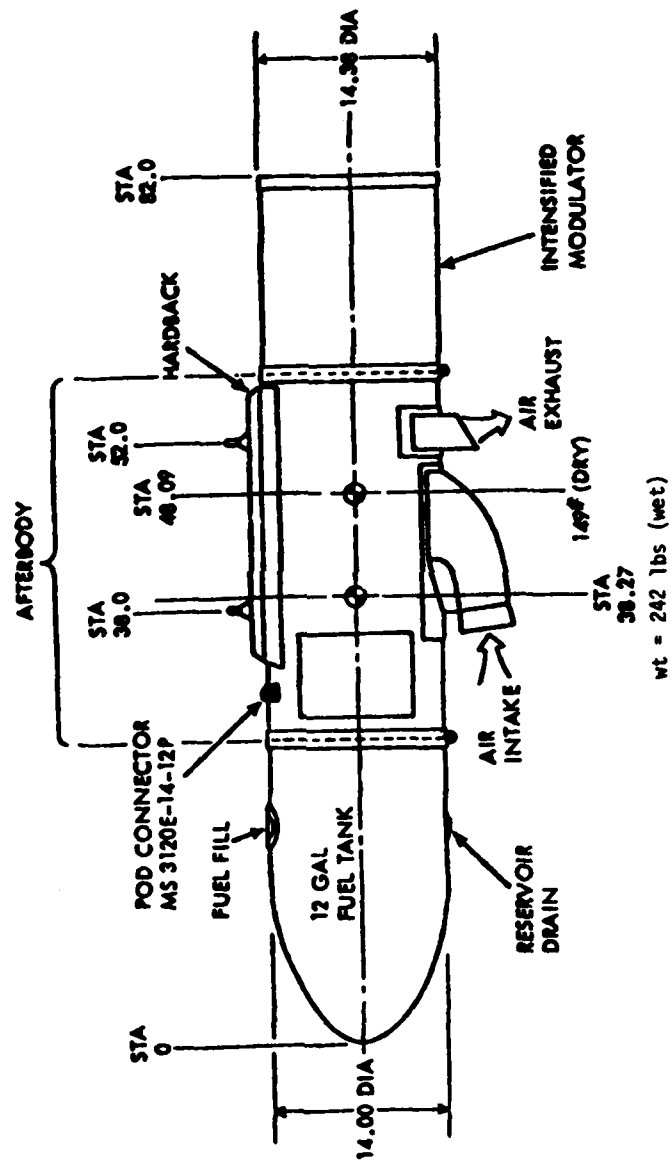


Figure 4. AN/ALQ-147 (XE-1) Stand-Alone With Modified Modulator.



Photo 1. AN/ALQ "Quick Look" Antenna installed on wing station 1.

7. During the PAE the aircraft was loaded in six different wing store configurations:

Configuration 1 - Clean wings (photo 2).

Configuration 2 - AN/ALQ-133 (Quick Look) antennas on wing store stations 1 and 6 (photo 3).

Configuration 3 - AN/ALQ-133 (Quick Look) antennas on wing store stations 1 and 6, drop tank on station 3, and the AN/ALQ-147(XE-2) on station 4 (photo 4).

Configuration 4 - AN/ALQ-147 (XE-1) on wing store station 1, drop tanks on stations 3 and 4, and SLAR boom on the fuselage (photo 5).

Configuration 5 - Drop tanks on wing store stations 3 and 4, SLAR boom on the fuselage, LS-59 flasher pod on station 5, and AN/ALQ-147(XE-1) on station 6 (photo 6).

Configuration 6 - Same as configuration 5 except LSSS installed on both engines.

8. The louvered scarfed shroud suppressor (LSSS) is a passive IRCM device designed to reduce the IR signature of the engines installed on the OV-1D. Photos 7 through 10 show the LSSS installed on the test aircraft.

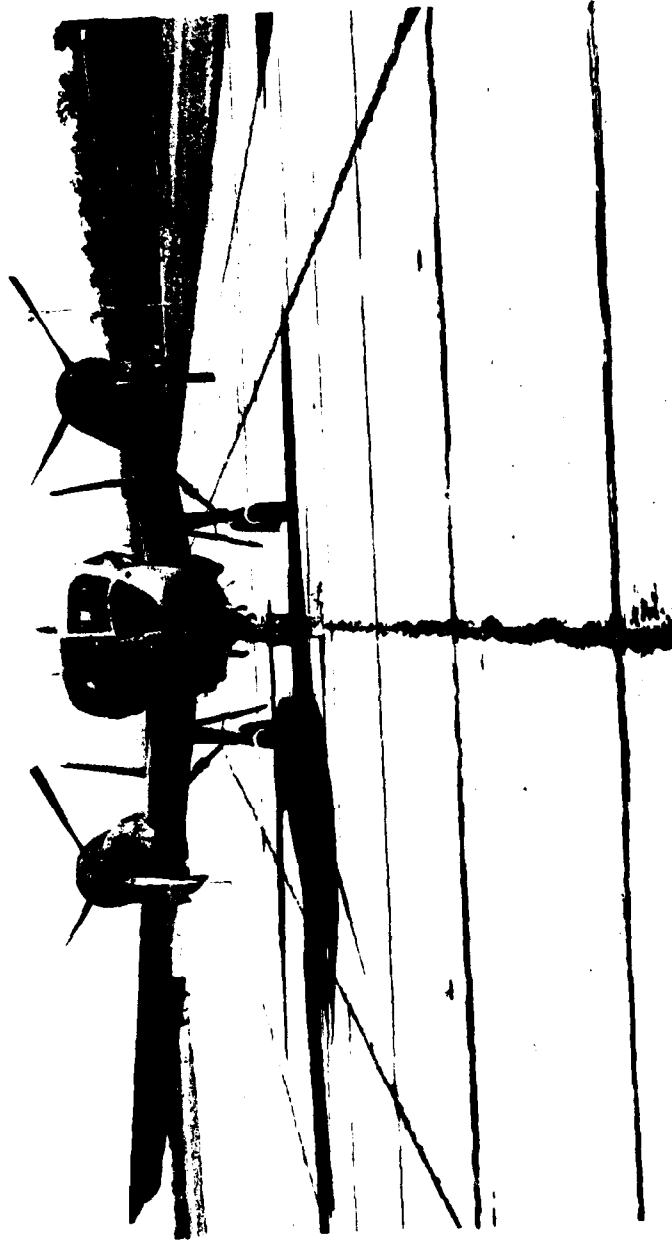


Photo 2. Configuration 1 - Clean Wings.

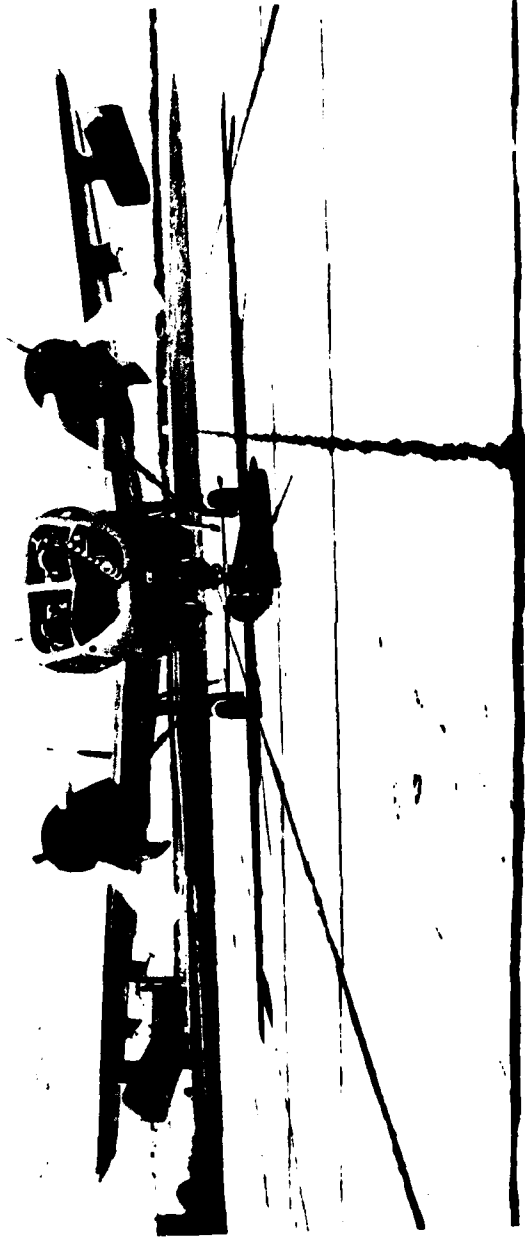


Photo 3. Configuration 2 - AN/ALQ-133 "Quick Look"  
Antennas on Wing Store Stations 1 and 6.



Photo 4. Configuration 3 - AN/ALQ-133 Antennas on Stations 1 and 6,  
Drop Tank Station 3, AN/ALQ-147 (XE-2) Station 4.

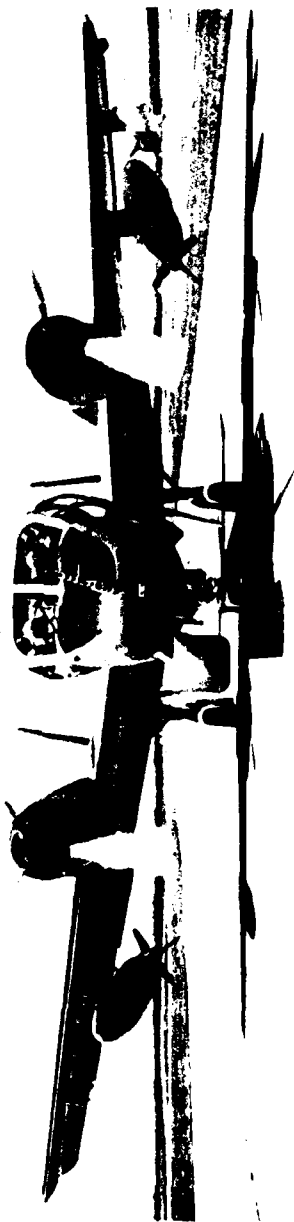


Photo 5. Configuration 4 - AN/ALQ-147 (XE-1) Wing Store Station 1,  
Drop Tanks Stations 3 and 4, SLAR Boom.





Photo 6. Configuration 6 - Drop Tanks on Wing Store Stations 3 and 4,  
SLAR Boom, LS-59 on Station 5, AN/ALQ-147 (XE-1) Station 6.



Photo 7. LSSS Installed on OV-1D.



Photo 8. LSSS Installed on OV-1D (Side View).



**Photo 9. LSSS Installed on OV-1D (Rear View).**



Photo 10. LSSS Installed on OV-10 (Front View).

## APPENDIX C. INSTRUMENTATION

Instrumentation for the OV-1D HOT BRICK XE-1 and XE-2 evaluation was installed, calibrated, and maintained by GAC at Calverton, New York. An instrumented boom was installed to provide pitot and static pressure, sideslip, and angle of attack. The following test instrumentation was used in addition to the standard aircraft instruments:

### Pilot Panel

Airspeed (boom)  
Altitude (boom)  
Angle of sideslip  
Angle of attack  
Center-of-gravity normal acceleration

### Magnetic Tape

Airspeed (boom)  
Altitude (boom)  
Free air temperature  
Lateral control position  
Control force:  
    Longitudinal  
    Lateral  
    Pedal  
Aircraft Attitude:  
    Pitch  
    Roll  
Control surface position:  
    Elevator  
    Right aileron  
    Center rudder  
Aircraft angular velocity:  
    Pitch  
    Roll  
    Yaw  
Angle of attack  
Angle of sideslip  
Acceleration:  
    Center-of-gravity lateral  
    Center-of-gravity normal

Gas producer speed (left and right)  
Power turbine speed (left and right)  
Engine torque (left and right)  
Exhaust gas temperature (left and right)  
Time  
Pilot event

## **APPENDIX D. TEST TECHNIQUES AND DATA ANALYSIS METHODS**

### **TEST TECHNIQUES**

#### **Takeoff Performance**

1. Takeoff performance tests were conducted from a concrete runway. Distances were estimated by aligning the airplane opposite a runway-remaining marker and observing the closest marker at lift-off. These markers were spaced at 1000-foot intervals along the runway. Pressure altitude, ambient temperature, and winds were obtained from the tower at the beginning of the takeoff roll. This information was used to enter the takeoff chart in the operator's manual to calculate a takeoff roll distance. The pilot technique and procedure used for takeoff were those presented in Chapters 3 and 14 of the operator's manual.

#### **Control Margins**

2. Control margins were evaluated with asymmetric wing loads. The takeoff was performed with full fuel in the drop tanks and approximately one-half fuel in the main fuel cell. Once airborne the fuel from one drop tank (except for trapped fuel) was transferred to the main cell to obtain the maximum asymmetric load. The aircraft was trimmed in level flight at 190 KCAS in the CR configuration and 140 KCAS in the TO configuration. Airspeed was then incrementally reduced. The airspeed at which full trim was required was noted. Airspeed was further reduced until full control travel or an airspeed 5 knots above operator's manual stall airspeed was obtained.

#### **Static Lateral-Directional Stability**

3. Static lateral-directional stability tests were conducted by trimming the aircraft at the desired airspeed in zero sideslip. Power, airspeed, and trim settings were held fixed. Steady-heading sideslips were increased incrementally, both left and right, up to the flight envelope limits.

#### **Stalls**

4. Stall characteristics tests were conducted by trimming the aircraft at 1.2V<sub>S</sub> for unaccelerated stalls and 140 KCAS for accelerated stalls in the CR configuration and 120 KCAS for accelerated stalls in the TO and PA configurations. The 1g stalls were conducted wings-level at an airspeed reduction of 1 knot per second or less. Accelerated stalls were conducted at a 60-degree bank, left and right, in the CR configuration, and at a 45-degree bank, left and right, for the TO and PA configurations.



### Single-Engine Minimum-Control Airspeed

5. The single-engine VMC test was conducted using military power on one engine and ground-idle power with the propeller feathered on the other engine. In the CR and PA configurations the aircraft was trimmed at the minimum trimmable airspeed and the test conducted. In the TO configuration the aircraft was trimmed at the trim settings recommended for takeoff in the operator's manual. Bank angle was held constant with lateral control and pedals used to conduct a steady-heading VMC maneuver.

6. The lateral control is connected to the aileron by a spring bungee; therefore, dynamic pressure, aileron trim, and lateral control position work together to define aileron surface position. VMC was usually defined by reaching a lateral control limit which did not always produce the same aileron surface deflection. That point where the lateral control limit was reached is shown as a vertical line on figures 50 through 61, appendix E.

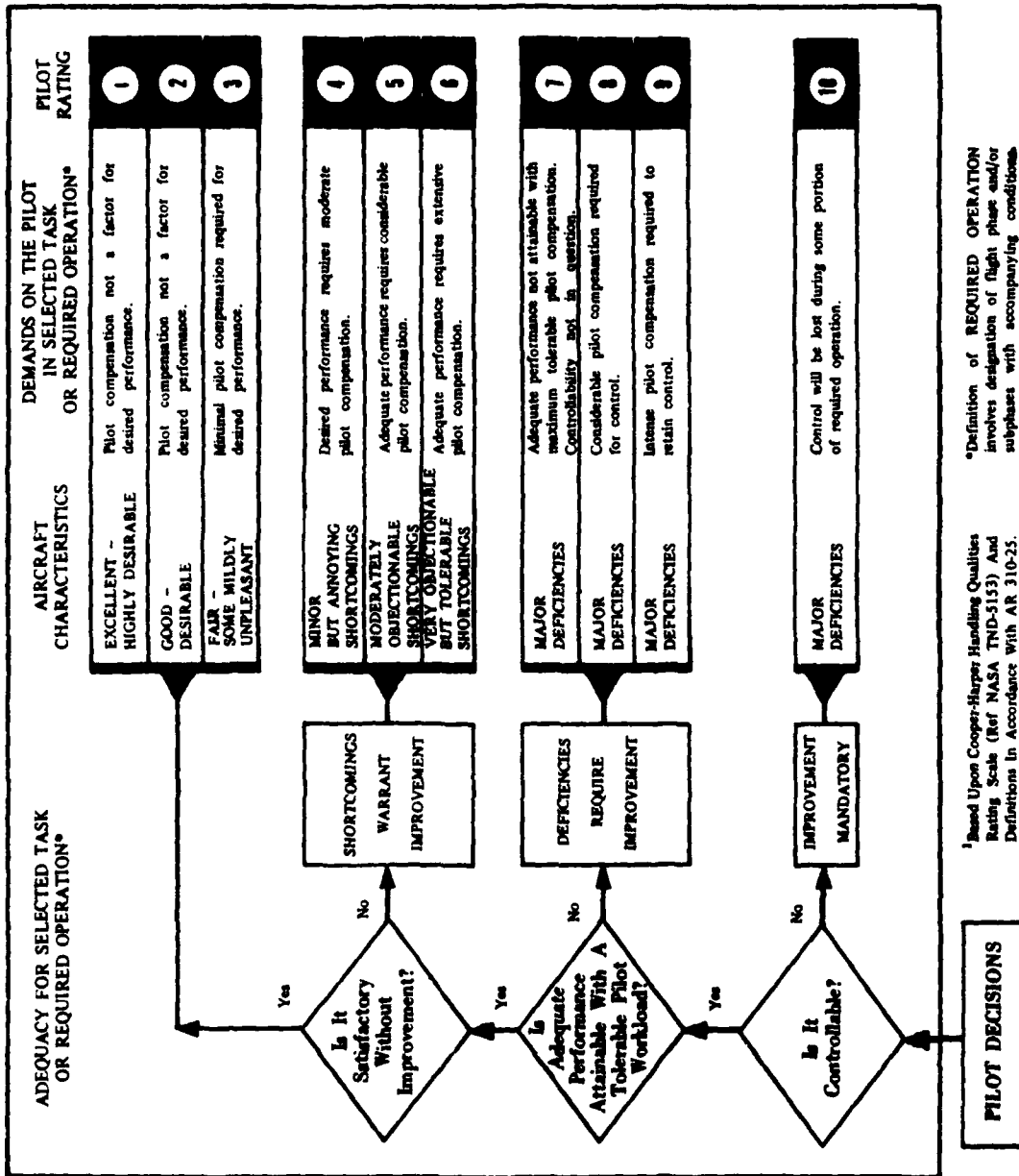
### DATA ANALYSIS METHODS

#### Takeoff Performance

7. Estimated takeoff performance data were compared with data presented in Figure 14-11 of the operator's manual for altitude, ambient temperature, gross weight, and winds. Power available was assumed to be equal to or in excess of minimum power available as contained in the engine model specification.

#### Handling Qualities

8. Data obtained during these tests were compared to previous reports, GAC data, and data presented in the operator's manual. Data were also compared for each airplane configuration tested to determine how the various IRCM equipment affected the handling qualities of the OV-1D/RV-1D. Pilot comments and reference to the HQRS (fig. 1) were also incorporated in the report.



\*Based Upon Cooper-Harper Handling Qualities Rating Scale (Ref NASA TND-5153) And Definitions In Accordance With AR 310-25.

\*Definition of REQUIRED OPERATION involves designation of flight phase and/or subphases with accompanying conditions.

Figure 1. Handling Qualities Rating Scale.

# APPENDIX E. TEST DATA

## INDEX

| <u>Figure</u>                          | <u>Figure Number</u> |
|--|----------------------|
| Control Margins/Trimmability           | 1 thru 6             |
| Static Lateral-Directional Stability   | 7 thru 18            |
| Stall Characteristics                  | 19 thru 49           |
| Single Engine Minimum Control Airspeed | 50 thru 61           |

FIGURE NO. 1  
CONTROL MARGIN

DV-10.0. USAF S/N 48-15992  
WIND STORE CONFIGURATION 3

CONFIGURATION CR  
GROSS WEIGHT = 17,150 LB  
CG 30.5 PERCENT MAC  
LAT. CG MOMENT = 280.426 IN LB

PRESSURE ALTITUDE = 10,340 FT  
FREE AIR TEMP. = -1.5 DEG C

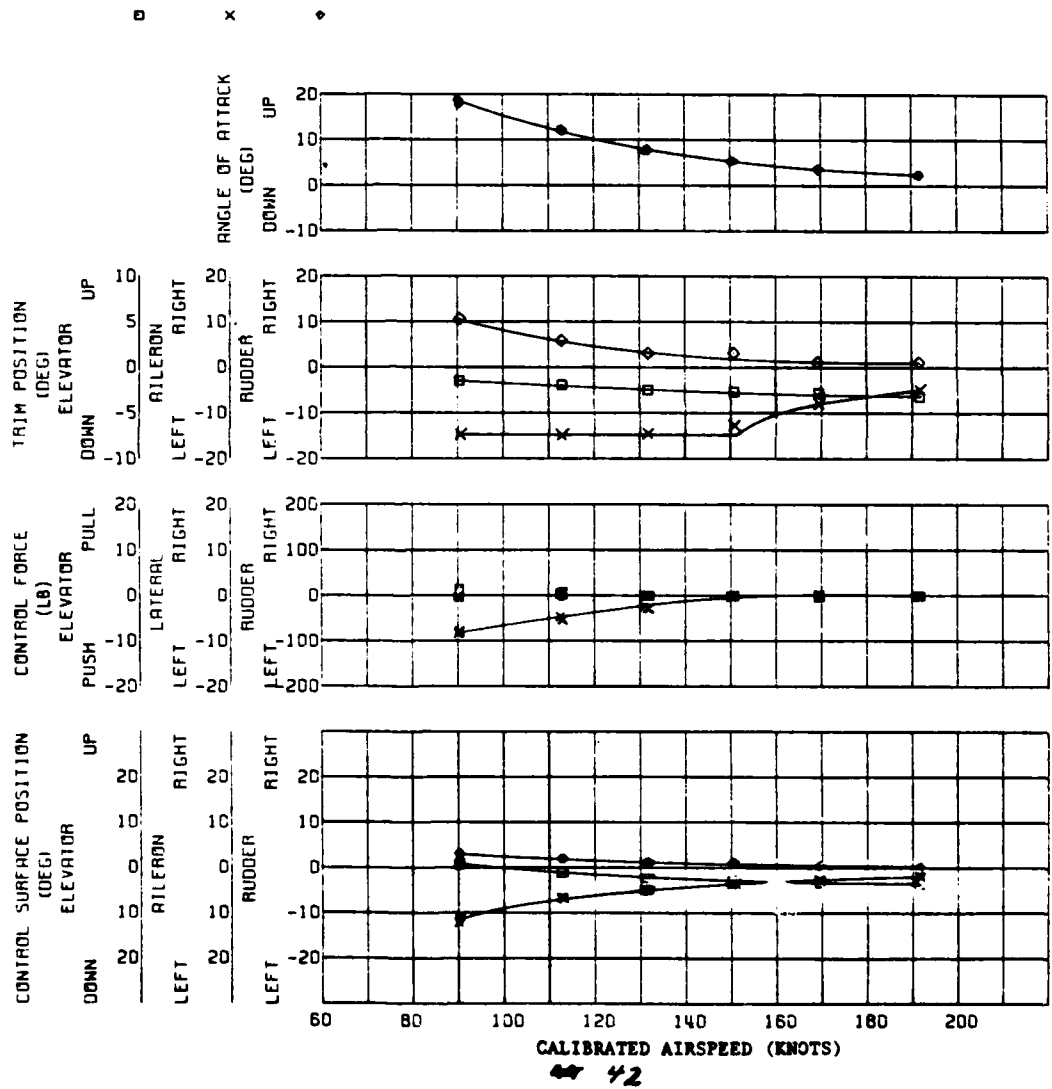


FIGURE NO. 2  
CONTROL MARGIN

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 3

CONFIGURATION TO  
GROSS WEIGHT = 16,540 LB  
CG 30.4 PERCENT MAC  
LAT. CG MOMENT = 280,426 IN.-LB

PRESSURE ALTITUDE = 9920 FT  
FREE AIR TEMP. = 0.0 DEG C

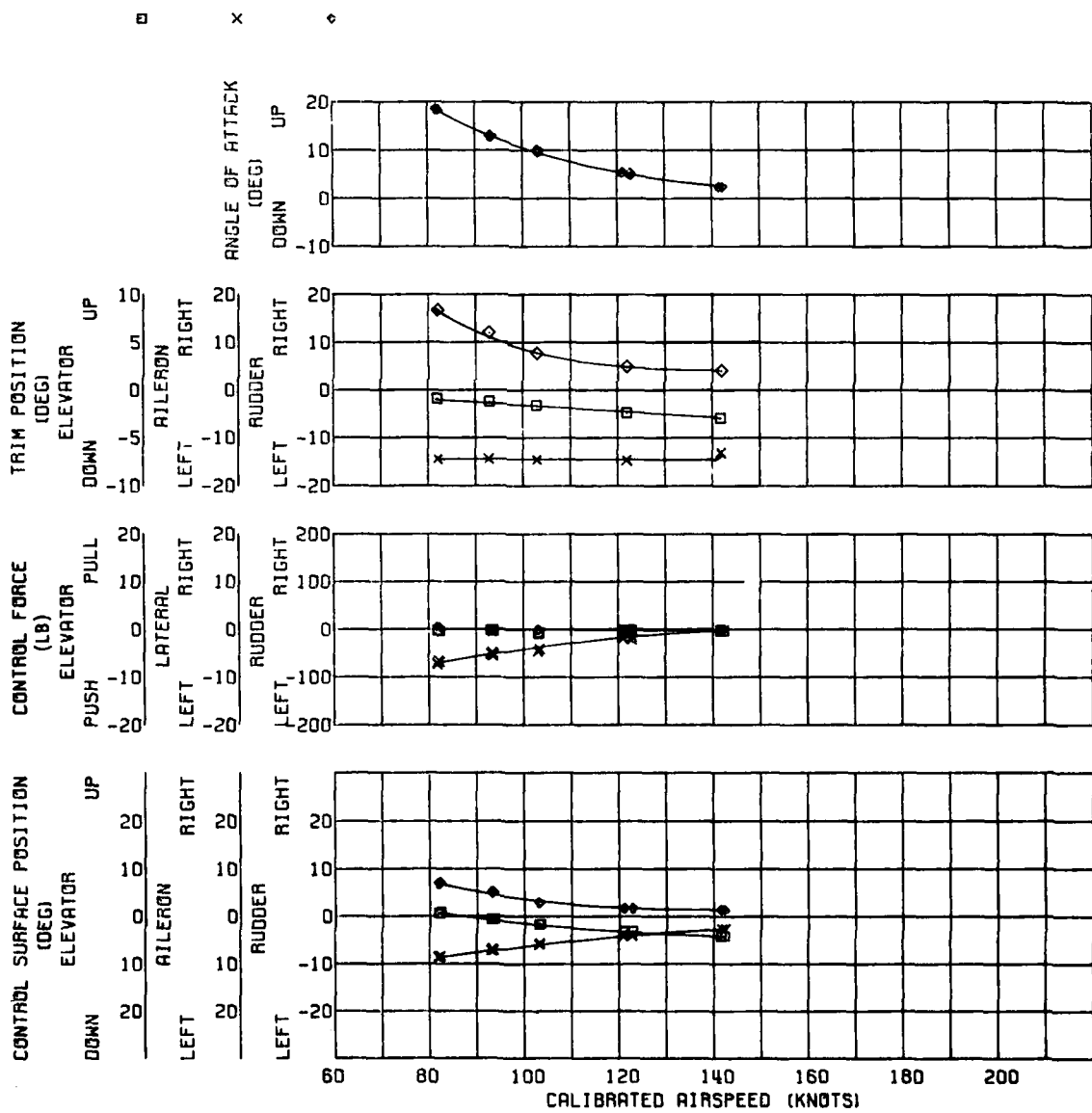


FIGURE NO. 3  
CONTROL MARGIN

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 4

CONFIGURATION CR  
GROSS WEIGHT = 16,590 LB  
CG 28.4 PERCENT MAC  
LAT. CG MOMENT = -220,118 IN,-LB

PRESSURE ALTITUDE = 10,160 FT  
FREE AIR TEMP. = 5.0 DEG C

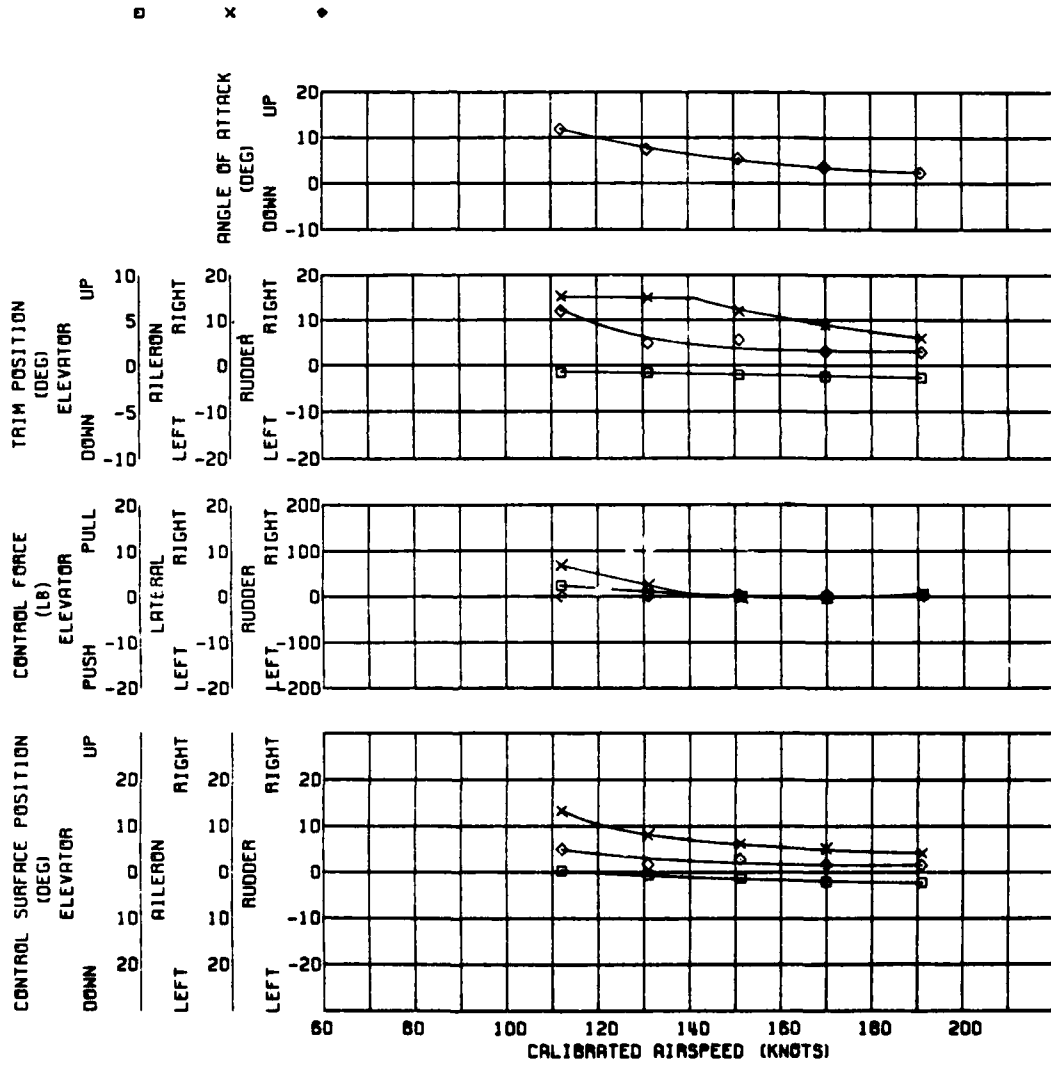


FIGURE NO. 4  
 CONTROL MARGIN  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION TO  
 GROSS WEIGHT = 16,040 LB  
 CG 28.3 PERCENT MAC  
 LAT. CG MOMENT = -220,118 IN-LB

PRESSURE ALTITUDE = 10,240 FT  
 FREE AIR TEMP. = 4.0 DEG C

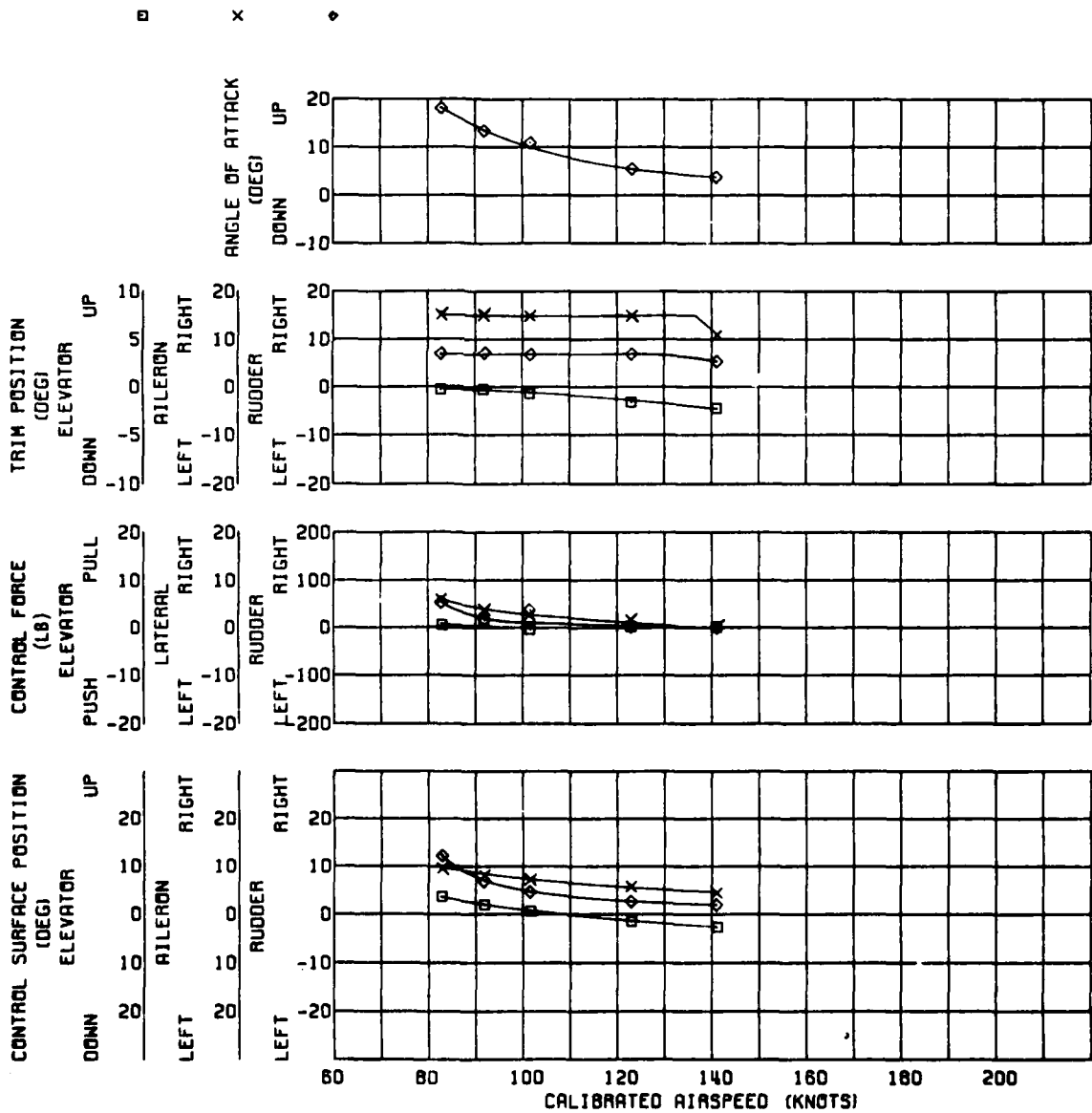


FIGURE NO. 5  
 CONTROL MARGIN  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION CR  
 GROSS WEIGHT = 17,390 LB  
 CG 28.4 PERCENT MAC  
 LAT. CG MOMENT = 301,549 IN.-LB

PRESSURE ALTITUDE = 9720 FT  
 FREE AIR TEMP. = 4.0 DEG C

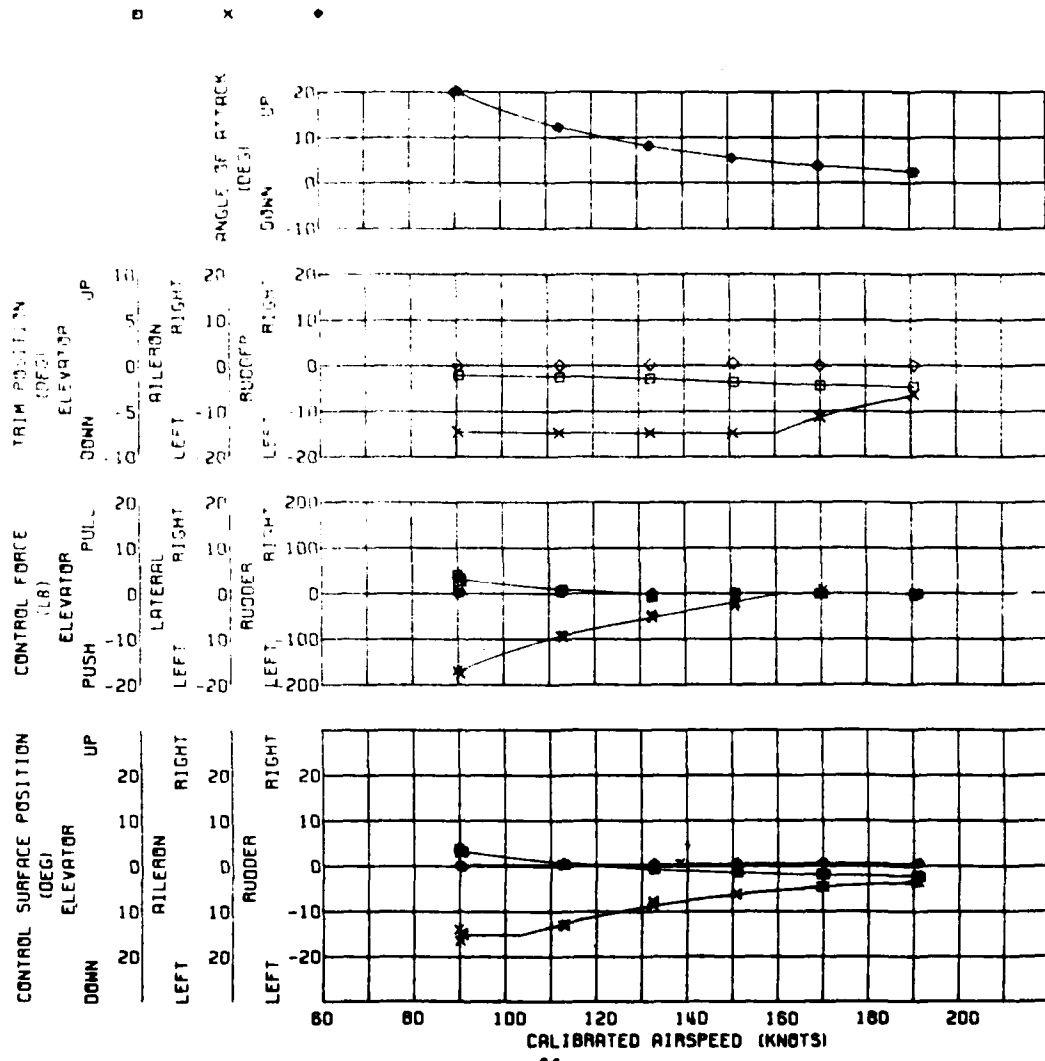




FIGURE NO. 6  
 CONTROL MARGIN  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION TO  
 GROSS WEIGHT = 16,610 LB  
 CG 28.3 PERCENT MAC  
 LAT. CG MOMENT = 301,549 IN.-LB

PRESSURE ALTITUDE = 10,100 FT  
 FREE AIR TEMP. = 2.5 DEG C

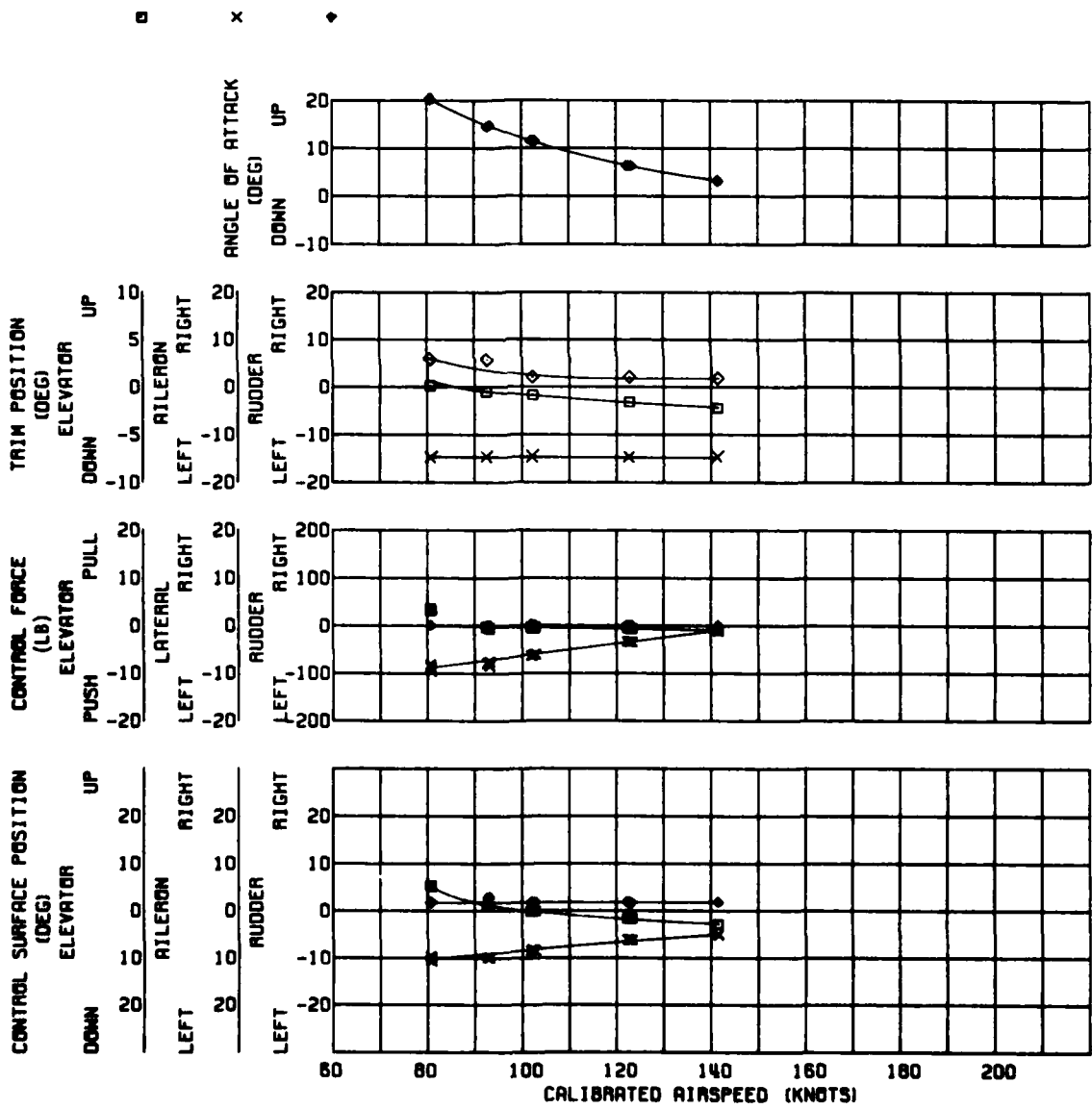


FIGURE NO. 7  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION CR  
 GROSS WEIGHT = 18,080 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 65,826 IN.-LB

TRIM CALIBRATED AIRSPEED = 139 KI  
 PRESSURE ALTITUDE = 10,020 FT  
 FREE AIR TEMP. = 0.5 DEG C

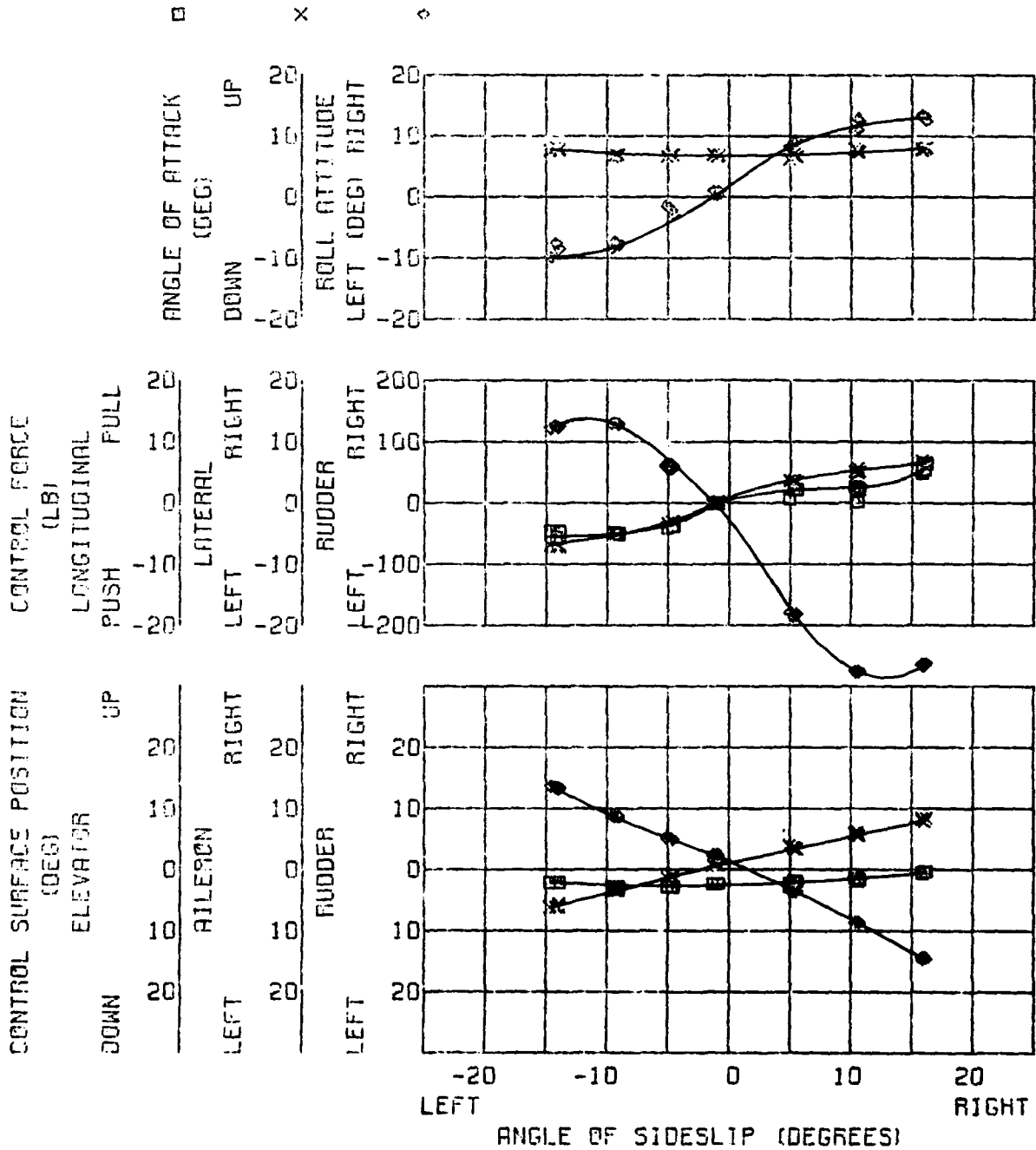


FIGURE NO. 8  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION CR  
 GROSS WEIGHT = 17,830 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 65,826 IN.-LB

TRIM CALIBRATED AIRSPEED = 113 KTS  
 PRESSURE ALTITUDE = 9880 FT  
 FREE AIR TEMP. = 1.0 DEG C

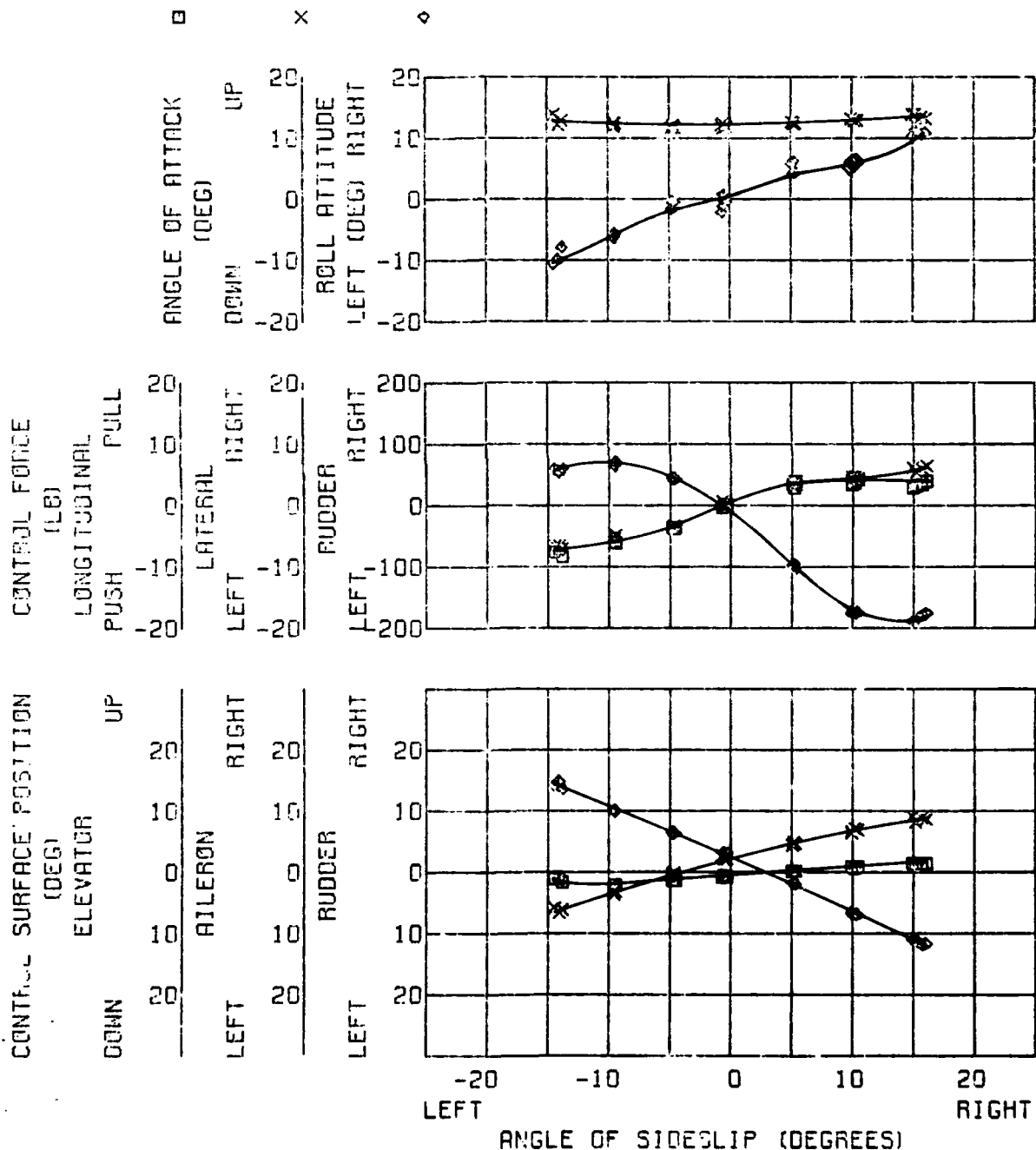


FIGURE NO. 9  
 STATIC LATERAL BIRECTIONAL STABILITY

OV-10 (C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION TO  
 GROSS WEIGHT = 17,640 LB  
 CG 30.0 PERCENT MAC  
 LAT. CG MOMENT = 65,826 IN.-LB

TRIM CALIBRATED AIRSPEED = 123 KT  
 PRESSURE ALTITUDE = 10,000 FT  
 FREE AIR TEMP. = 0.5 DEG C

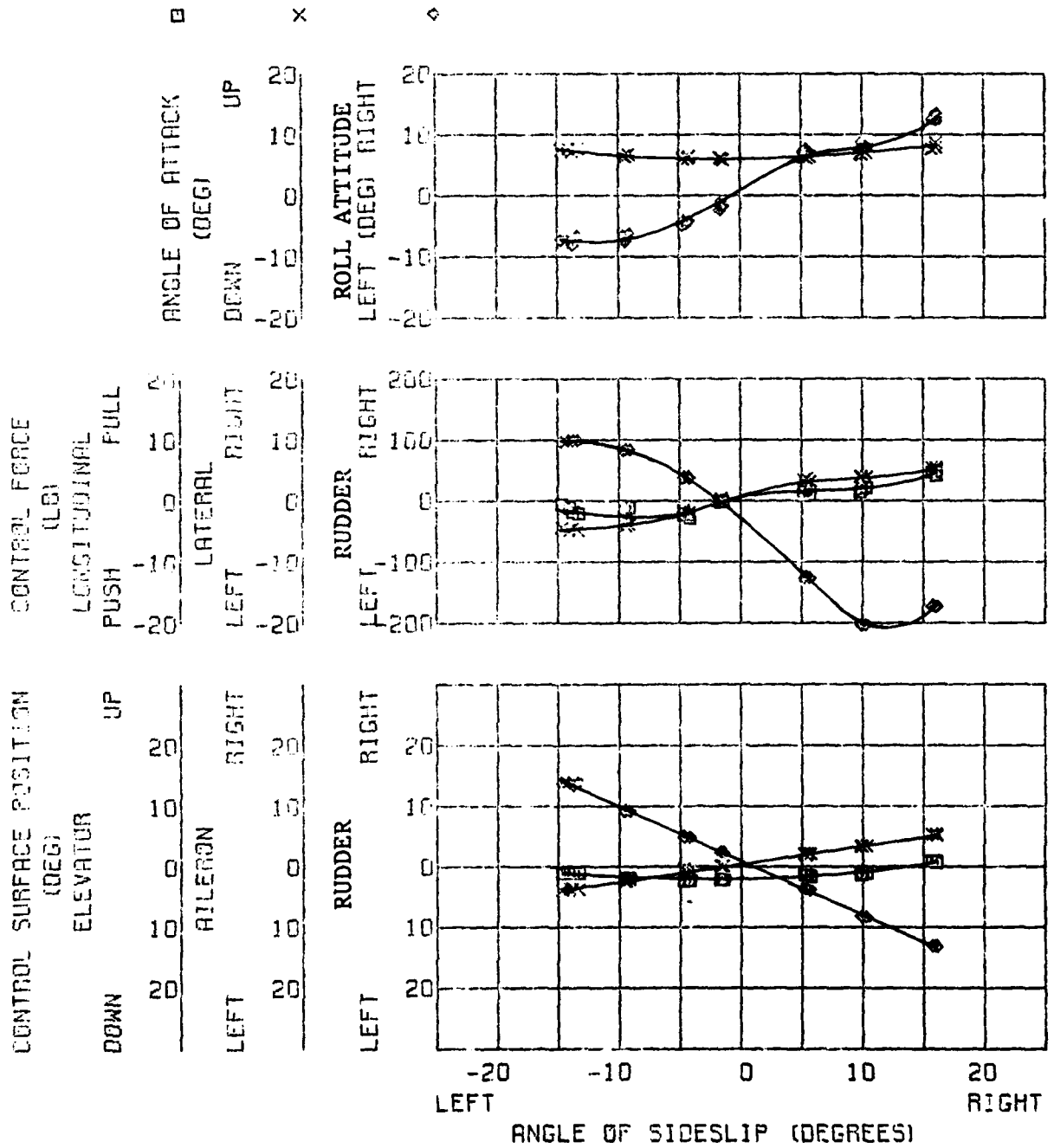


FIGURE NO. 10  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10 (C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION PA  
 GROSS WEIGHT = 16,820 LB  
 CS 30.2 PERCENT MAC  
 LAT. CG MOMENT = 65,826 IN.-LB

TRIM CALIBRATED AIRSPEED = 92 KTS  
 PRESSURE ALTITUDE = 10,180 FT  
 FREE AIR TEMP. = -1.5 DEG C

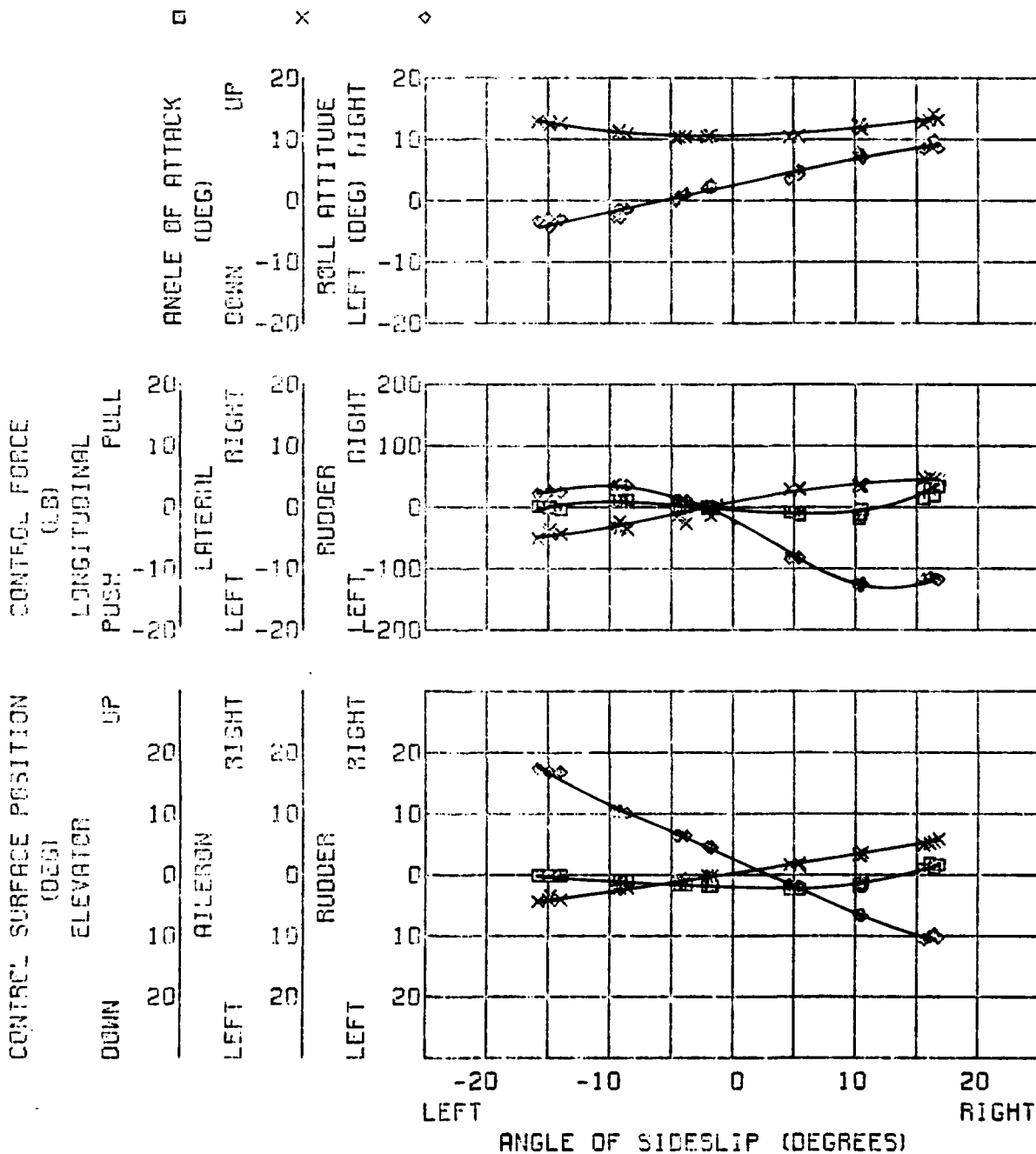


FIGURE NO. 11  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION CR  
 GROSS WEIGHT = 17,780 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

TRIM CALIBRATED AIRSPEED = 144 KTS  
 PRESSURE ALTITUDE = 10,080 FT  
 FREE AIR TEMP. = 5.0 DEG C

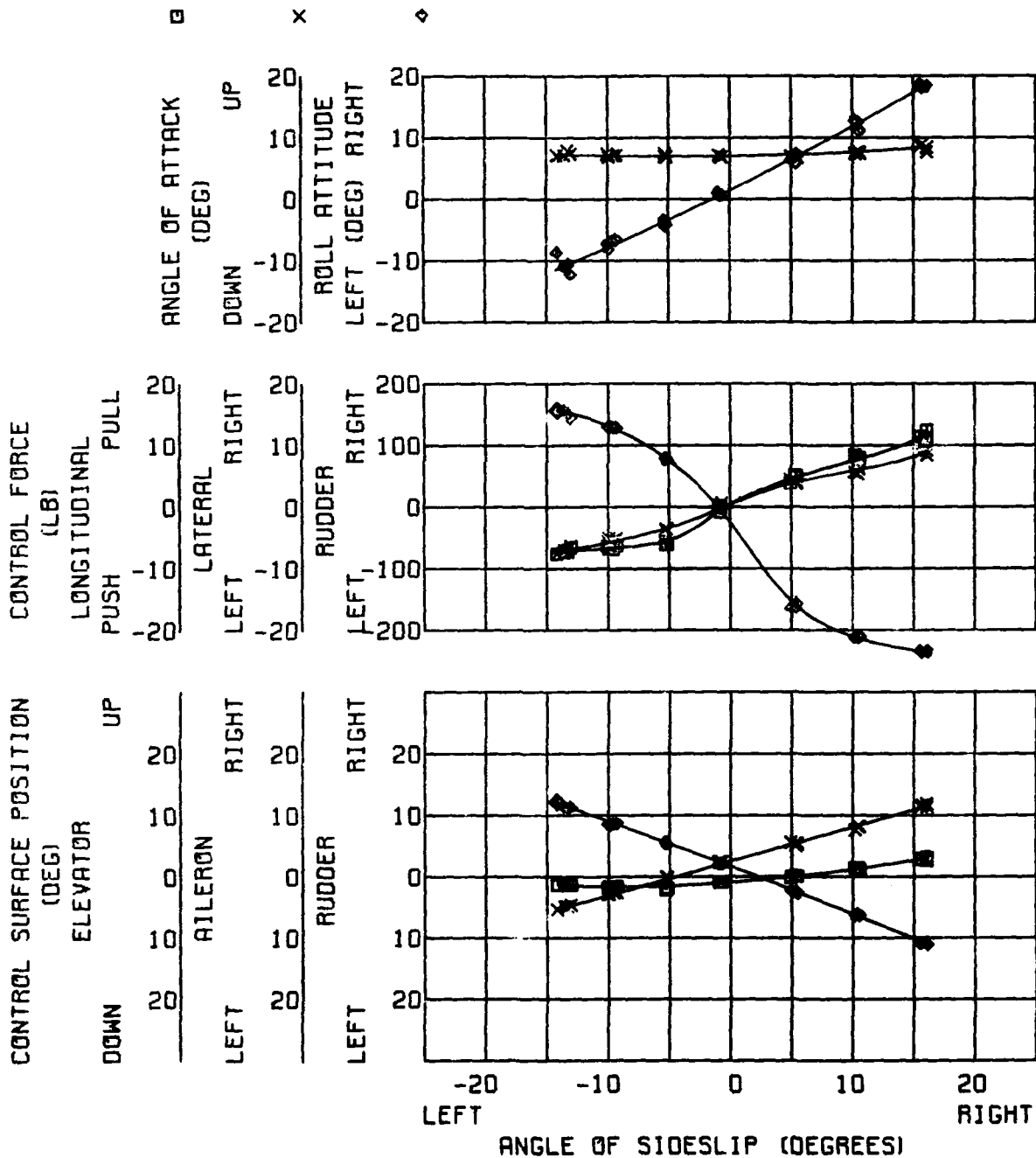


FIGURE NO. 12  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION CR  
 GROSS WEIGHT = 17,480 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

TRIM CALIBRATED AIRSPEED = 113 KT  
 PRESSURE ALTITUDE = 10,160 FT  
 FREE AIR TEMP. = 4.5 DEG C

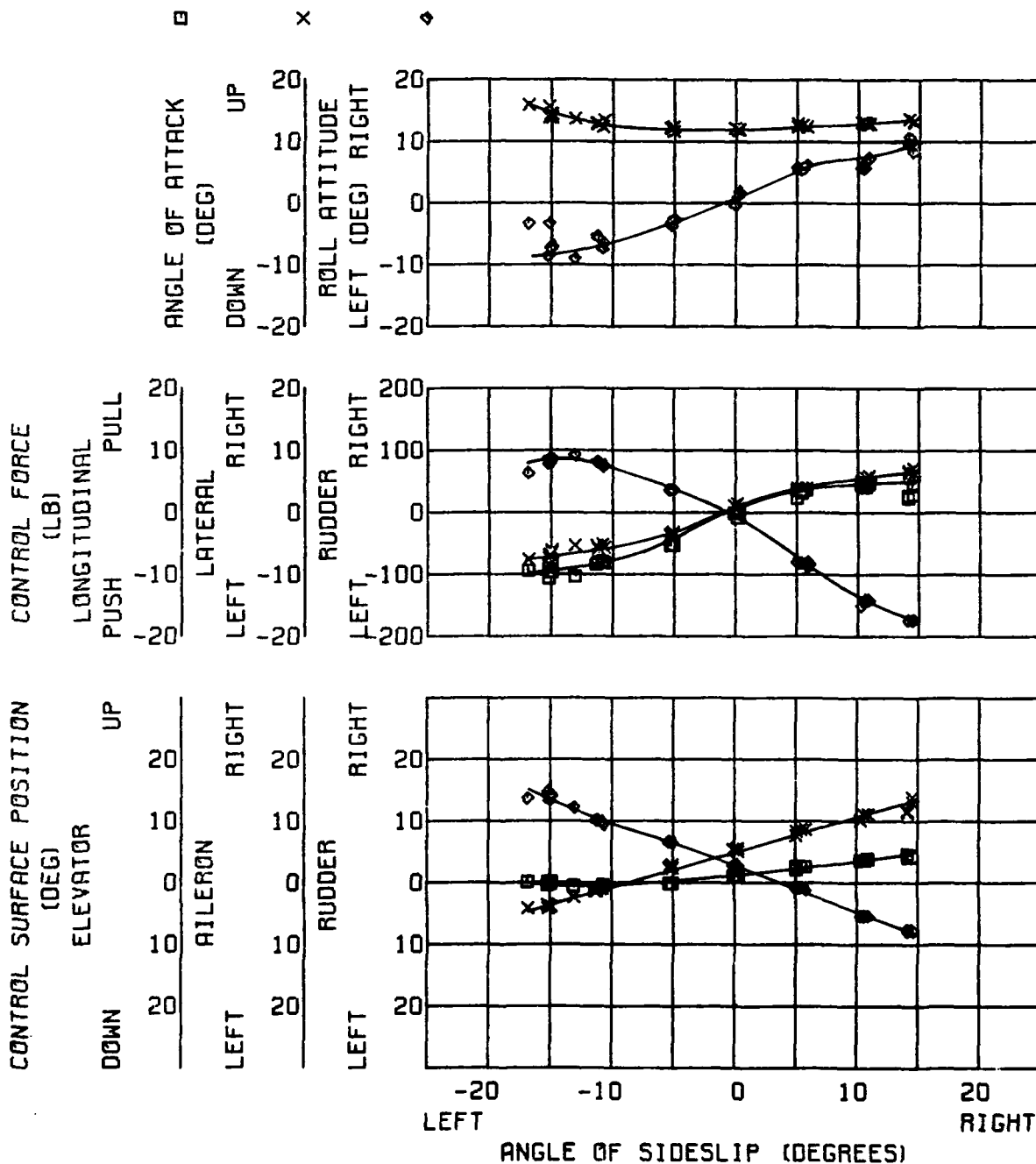


FIGURE NO. 13  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION TO  
 GROSS WEIGHT = 17,170 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

TRIM CALIBRATED AIRSPEED = 122 KT  
 PRESSURE ALTITUDE = 10240 FT  
 FREE AIR TEMP. = 4.5 DEG C

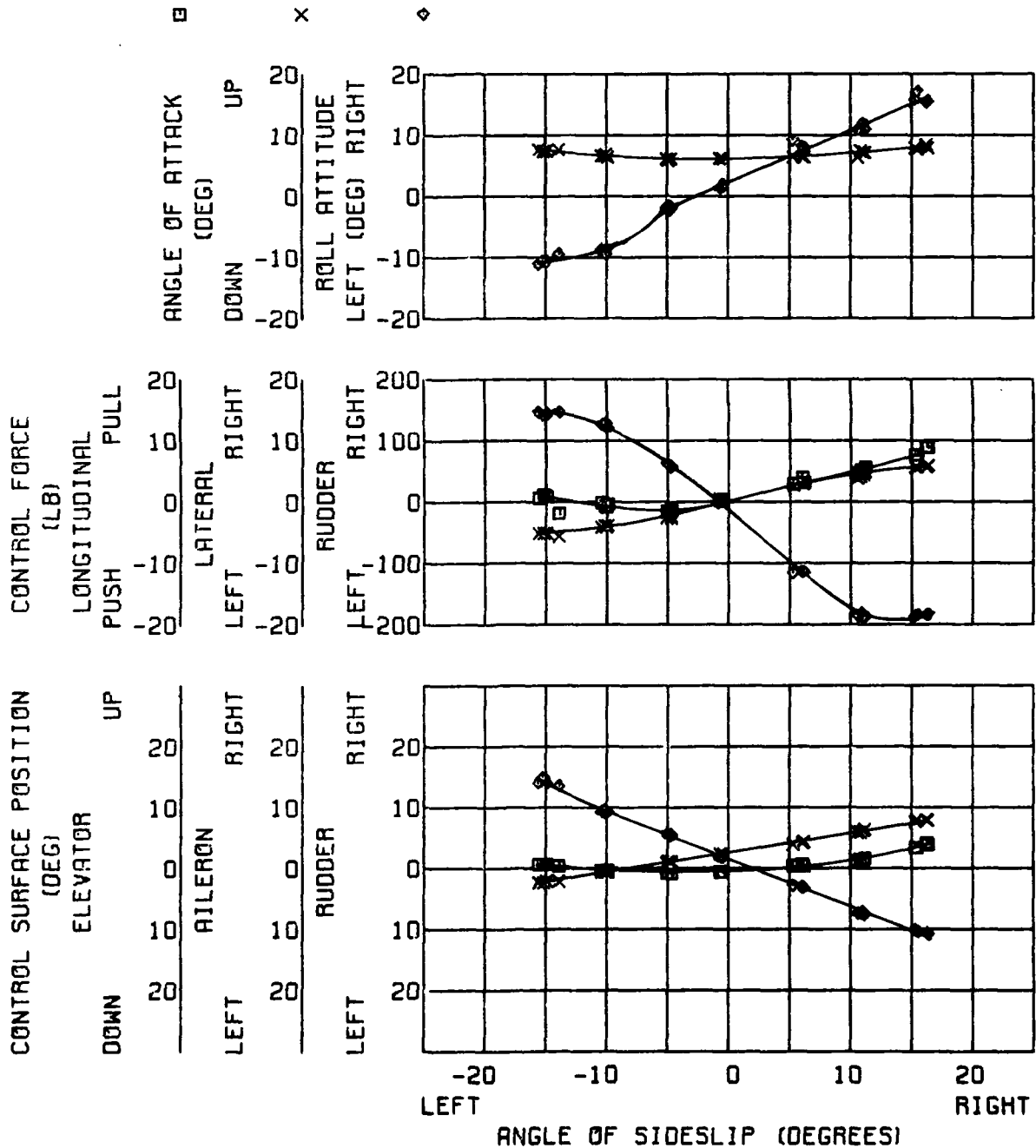




FIGURE NO. 14  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION PA  
 GROSS WEIGHT = 17,720 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

TRIM CALIBRATED AIRSPEED = 91 KTS  
 PRESSURE ALTITUDE = 10,020 FT  
 FREE AIR TEMP. = 3.0 DEG C

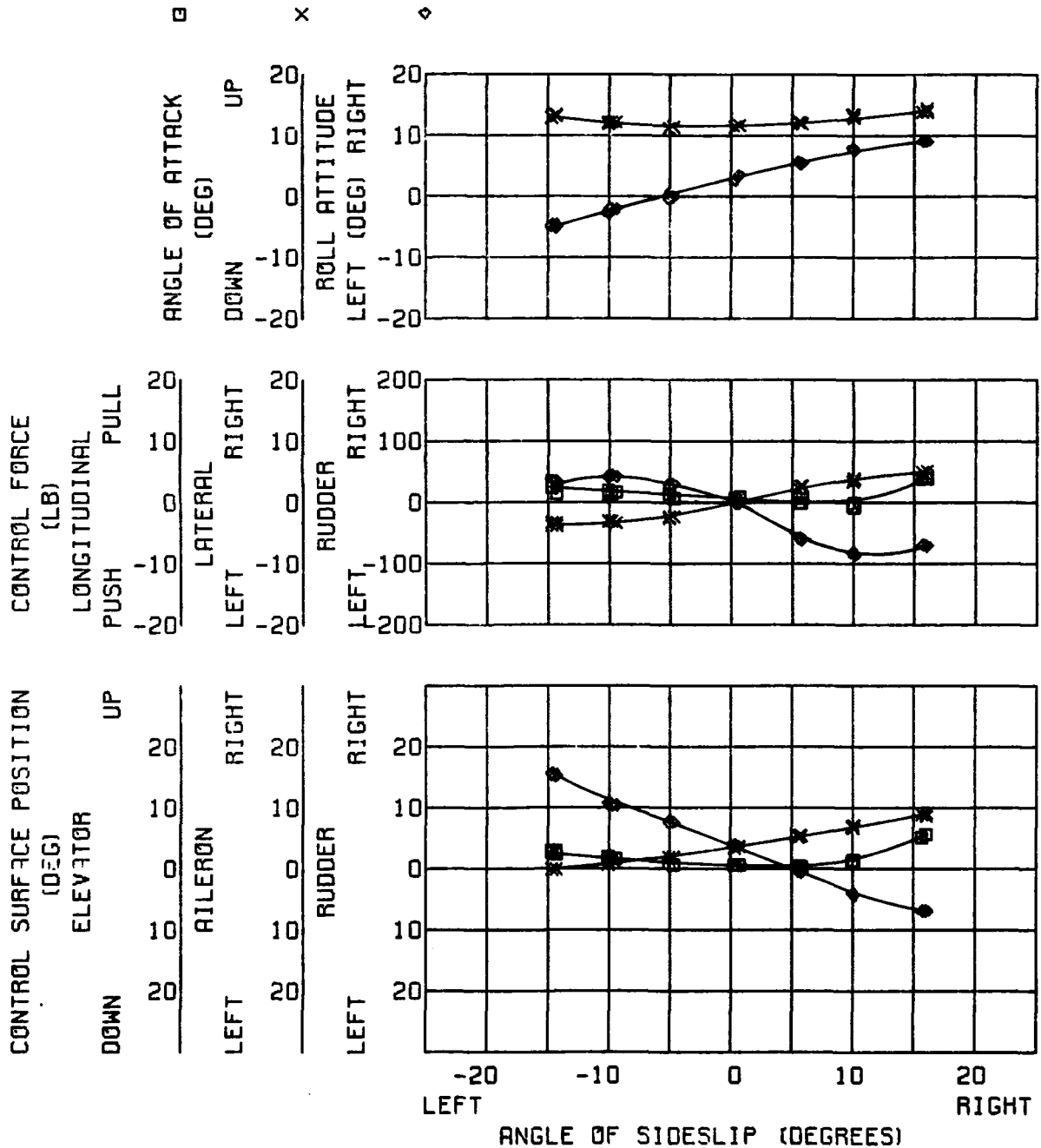


FIGURE NO. 15  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION CR  
 GROSS WEIGHT = 18,070 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = 135,049 IN.-LB

TRIM CALIBRATED AIRSPEED = 143 KI  
 PRESSURE ALTITUDE = 9840 FT  
 FREE AIR TEMP. = 0 DEG C

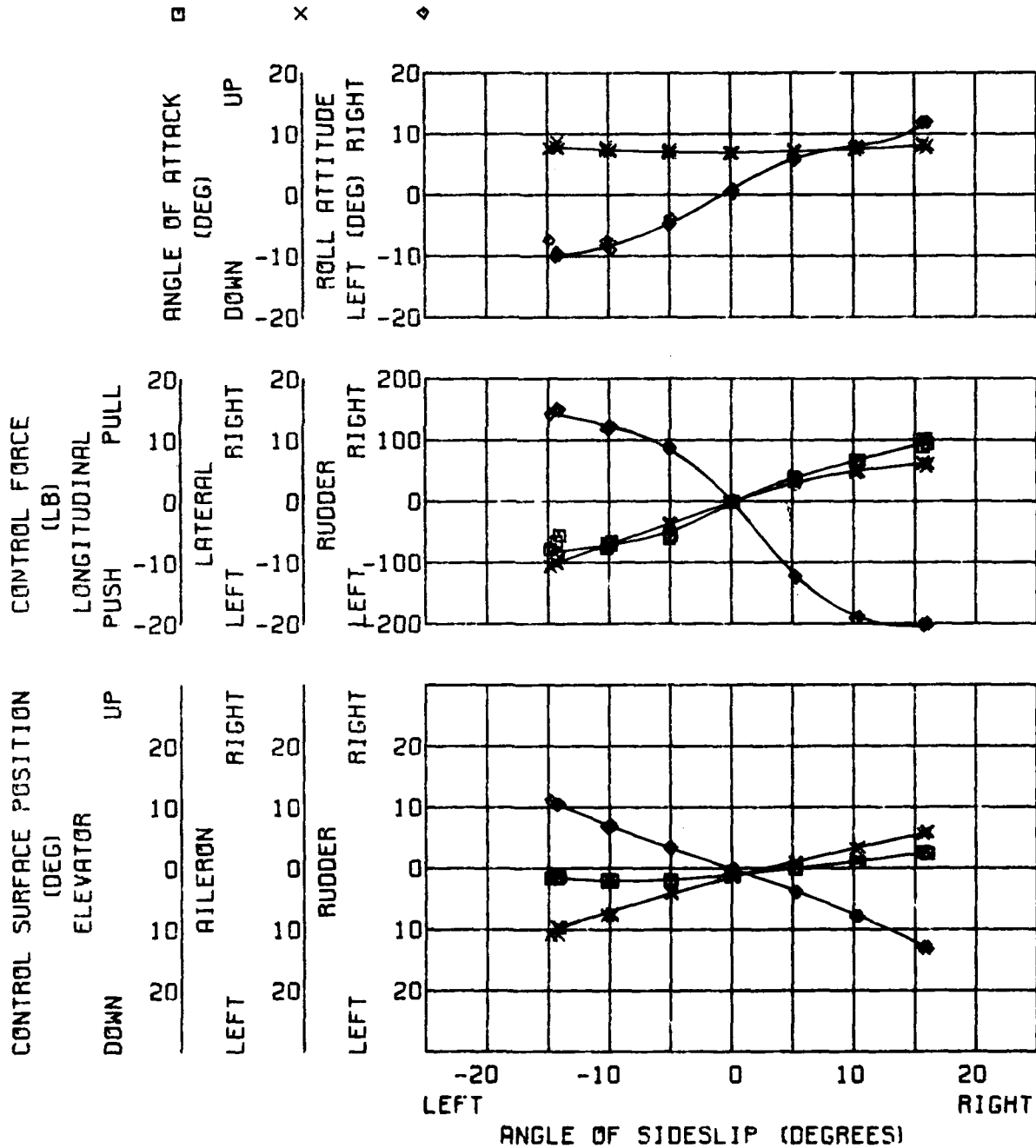


FIGURE NO. 16  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION CR  
 GROSS WEIGHT = 17,890 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = 135,049 IN. -LB

TRIM CALIBRATED AIRSPEED = 113 KT  
 PRESSURE ALTITUDE = 9900 FT  
 FREE AIR TEMP. = 0 DEG C

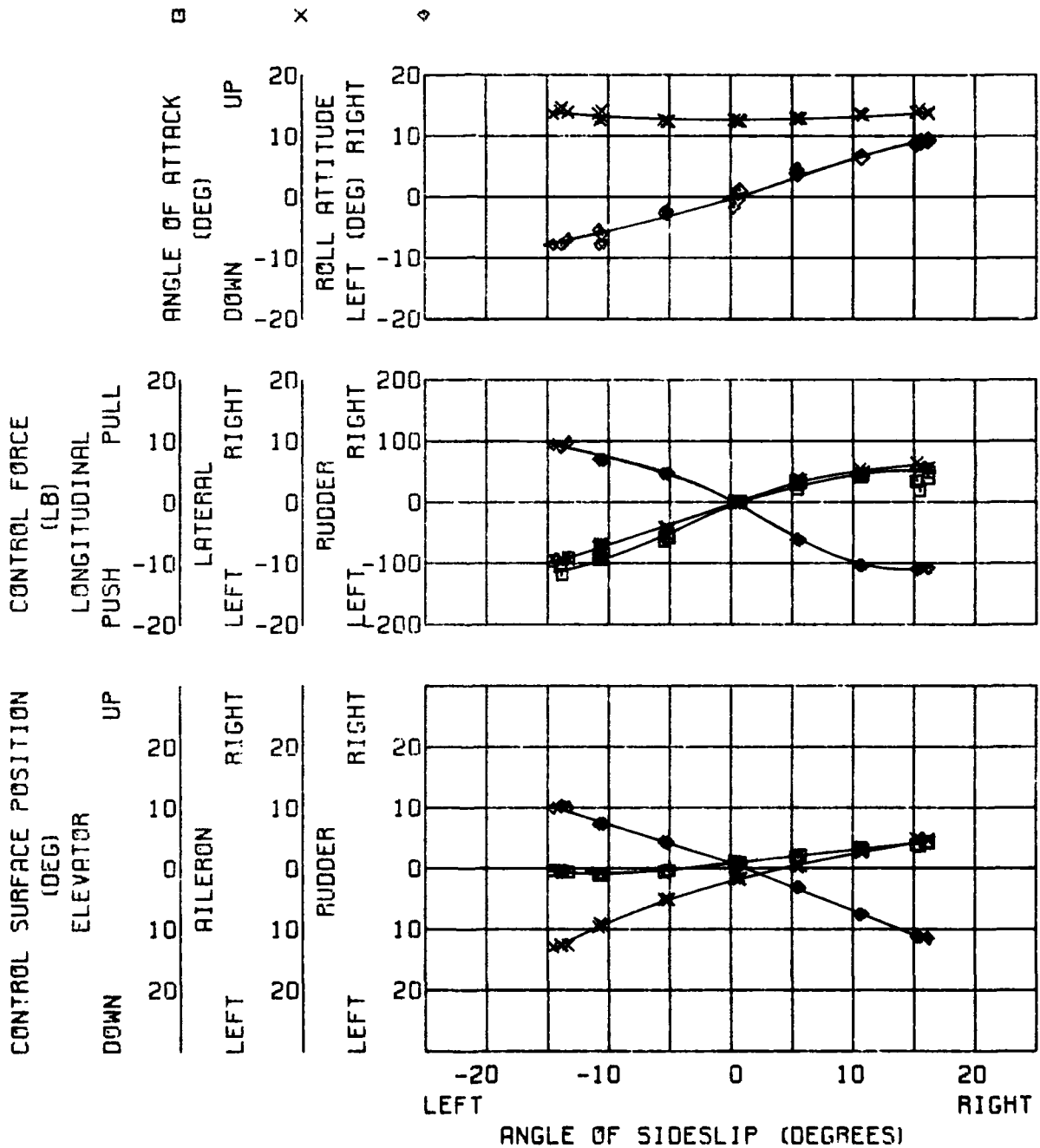


FIGURE NO. 17  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION TO  
 GROSS WEIGHT = 17,740 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = 135,049 IN.-LB

TRIM CALIBRATED AIRSPEED = 123 KI  
 PRESSURE ALTITUDE = 10,360 FT  
 FREE AIR TEMP. = -0.5 DEG C

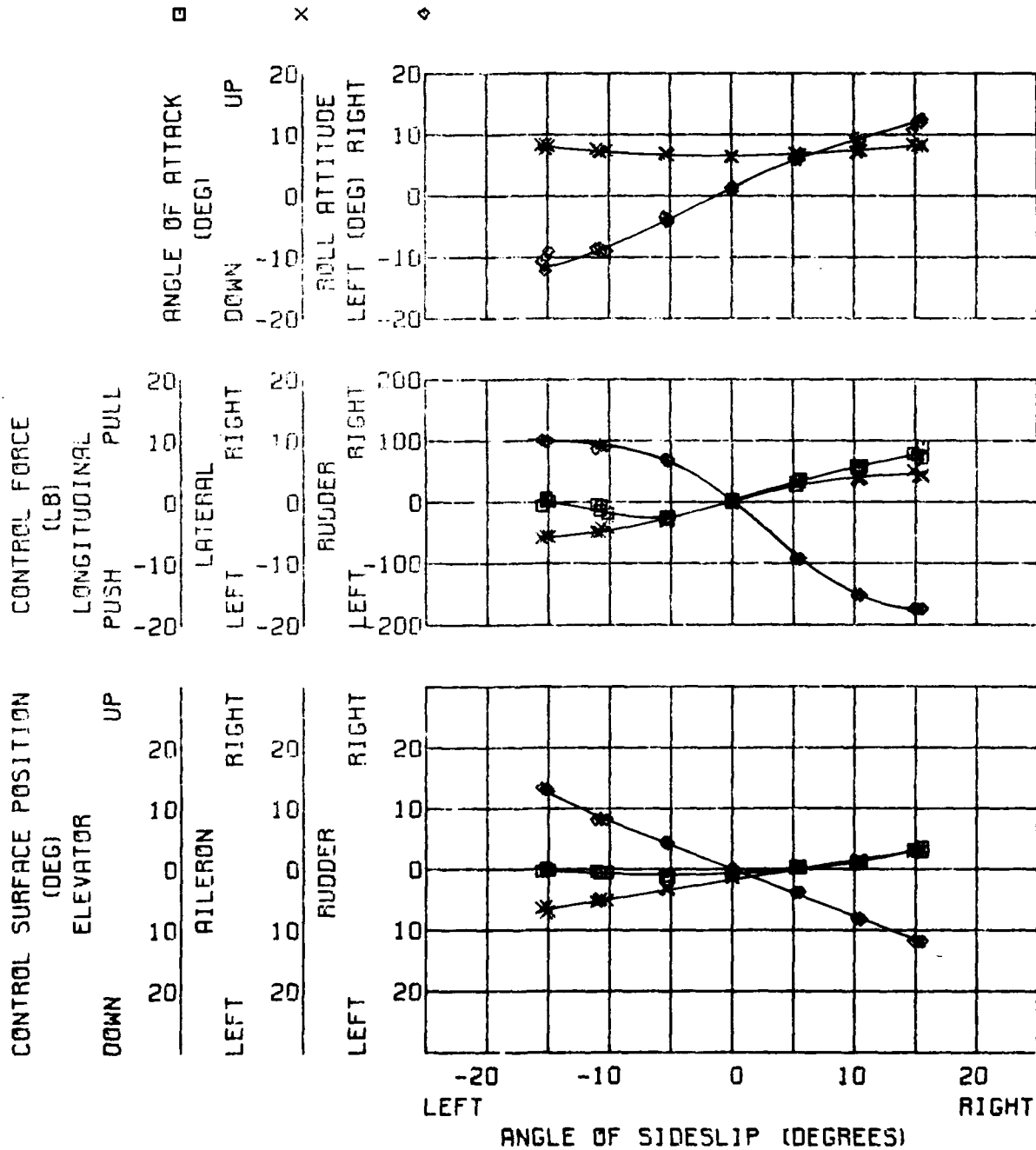


FIGURE NO. 18  
 STATIC LATERAL DIRECTIONAL STABILITY

OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION PA  
 GROSS WEIGHT = 16,960 LB  
 CG 28.1 PERCENT MAC  
 LAT. CG MOMENT = 135,049 IN.-LB

TRIM CALIBRATED AIRSPEED = 93 KTS  
 PRESSURE ALTITUDE = 10,030 FT  
 FREE AIR TEMP. = -0.5 DEG C

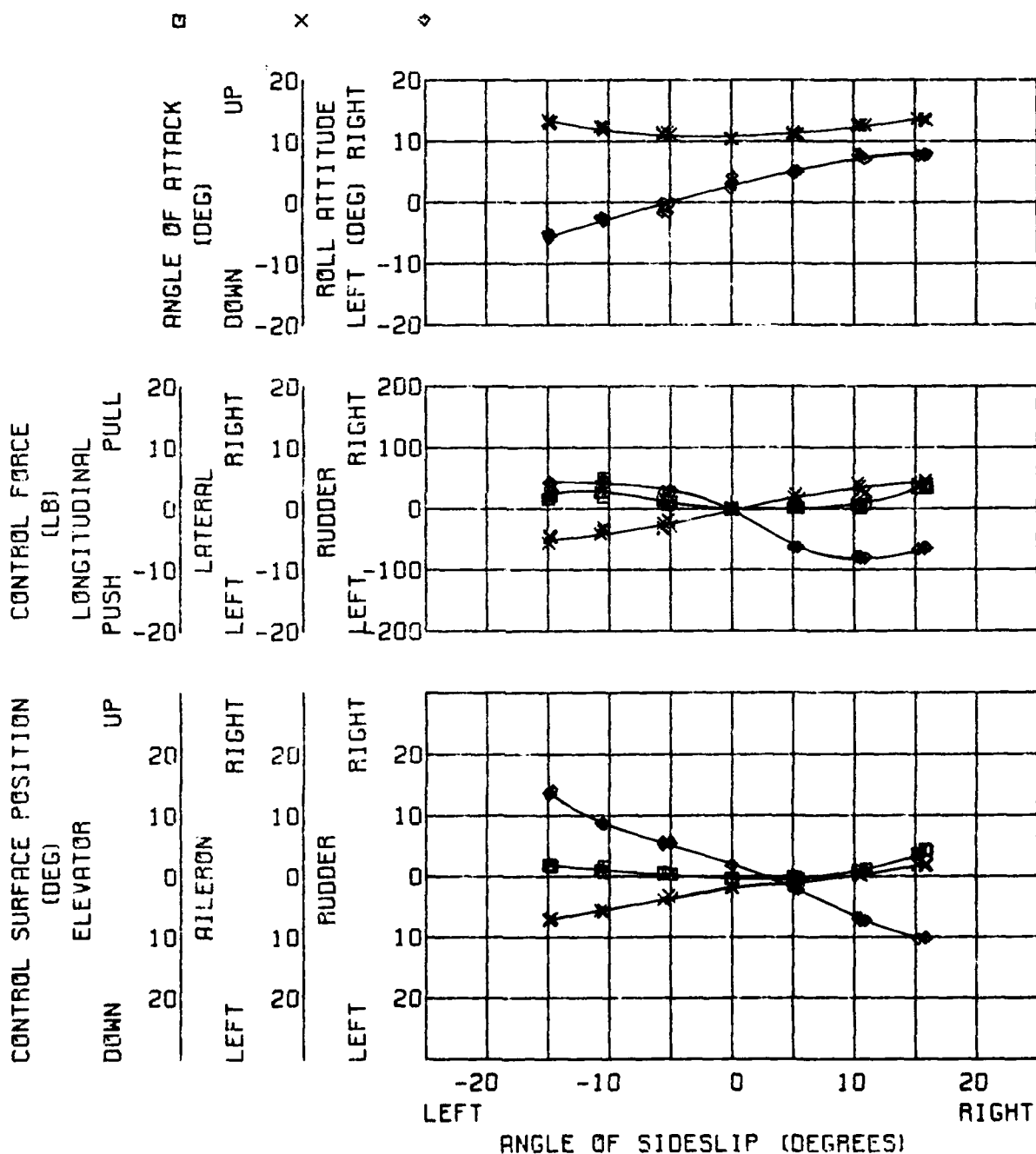


FIGURE NO. 19  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 1

CONFIGURATION CR  
 GROSS WEIGHT = 14,840 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 15,309 IN.-LB

PRESSURE ALTITUDE = 10,170 FT  
 FREE AIR TEMP. = -1.5 DEG C

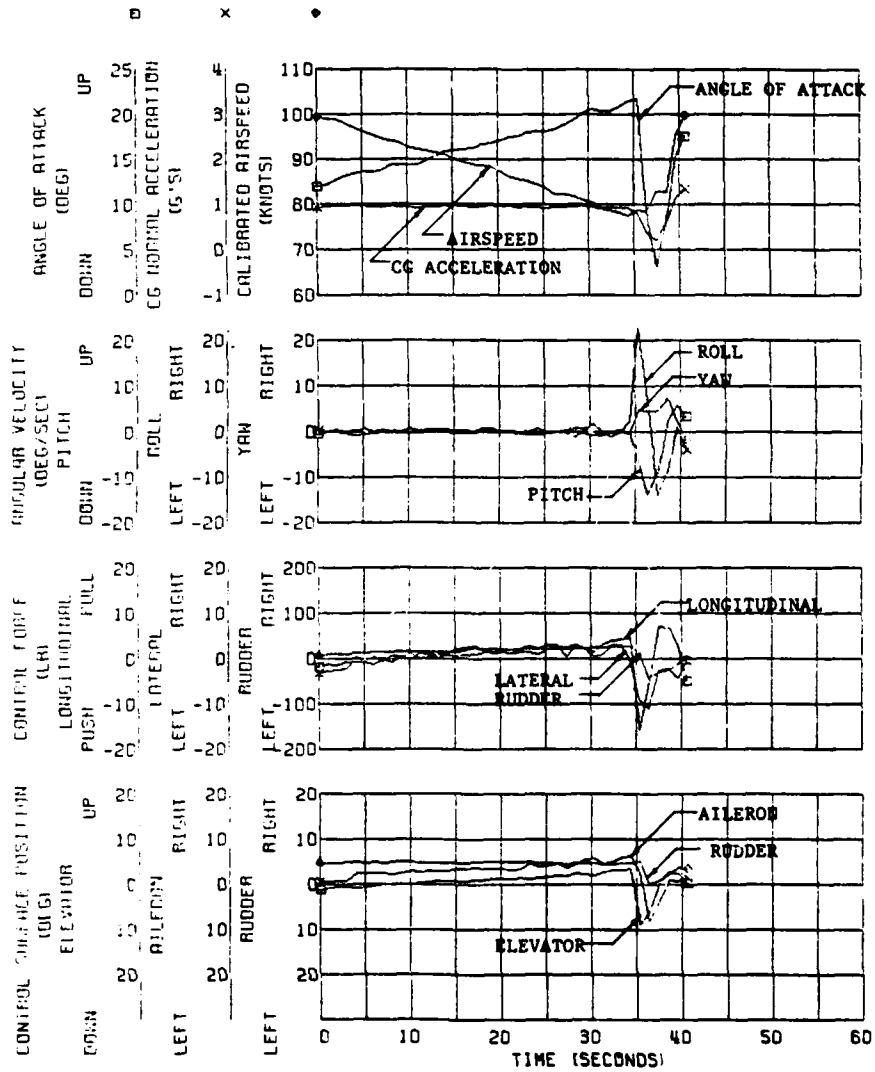


FIGURE NO. 20  
 DUAL ENGINE STALLS  
 OV-10(1) USA S/N 68-15937  
 WING STORE CONFIGURATION 1

CONFIGURATION PA  
 GROSS WEIGHT = 14,700 LB  
 CG 29.9 PERCENT MAC  
 LAT. CG MOMENT = 15,309 IN.-LB

PRESSURE ALTITUDE = 9,620 FT  
 FREE AIR TEMP. = -0.5 DEG C

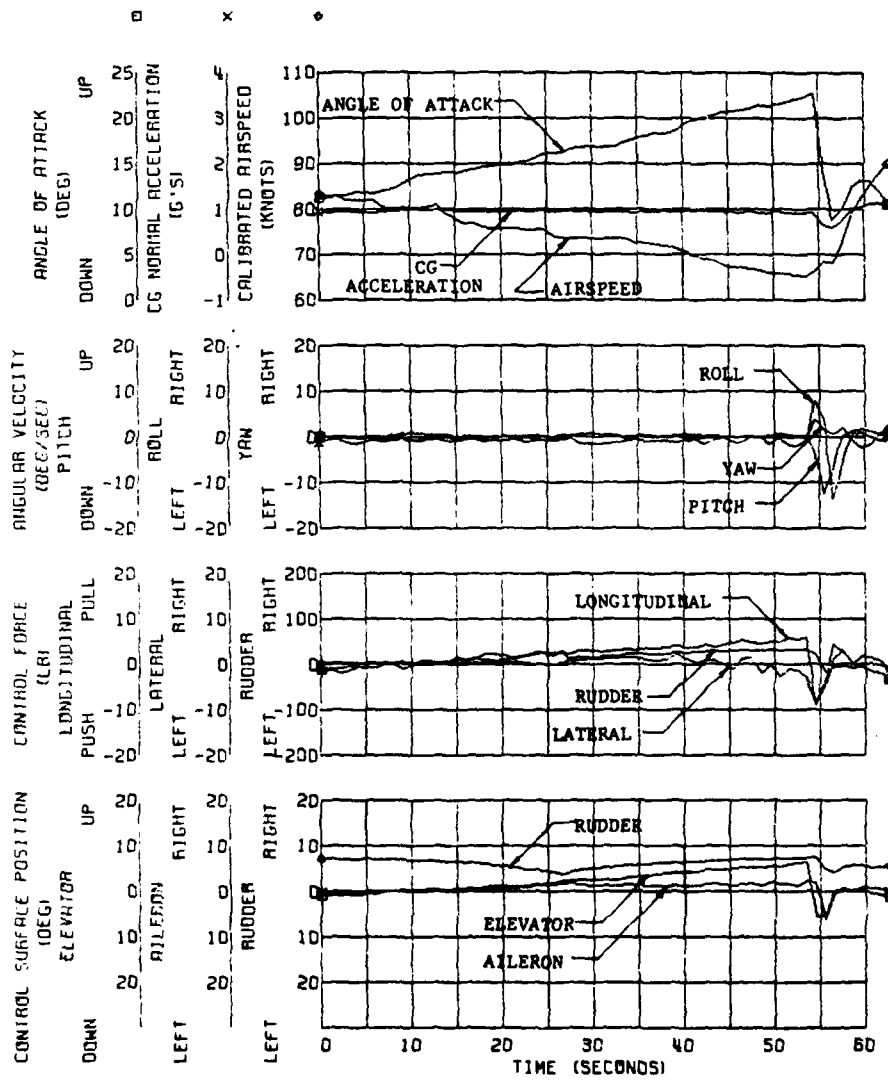


FIGURE NO. 21  
 DUAL ENGINE STALLS  
 OV-10 (C) USA S/N 68-15932  
 WING STORE CONFIGURATION 1

CONFIGURATION CR  
 GROSS WEIGHT = 14,540 LB  
 CG 30.2 PERCENT MAC  
 LAT. CG MOMENT = 15,309 IN.-LB

PRESSURE ALTITUDE = 10,920 FT  
 FREE AIR TEMP. = -1.5 DEG C

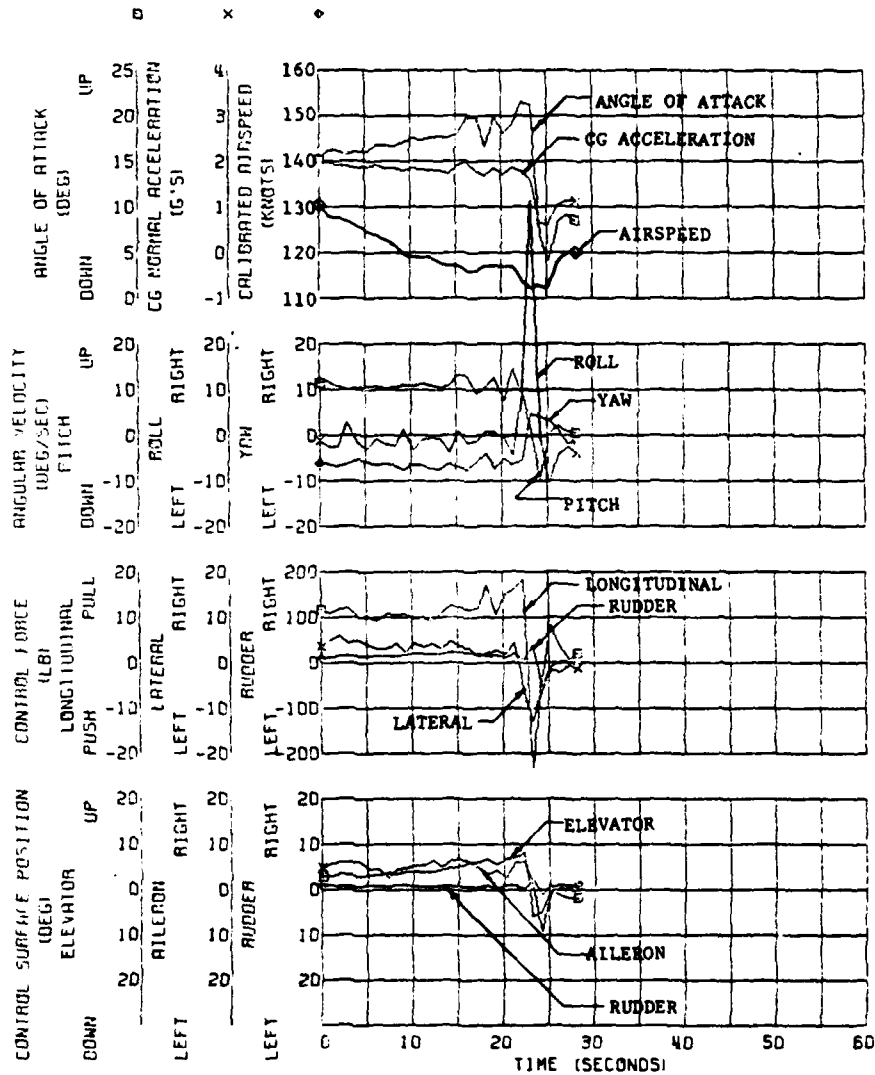




FIGURE NO. 22  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 1

CONFIGURATION TO  
 GROSS WEIGHT = 14,420 LB  
 CG 30.0 PERCENT MAC  
 LAT. CG MOMENT = 15,309 IN.-LB

PRESSURE ALTITUDE = 9,260 FT  
 FREE AIR TEMP. = -0.5 DEG C

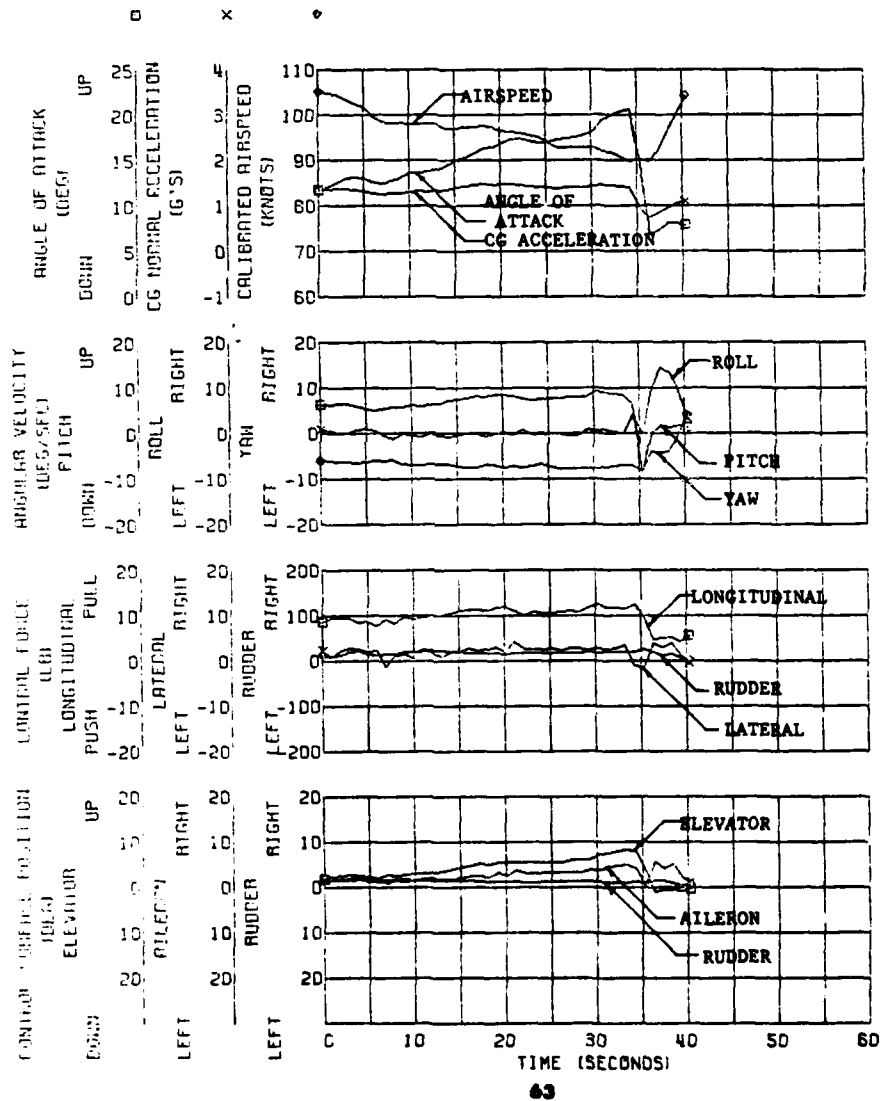


FIGURE NO. 23  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 2

CONFIGURATION CR  
 GROSS WEIGHT = 15,600 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 19,575 IN.-LB

PRESSURE ALTITUDE = 9,500 FT  
 FREE AIR TEMP. = -1.0 DEG C

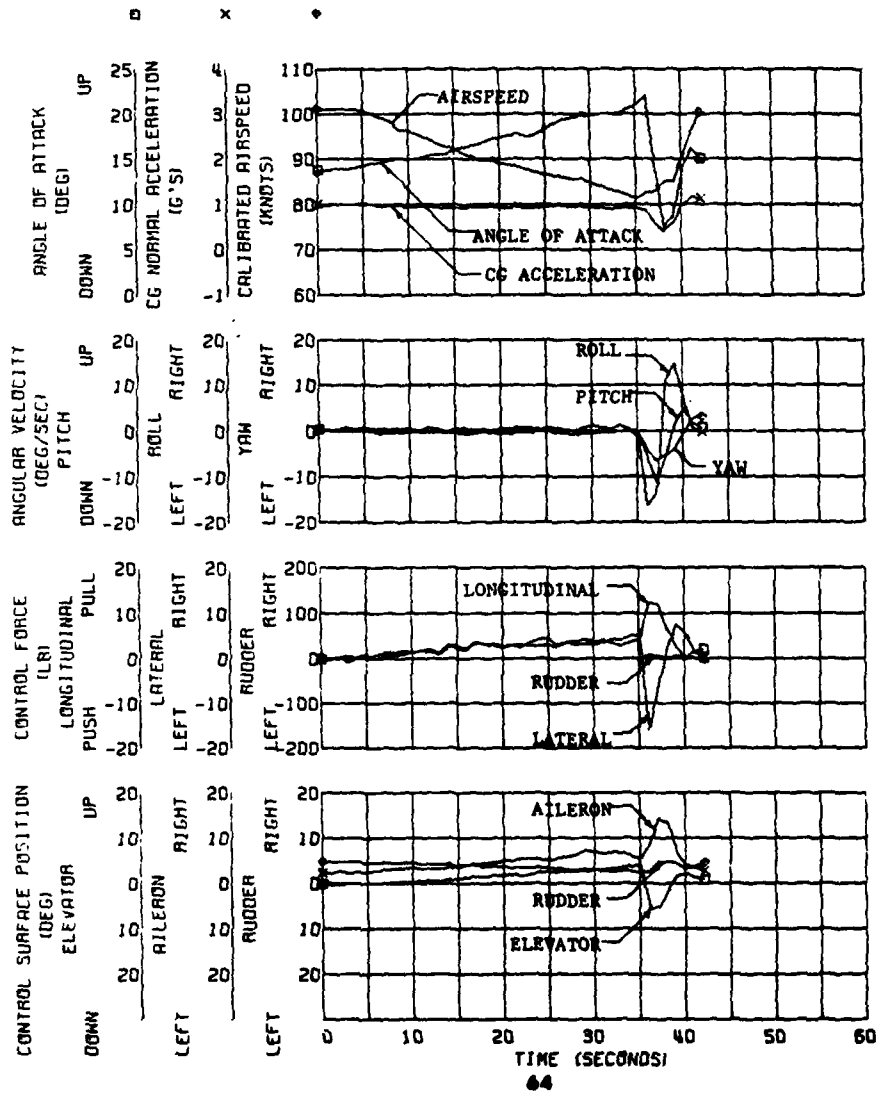


FIGURE NO. 24  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 2

CONFIGURATION PA  
 GROSS WEIGHT = 15,450 LB  
 CG 30.0 PERCENT MAC  
 LAT. CG MOMENT = 19,575 IN.-LB

PRESSURE ALTITUDE = 9,800 FT  
 FREE AIR TEMP. = -1.5 DEG C

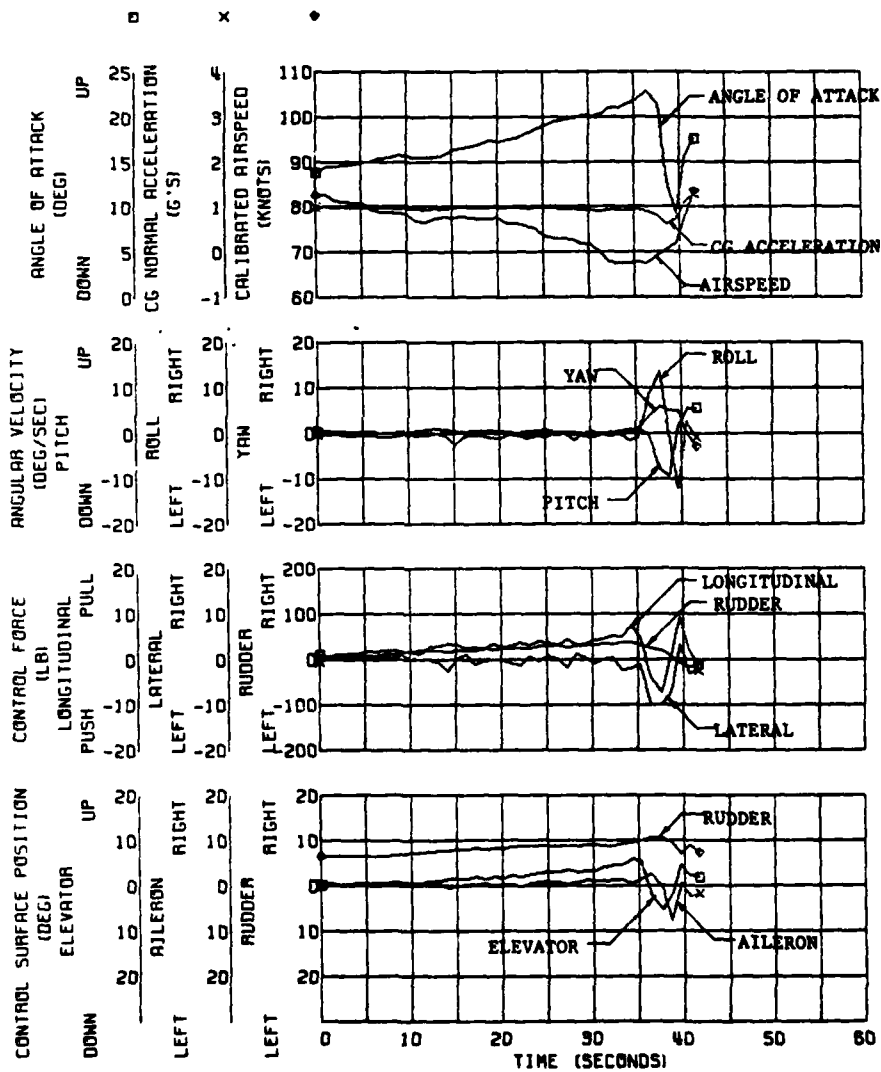


FIGURE NO. 25  
DUAL ENGINE STALLS

OV-10 (C) 1<sup>ST</sup> S/N 68-15932  
WING STORE CONFIGURATION 2

CONFIGURATION CR  
GROSS WEIGHT = 15,170 LB  
CG 30.2 PERCENT MAC  
LAT. CG MOMENT = 19,575 IN.-LB

PRESSURE ALTITUDE = 10,620 FT  
FREE AIR TEMP. = -2.0 DEG C

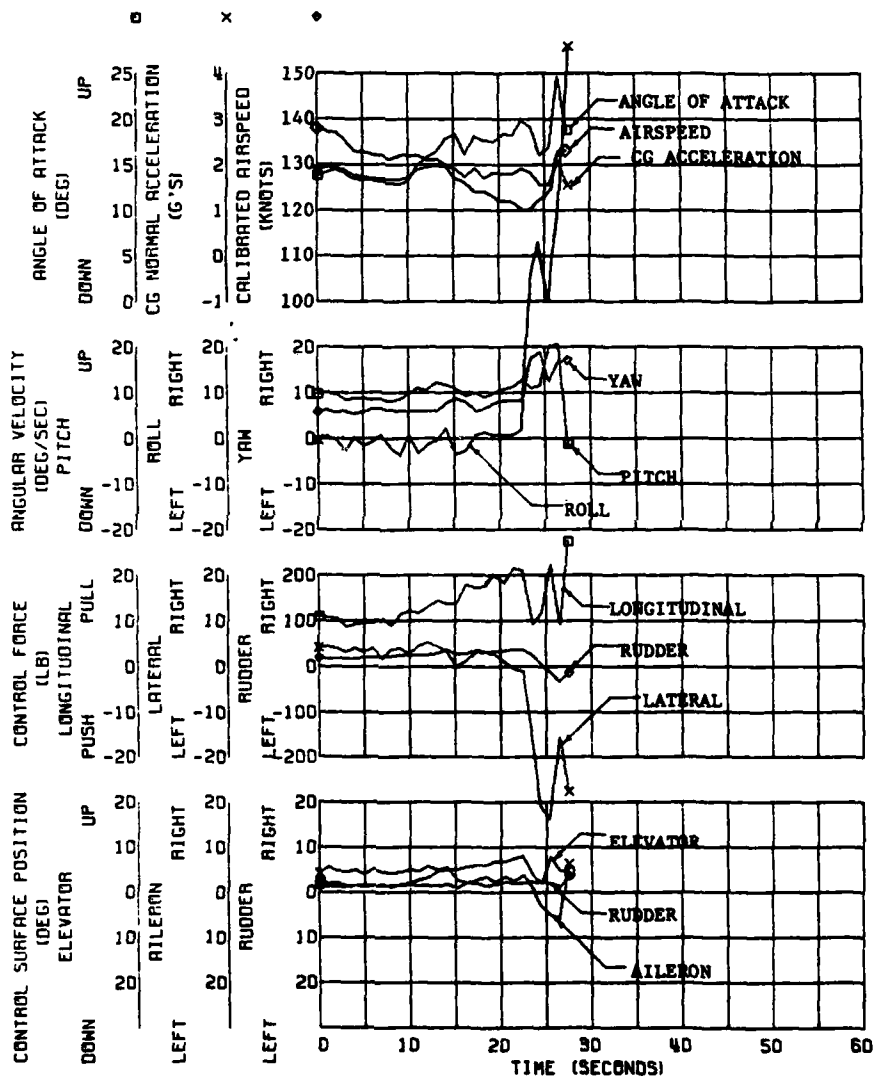


FIGURE NO. 26  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 2

CONFIGURATION PA  
 GROSS WEIGHT = 14,940 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 19,575 IN.-LB

PRESSURE ALTITUDE = 10,240 FT  
 FREE AIR TEMP. = -1.0 DEG C

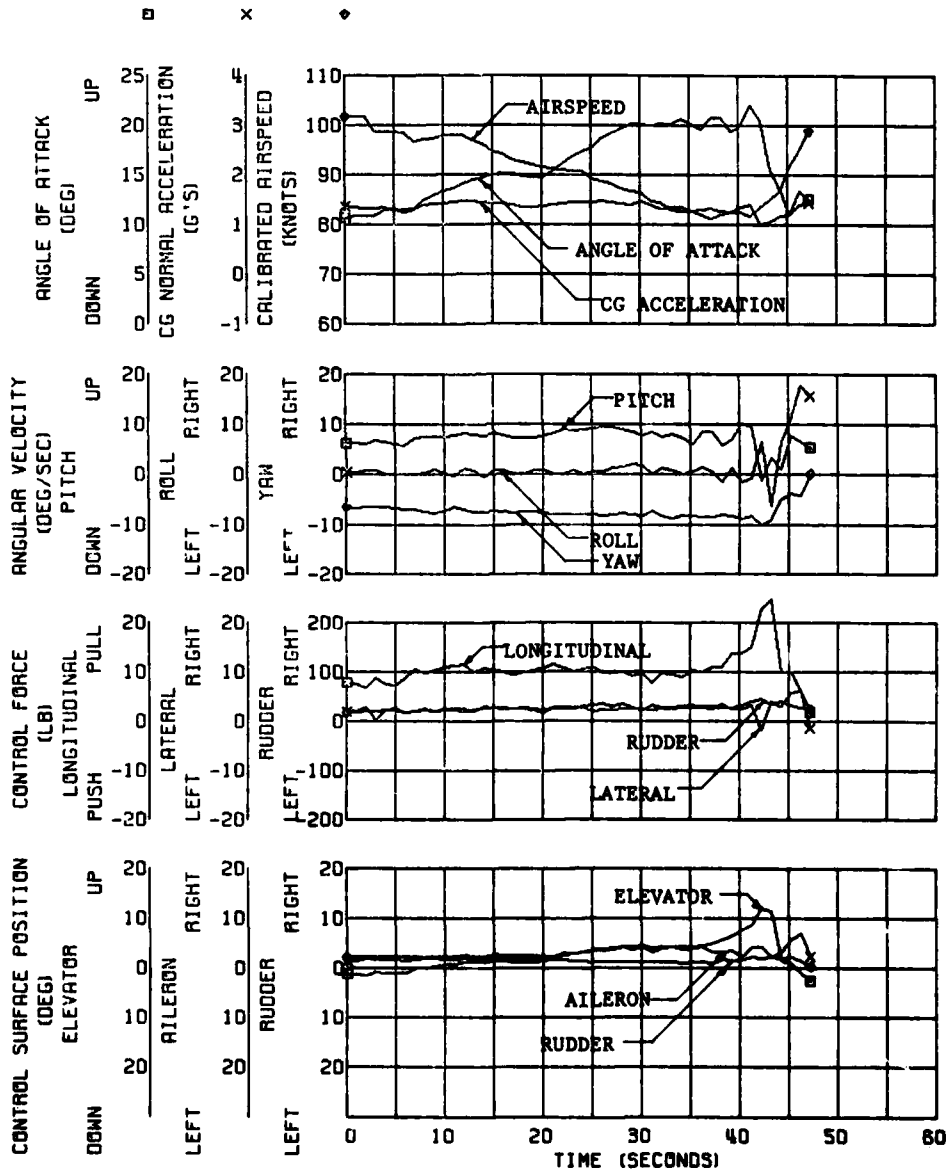


FIGURE NO. 27  
 DUAL ENGINE STALLS  
 OV-10 (C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION CR  
 GROSS WEIGHT = 18,200 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 65,825 IN.-LB

PRESSURE ALTITUDE = 9,620 FT  
 FREE AIR TEMP. = -0.5 DEG C

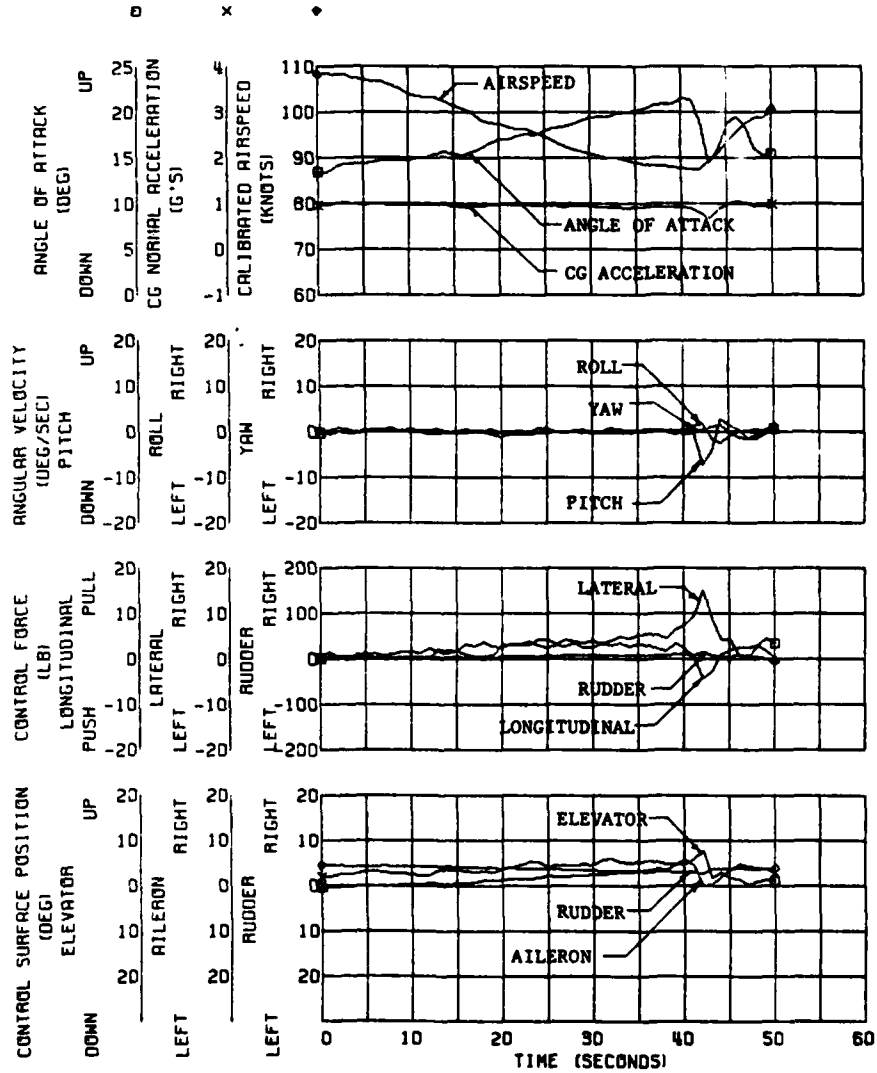


FIGURE NO. 28  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION PA  
 GROSS WEIGHT = 18,040 LB  
 CG 29.9 PERCENT MAC  
 LAT. CG MOMENT = 65,825 IN.-LB

PRESSURE ALTITUDE = 9,780 FT  
 FREE AIR TEMP. = 0.5 DEG C

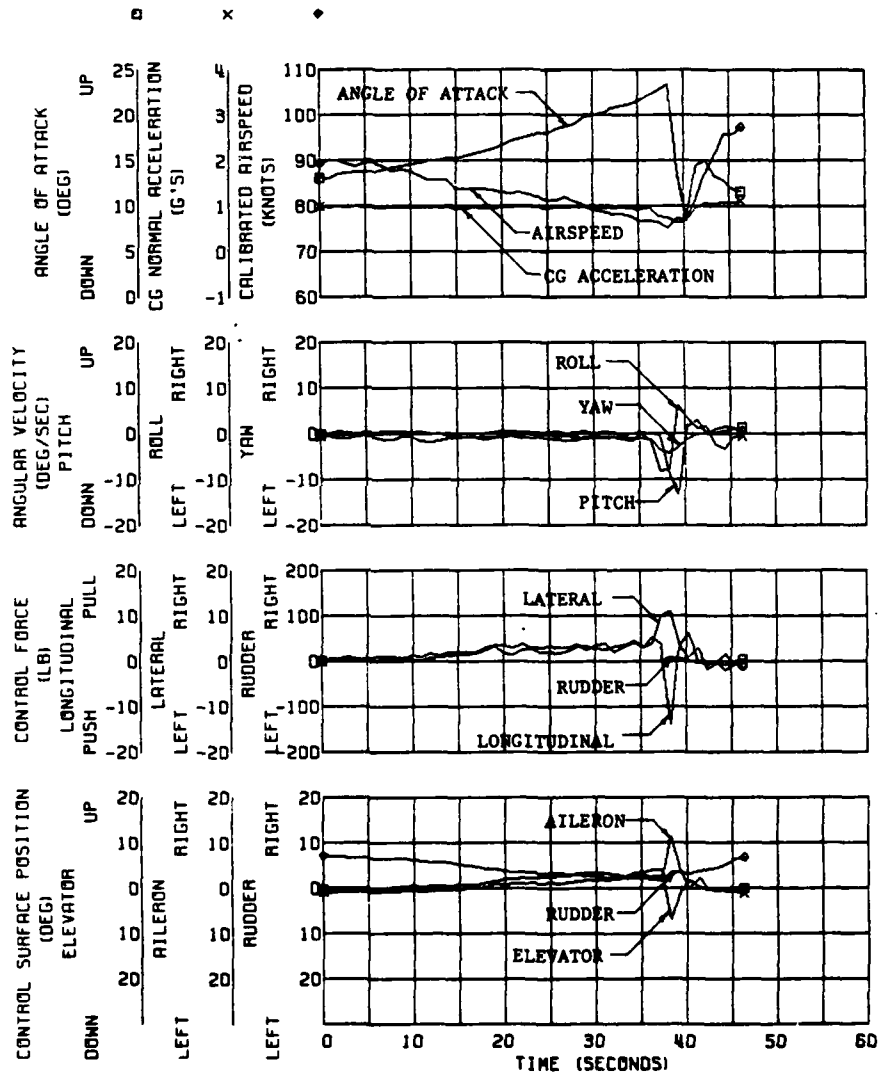


FIGURE NO. 29  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 3

CONFIGURATION CR  
 GROSS WEIGHT = 17,810 LB  
 CG 30.1 PERCENT MAC  
 LAT. CG MOMENT = 65,825 IN.-LB

PRESSURE ALTITUDE = 11,360 FT  
 FREE AIR TEMP. = -1.0 DEG C

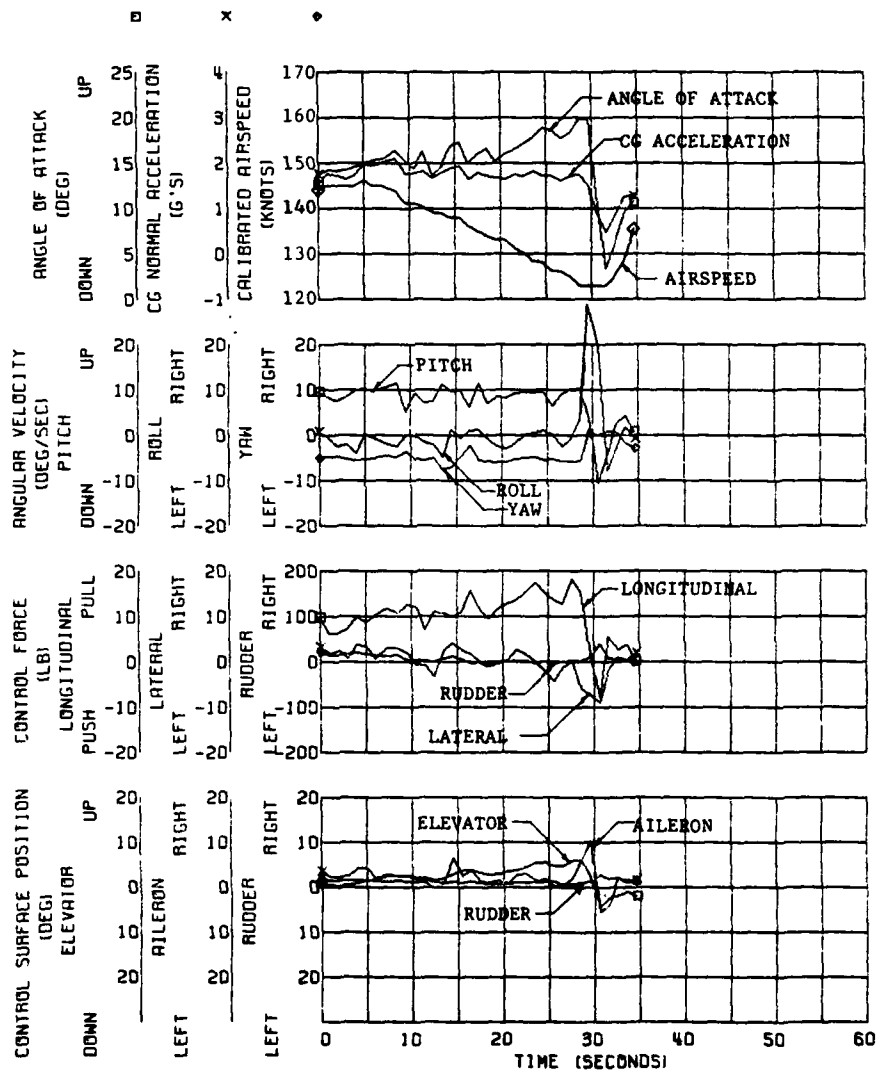




FIGURE NO. 30  
DUAL ENGINE STALLS

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 3

CONFIGURATION PA  
GROSS WEIGHT = 16,730 LB  
CG 30.2 PERCENT MAC  
LAT. CG MOMENT = 65,825 IN.-LB

PRESSURE ALTITUDE = 10,100 FT  
FREE AIR TEMP. = 0.5 DEG C

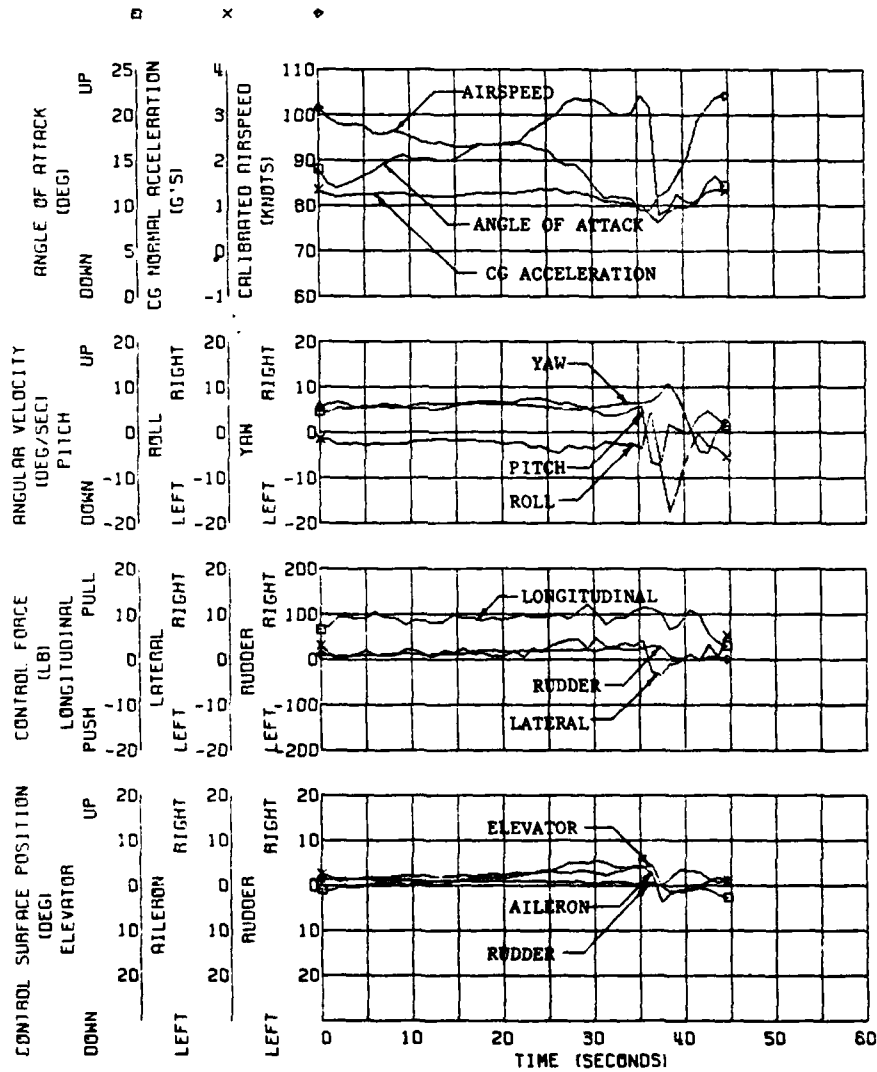


FIGURE NO. 31  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION CR  
 GROSS WEIGHT = 17,990 LB  
 CG 28.1 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 10,220 FT  
 FREE AIR TEMP. = 4.5 DEG C

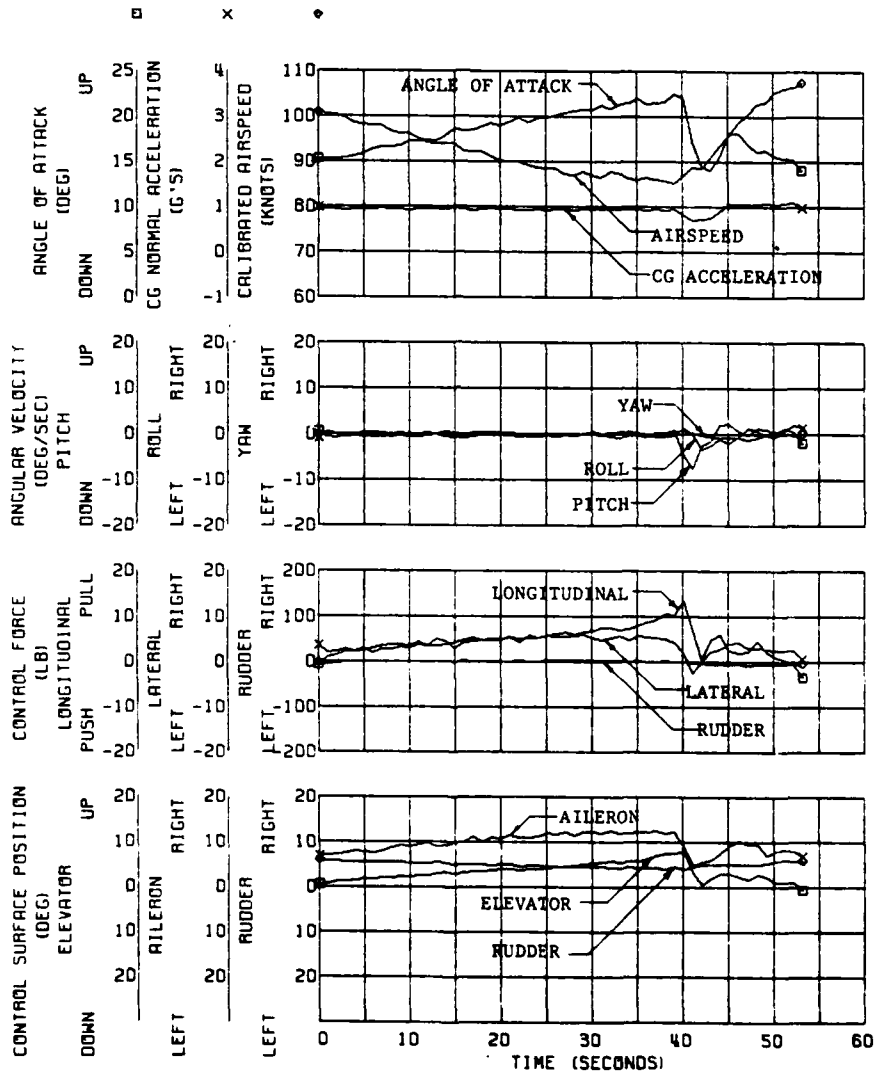


FIGURE NO. 32  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION TO  
 GROSS WEIGHT = 17,880 LB  
 CG 28.1 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 10,140 FT  
 FREE AIR TEMP. = 4.0 DEG C

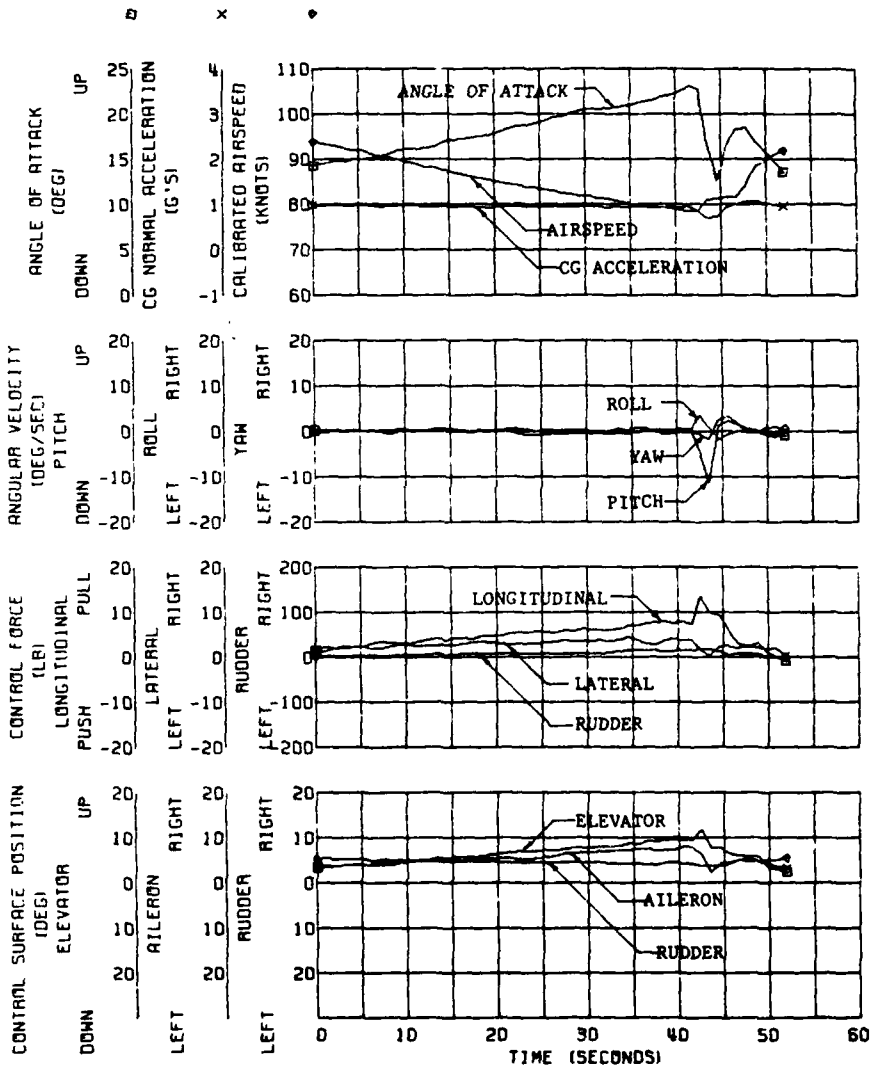


FIGURE NO. 33  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION PA  
 GROSS WEIGHT = 17,740 LB  
 CG 28.1 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 10,080 FT  
 FREE AIR TEMP. = 3.5 DEG C

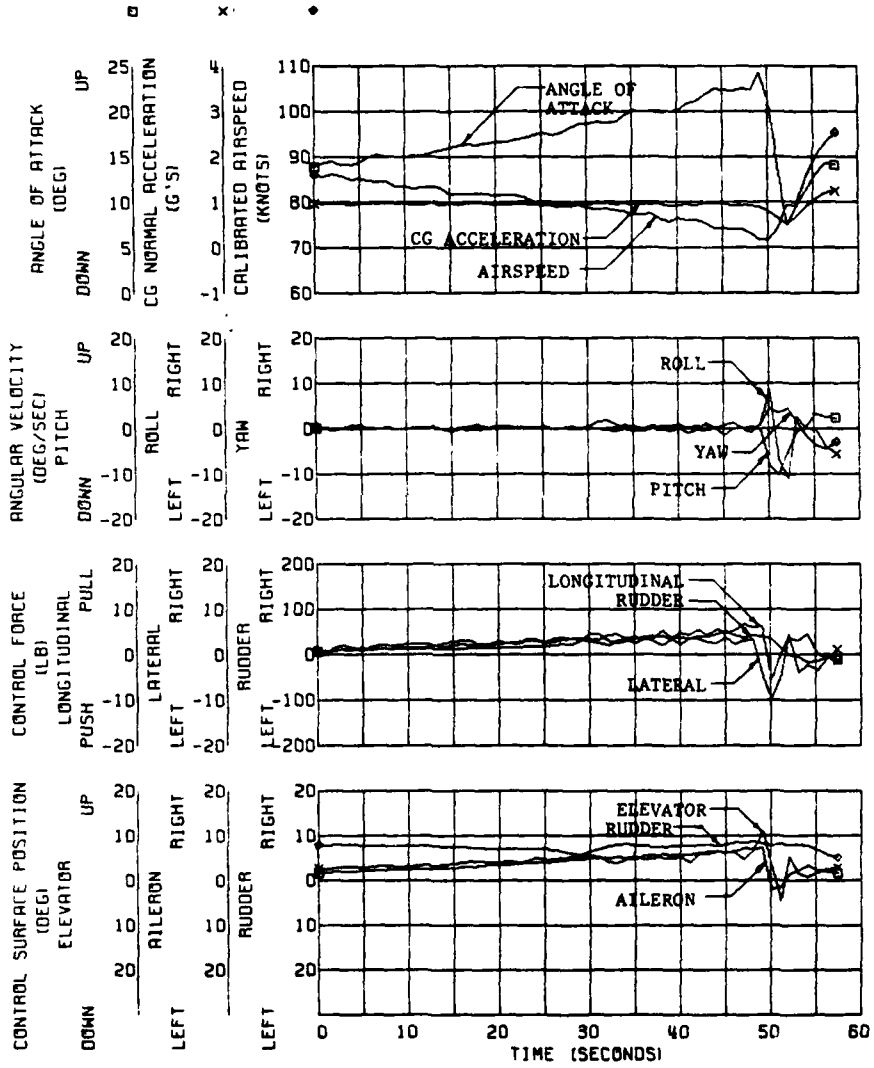


FIGURE NO. 34  
 DUAL ENGINE STALLS  
 OV-10 (C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION CR  
 GROSS WEIGHT = 17,130 LB  
 CG 28.5 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 10,860 FT  
 FREE AIR TEMP. = 4.5 DEG C

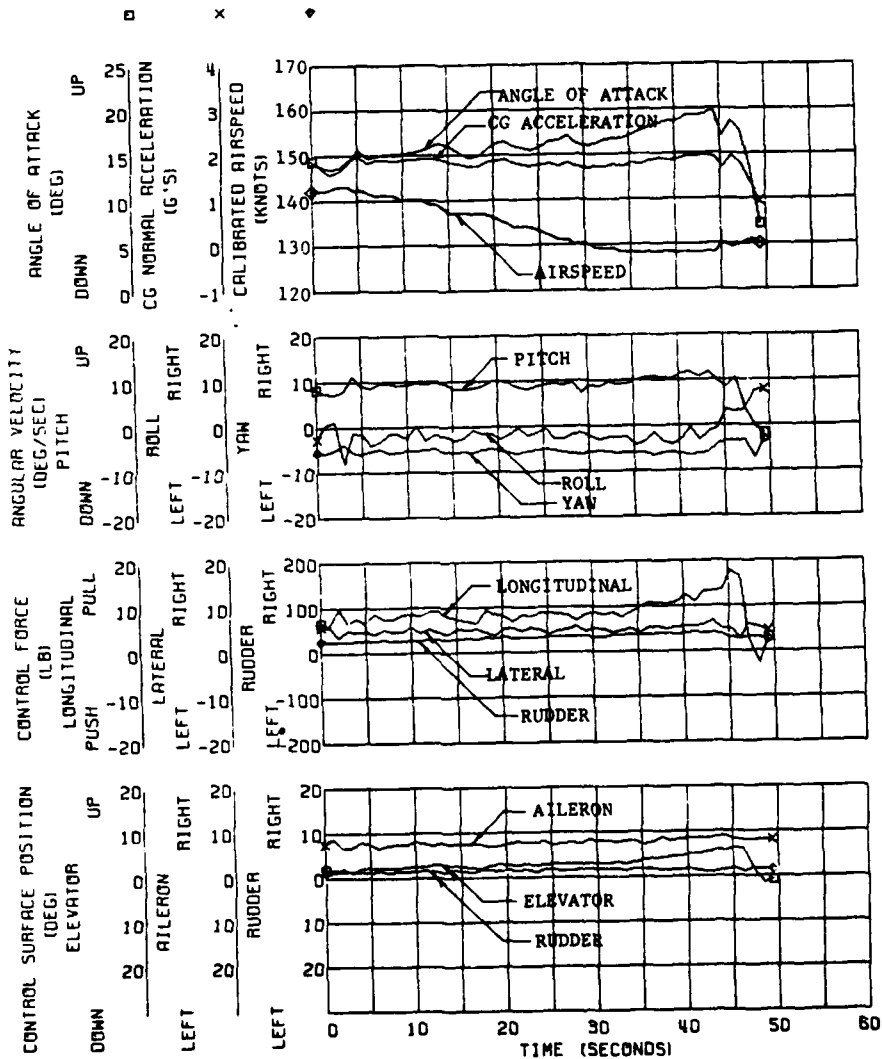


FIGURE NO. 35  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 4

CONFIGURATION TO  
 GROSS WEIGHT = 16,900 LB  
 CG 28.4 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 11,000 FT  
 FREE AIR TEMP. = 5.0 DEG C

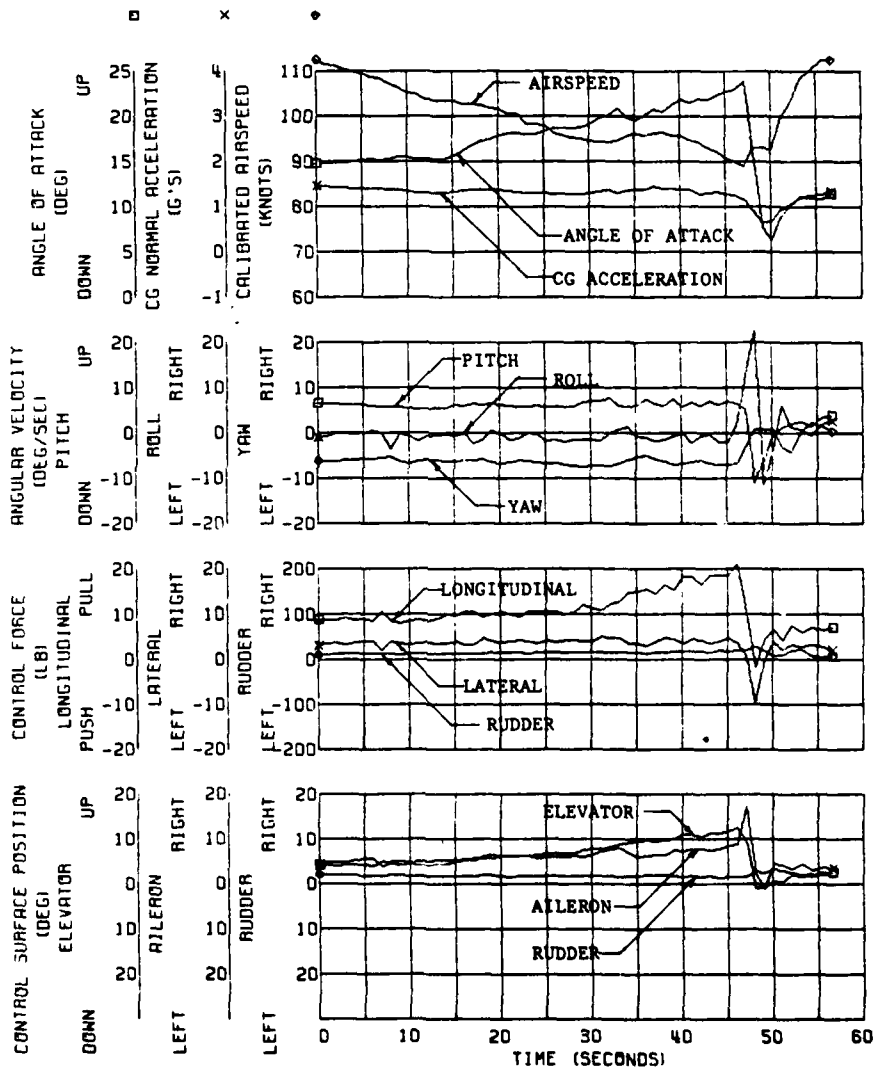


FIGURE NO. 36  
 DUAL ENGINE STALLS  
 OV-10 (C) USA S/N 68 15932  
 WING STORE CONFIGURATION 4

CONFIGURATION PA  
 GROSS WEIGHT = 16,680 LB  
 CG 28.4 PERCENT MAC  
 LAT. CG MOMENT = -31,418 IN.-LB

PRESSURE ALTITUDE = 10,480 FT  
 FREE AIR TEMP. = 5.0 DEG C

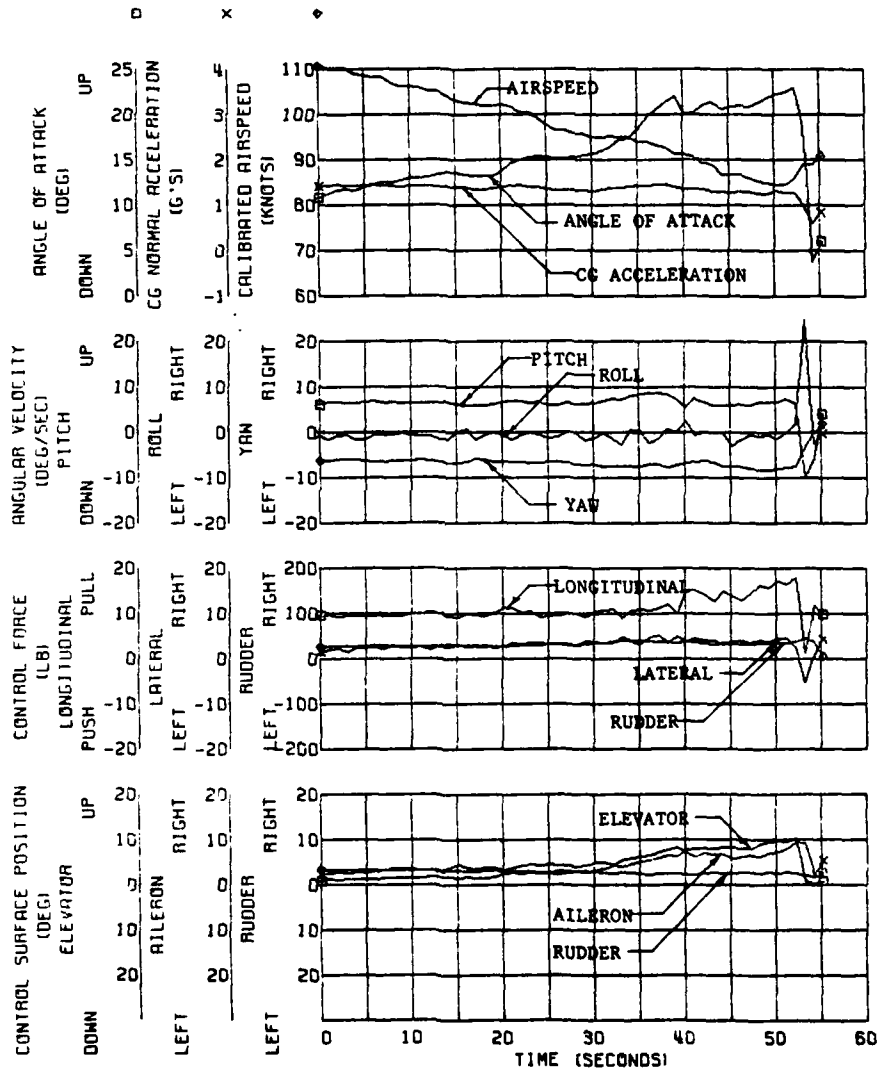


FIGURE NO. 37  
DUAL ENGINE STALLS

BV-10 (C) USA S/N 68-15832  
WING STORE CONFIGURATION 5

CONFIGURATION CR  
GROSS WEIGHT = 18,110 LB  
CG 28.2 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 9,860 FT  
FREE AIR TEMP. = -6.0 DEG C

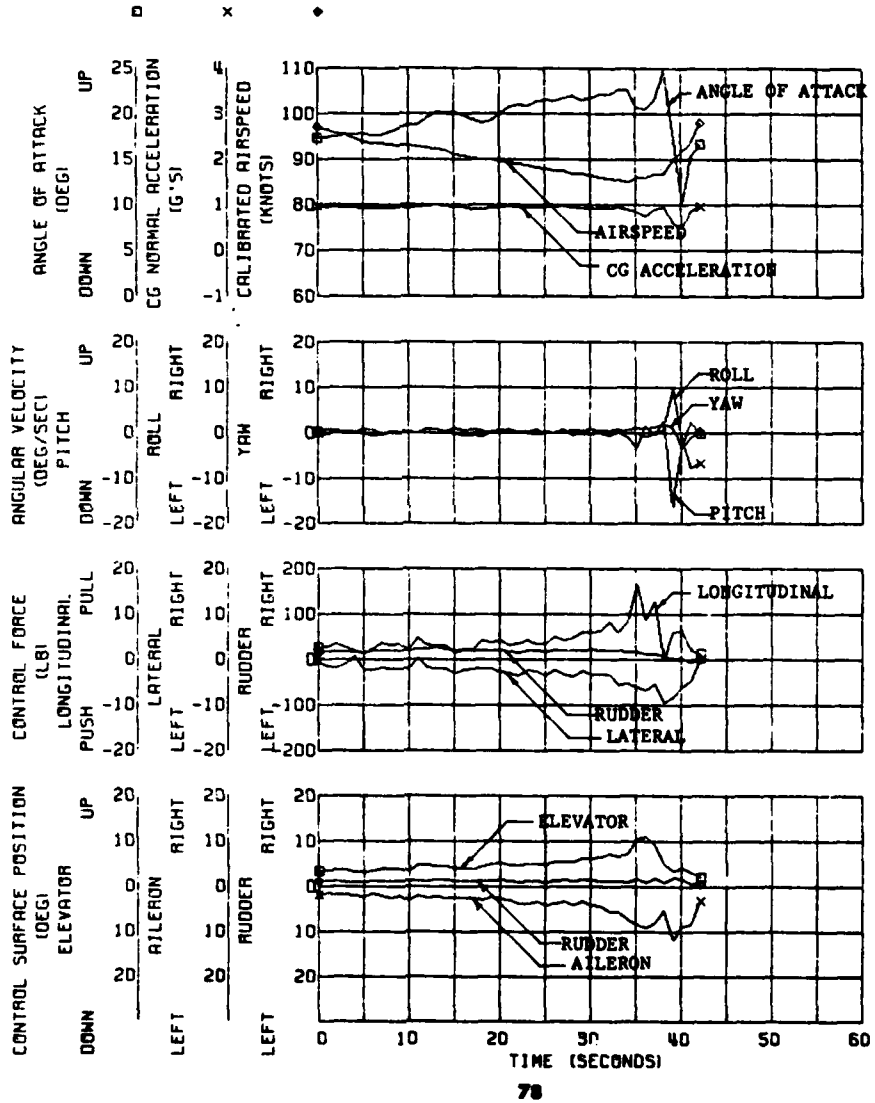




FIGURE NO. 38  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION PA  
 GROSS WEIGHT = 17,970 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 9,780 FT  
 FREE AIR TEMP. = -6.5 DEG C

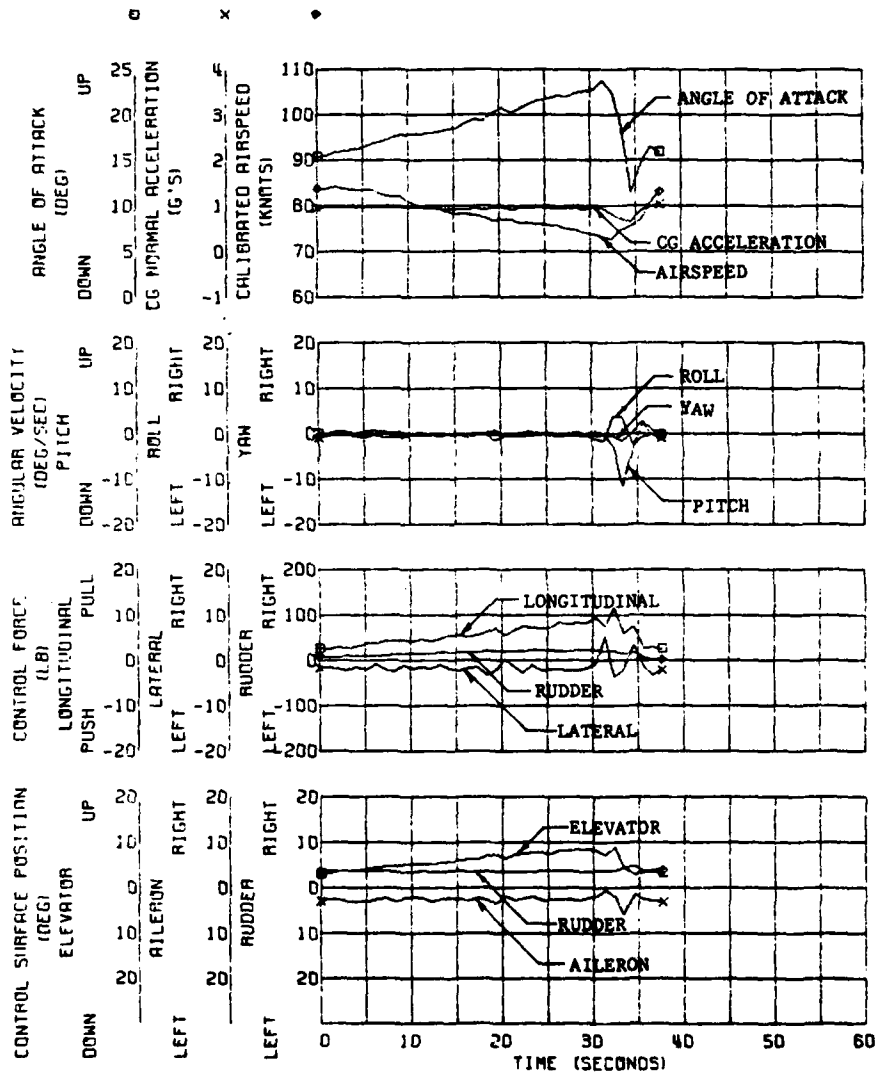


FIGURE NO. 39  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION L  
 GROSS WEIGHT = 17,880 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 9,920 FT  
 FREE AIR TEMP. = -6.5 DEG C

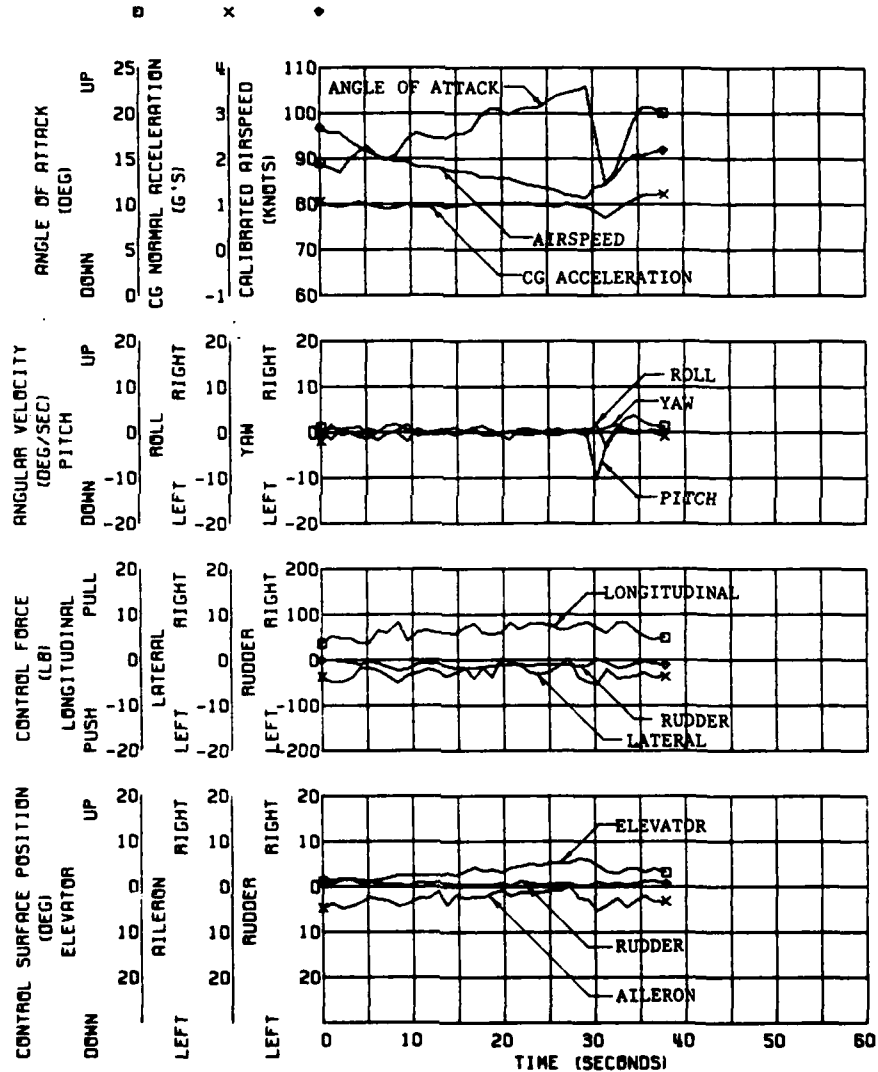


FIGURE NO. 40  
DUAL ENGINE STALLS

OV-10 (C) USA S/N 68-15932  
WING STORE CONFIGURATION 5

CONFIGURATION CR  
GROSS WEIGHT = 17,880 LB  
CG 28.2 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,760 FT  
FREE AIR TEMP. = -8 DEG C

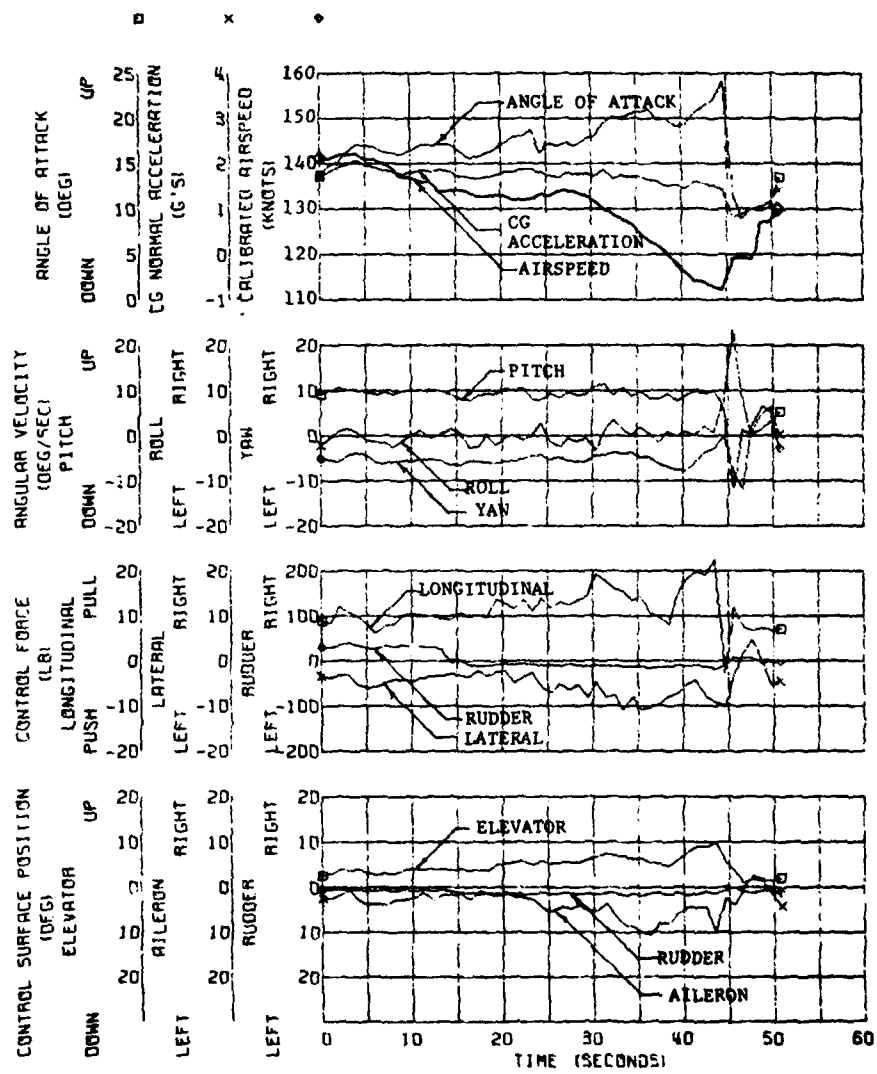


FIGURE NO. 41  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

CONFIGURATION TO  
 GROSS WEIGHT = 17,720 LB  
 CG 28.0 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,180 FT  
 FREE AIR TEMP. = -7.5 DEG C

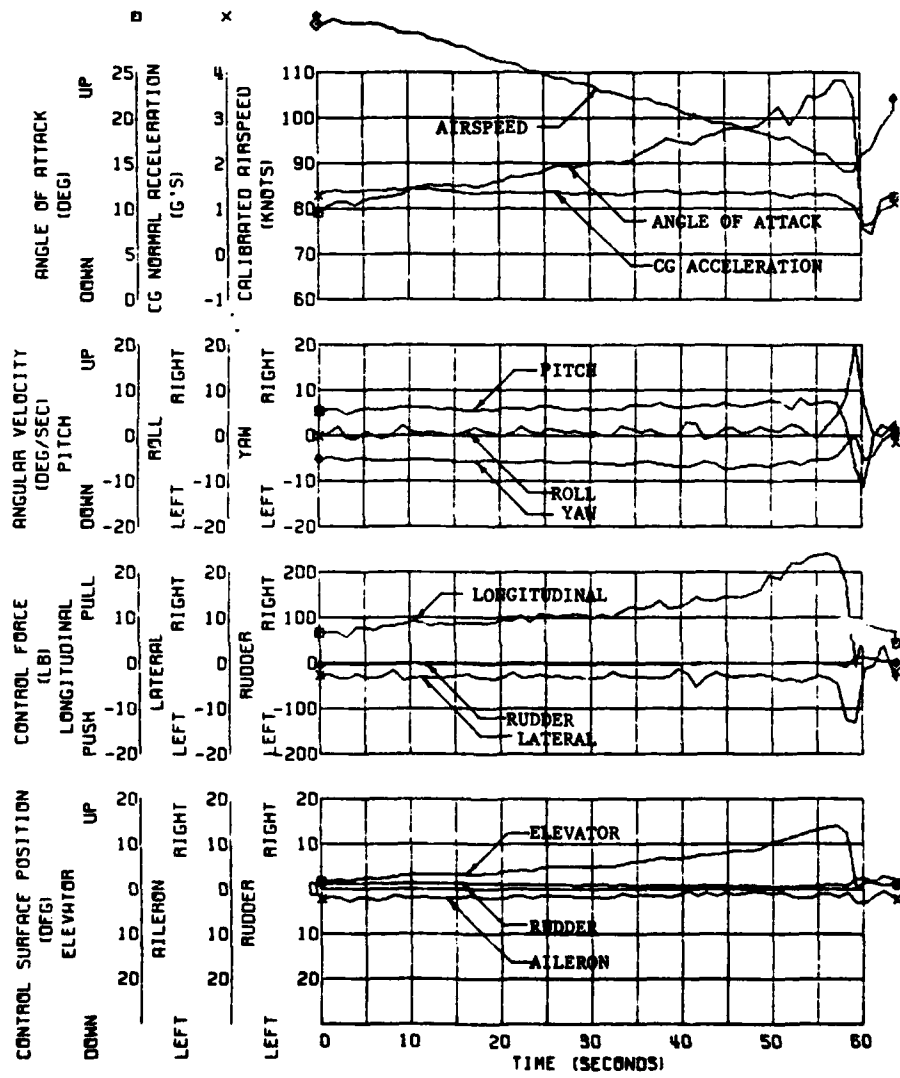


FIGURE NO. 42  
DUAL ENGINE STALLS

OY-1D(C) USA S/N 68-15932  
WING STORE CONFIGURATION 5

CONFIGURATION PA  
GROSS WEIGHT = 17,410 LB  
CG 28.1 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,000 FT  
FREE AIR TEMP. = -6.5 DEG C

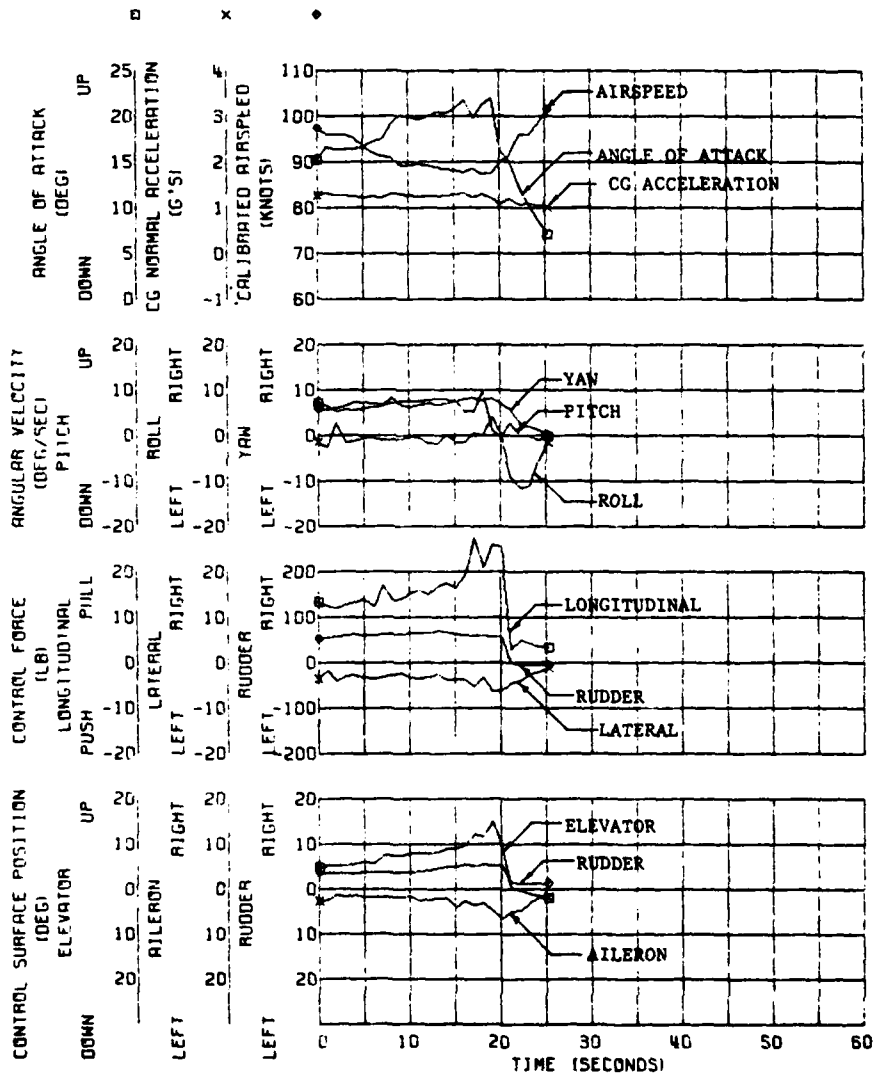


FIGURE NO. 43  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 6A 15932  
 WING STORE CONFIGURATION 6

CONFIGURATION CR  
 GROSS WEIGHT = 18,100 LB  
 CG 28.3 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 9,700 FT  
 FREE AIR TEMP. = 3.0 DEG C

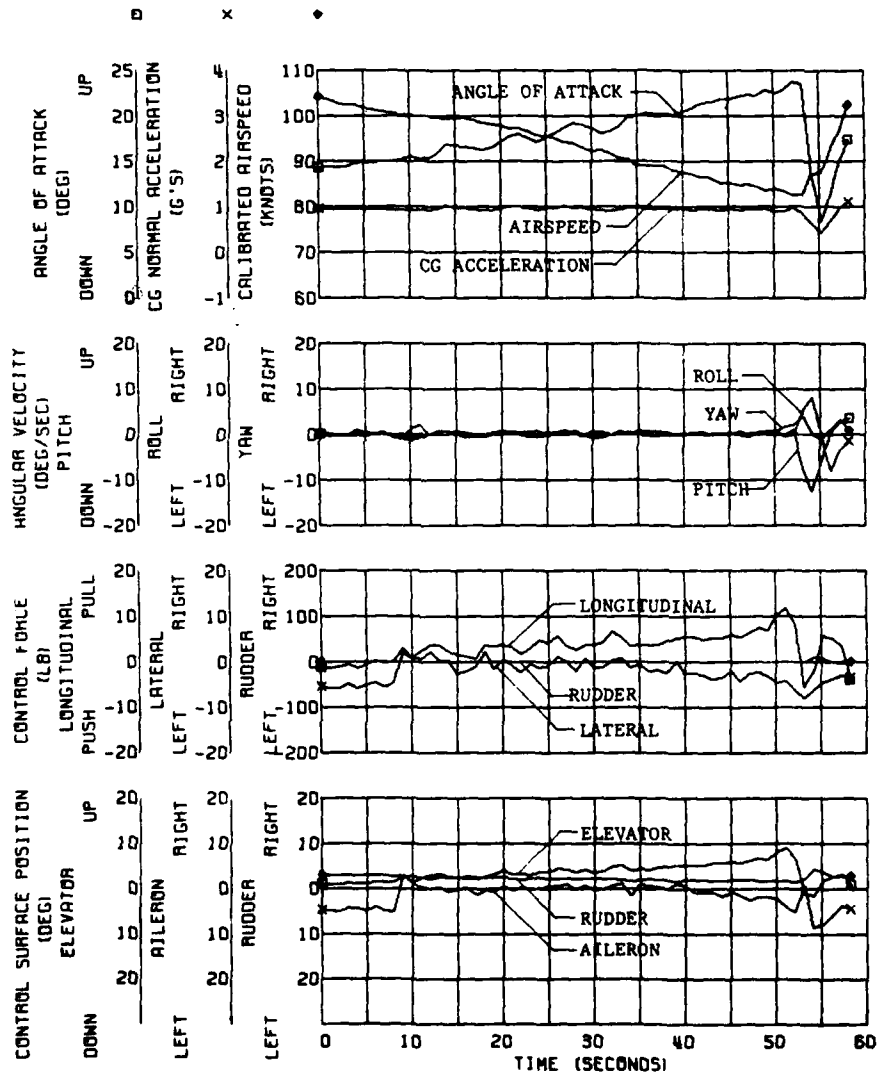


FIGURE NO. 44  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STOWE CONFIGURATION 6

CONFIGURATION TO  
 GROSS WEIGHT = 18,010 LB  
 CG 28.1 PERCENT MAC  
 LAT, CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 9,760 FT  
 FREE AIR TEMP. = 4.0 DEG C

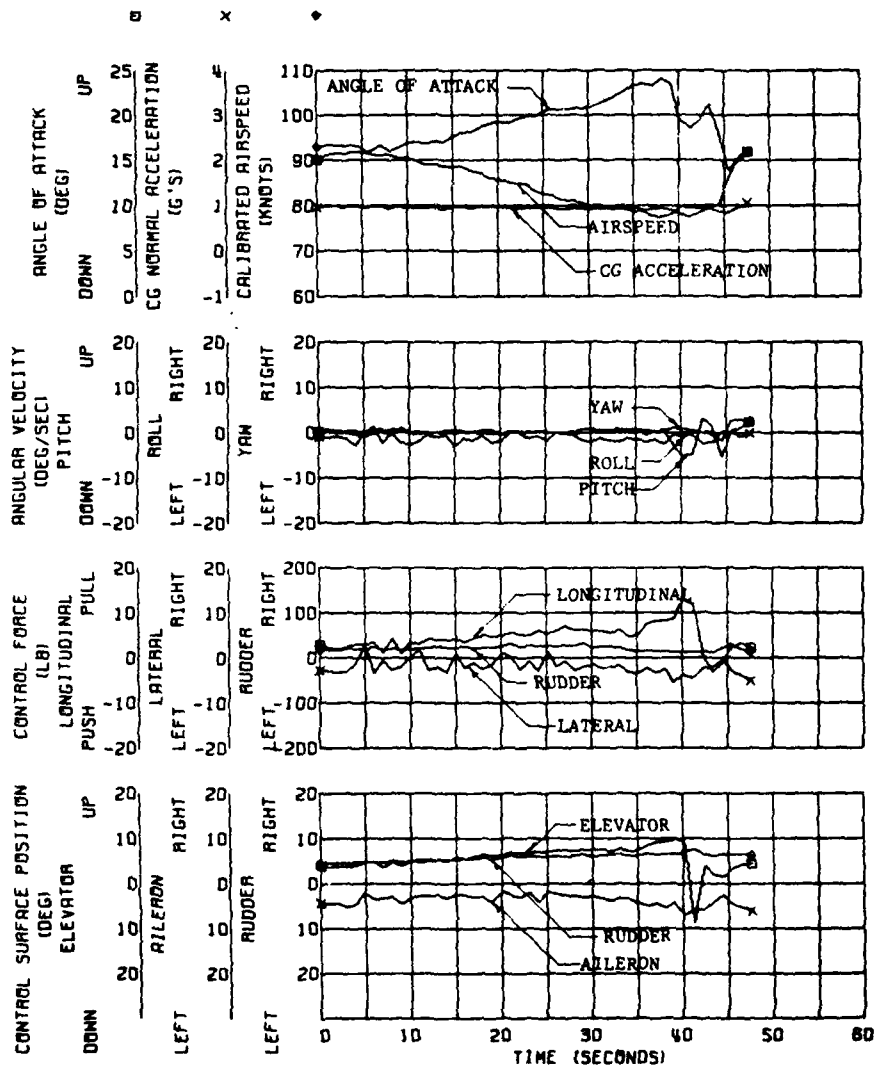


FIGURE NO. 45  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION PA  
 GROSS WEIGHT = 17,940 LB  
 CG 28.1 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN,-LB

PRESSURE ALTITUDE = 9,800 FT  
 FREE AIR TEMP. = 4.0 DEG C

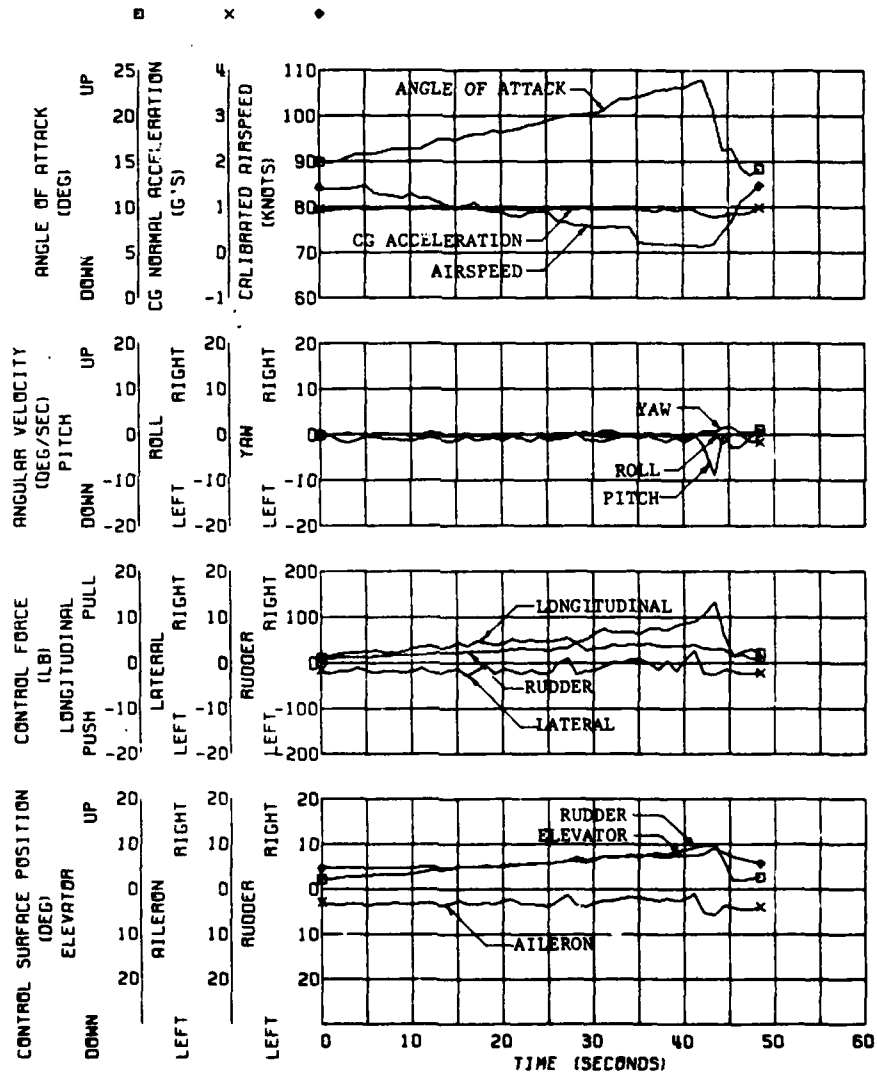




FIGURE NO. 46  
DUAL ENGINE STALLS

OV-10(C) USA S/N 68-15992  
WING STORE CONFIGURATION 6

CONFIGURATION 1  
GROSS WEIGHT = 17,550 LB  
CG 28.2 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,060 FT  
FREE AIR TEMP. = 4.5 DEG C

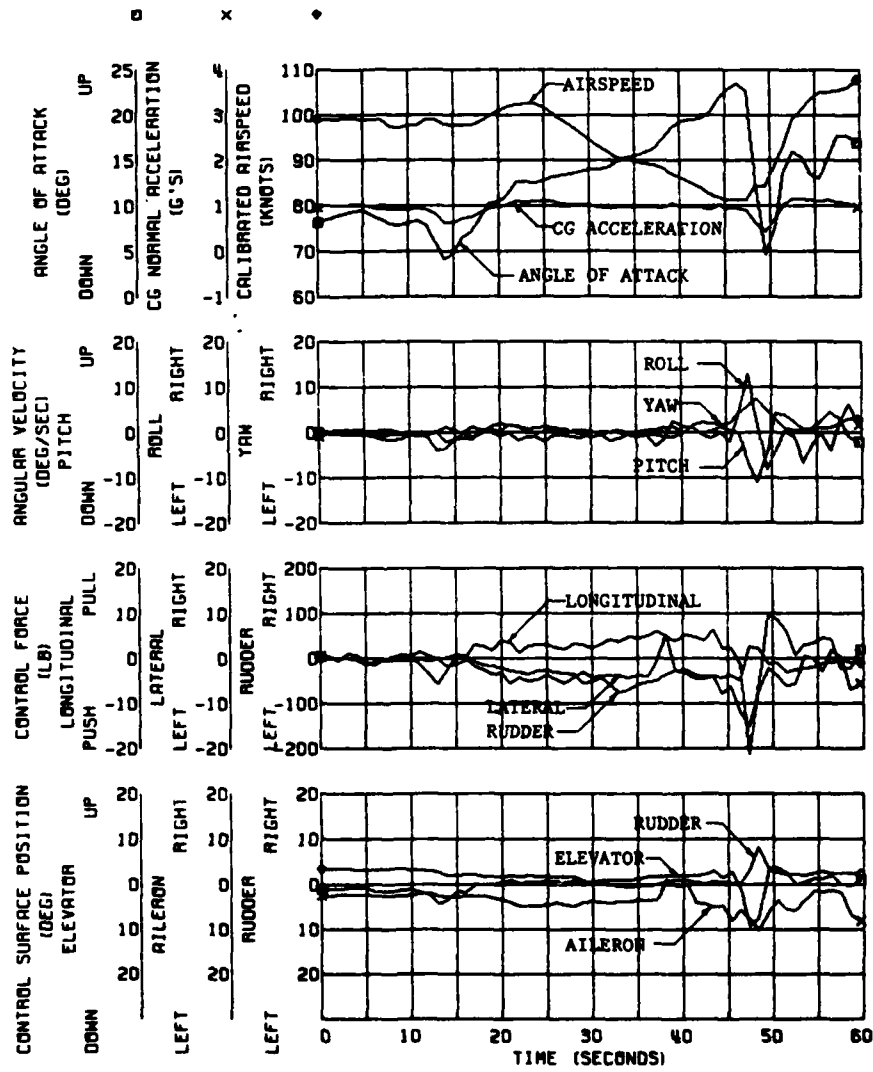


FIGURE NO. 47  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION CR  
 GROSS WEIGHT = 17,430 LB  
 CG 28.3 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,760 FT  
 FREE AIR TEMP. = 3.5 DEG C

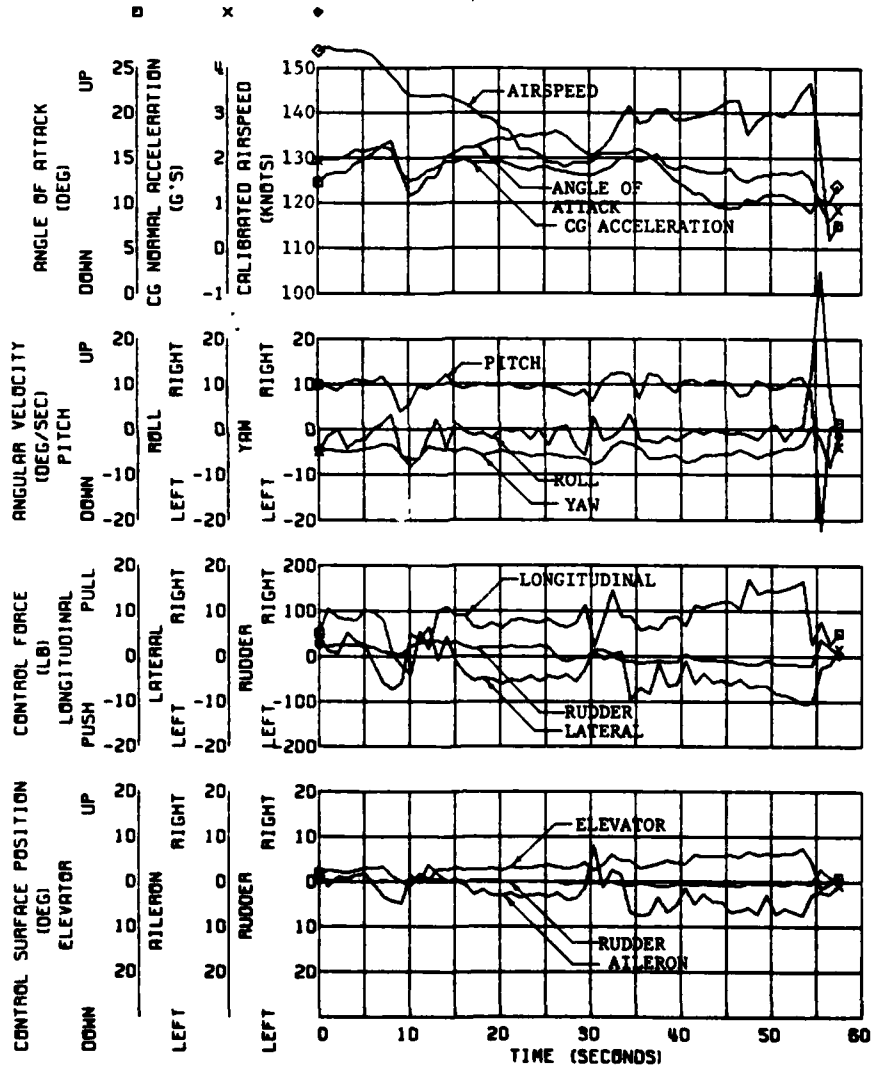


FIGURE NO. 48  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION TO  
 GROSS WEIGHT = 17,080 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,300 FT  
 FREE AIR TEMP. = 4.5 DEG C

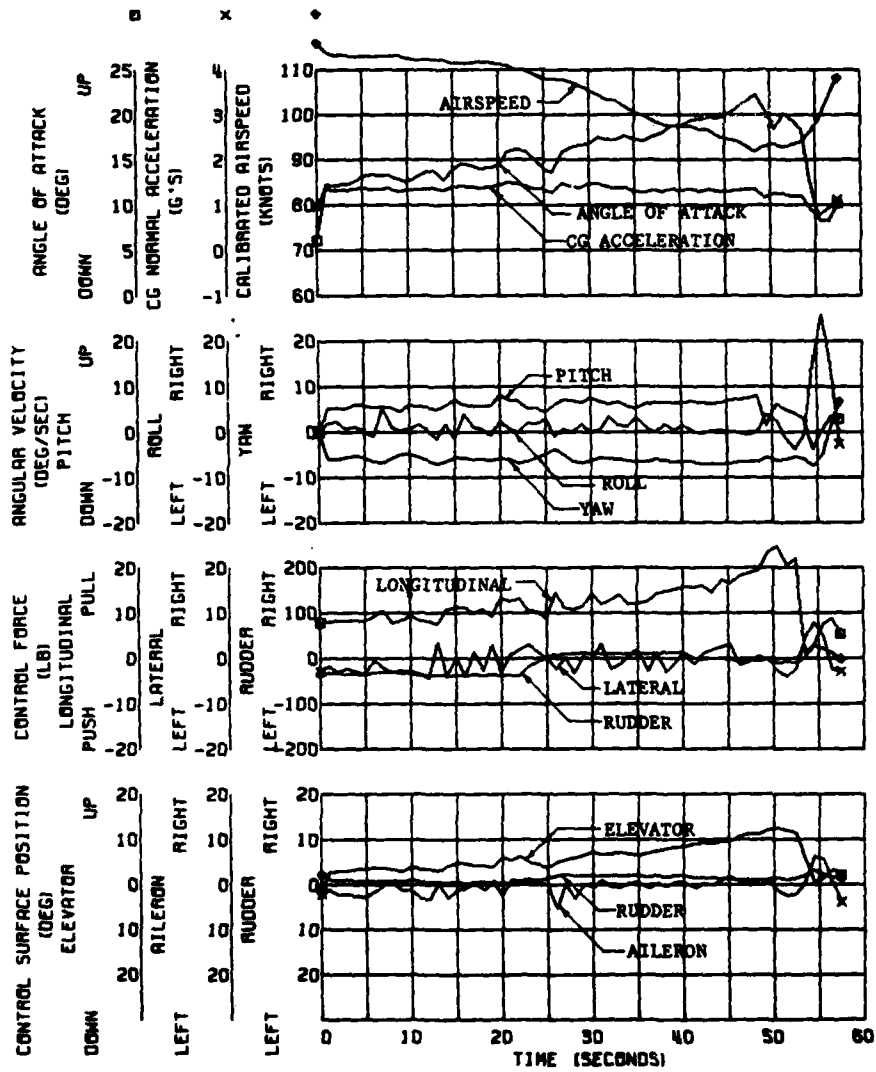


FIGURE NO. 49  
 DUAL ENGINE STALLS  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 6

CONFIGURATION PA  
 GROSS WEIGHT = 16,590 LB  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN.-LB

PRESSURE ALTITUDE = 10,000 FT  
 FREE AIR TEMP. = 4.5 DEG C

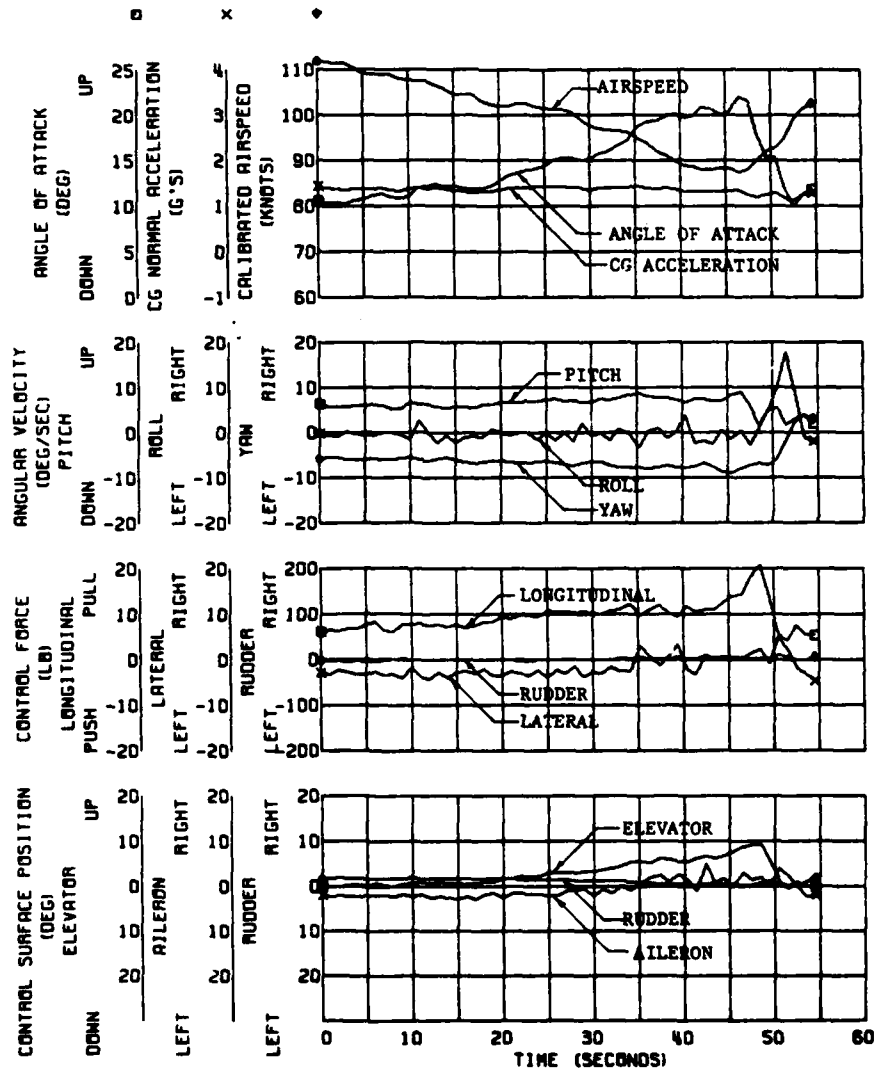


FIGURE NO. 50  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 1

LEFT PROP FEATHERED

CONFIGURATION CR  
GROSS WEIGHT - 14,850 LBS  
CG 30.1 PERCENT MAC

TRIM CAL. AIRSPEED - 140 KTS  
FREE AIR TEMP - 1.5 DEG C

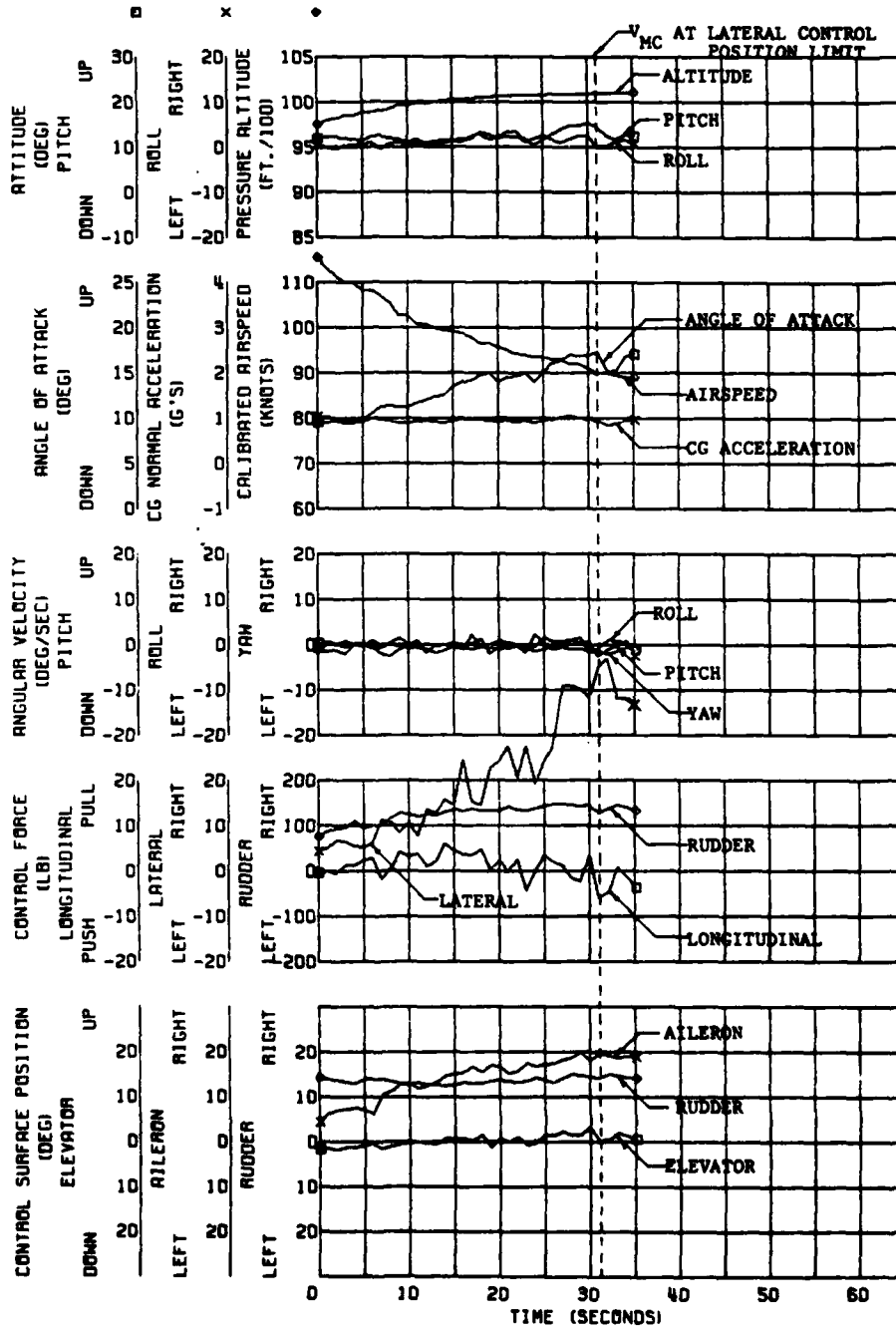


FIGURE NO. 51  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10 (C) USA S/N 68-15932  
WING STORE CONFIGURATION 1

LEFT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT - 14,500 LBS  
CG 30.0 PERCENT MAC

RECOMMENDED TAKEOFF TRIM  
FLE AIR TEMP = -0.5 DEG C

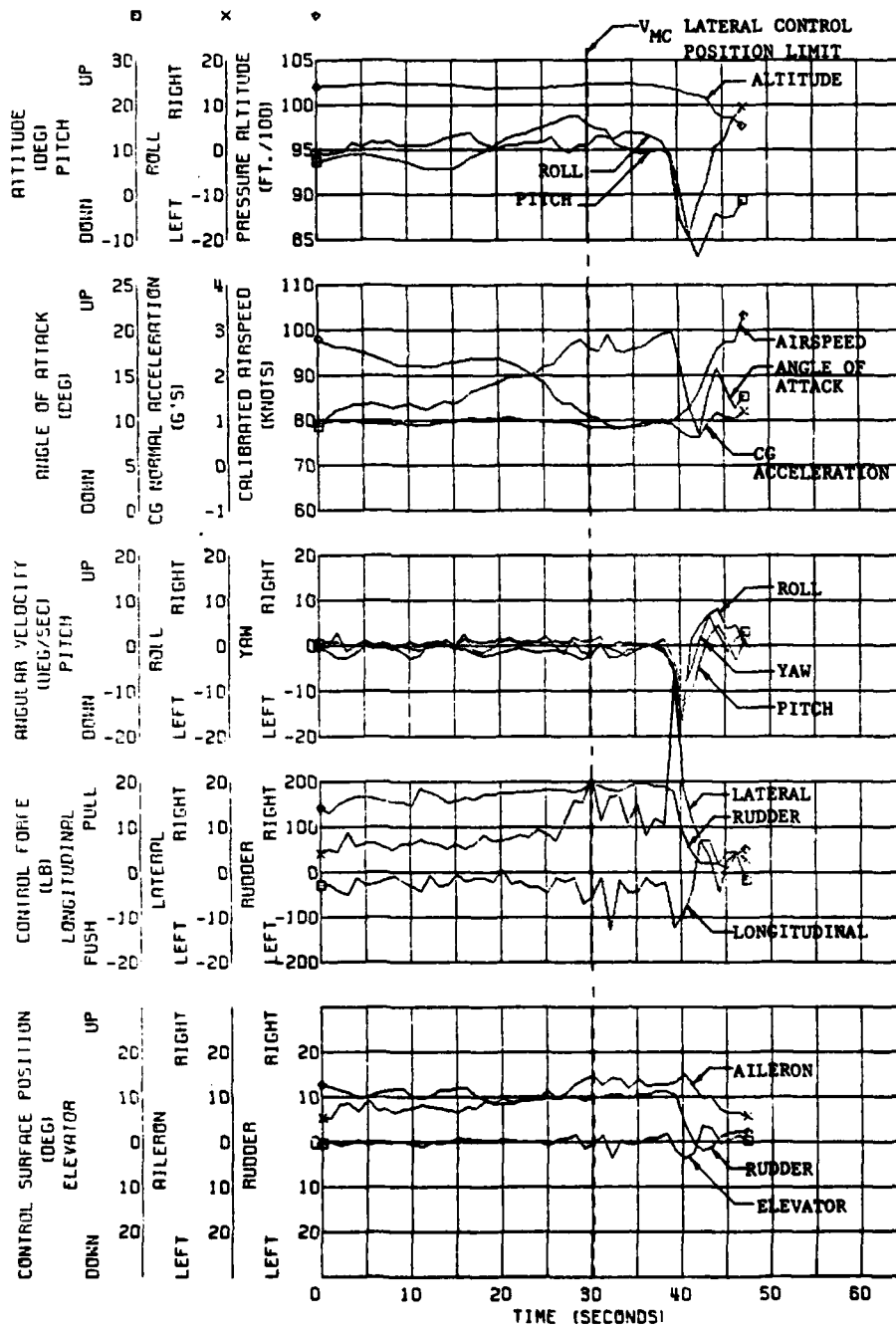


FIGURE NO. 52  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15832  
WING STORE CONFIGURATION 1

RIGHT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT = 14,390 LBS  
CG 30.0 PERCENT MAC

RECOMMENDED TAKEOFF TRIM  
FREE AIR TEMP = 0.5 DEG C

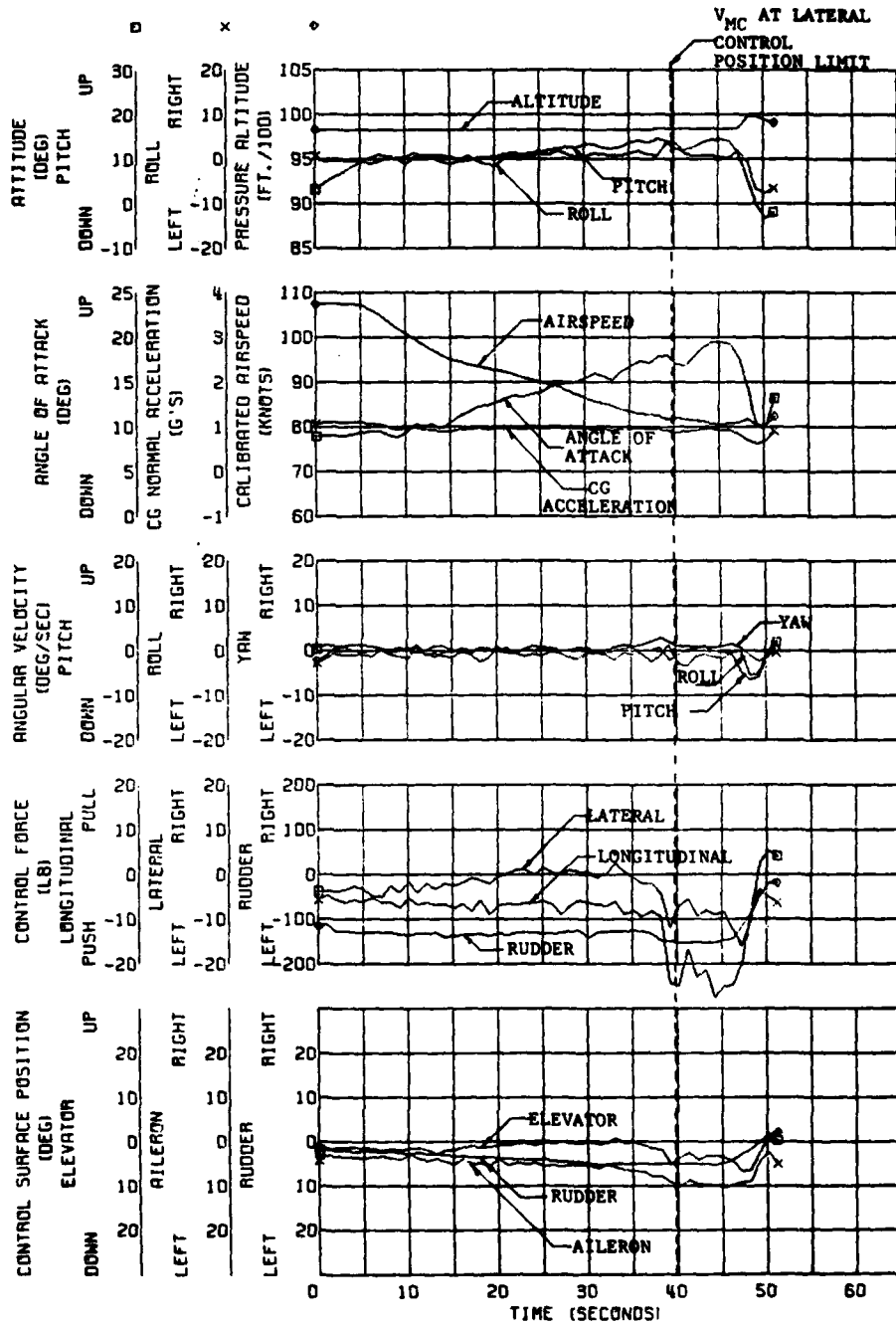


FIGURE NO. 53  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 1

LEFT PROP FEATHERED

CONFIGURATION PA  
GROSS WEIGHT - 14,150 LBS  
CG 30.0 PERCENT MAC

TRIM CAL. AIRSPEED - 108 KTS  
FREE AIR TEMP - .0 DEG C

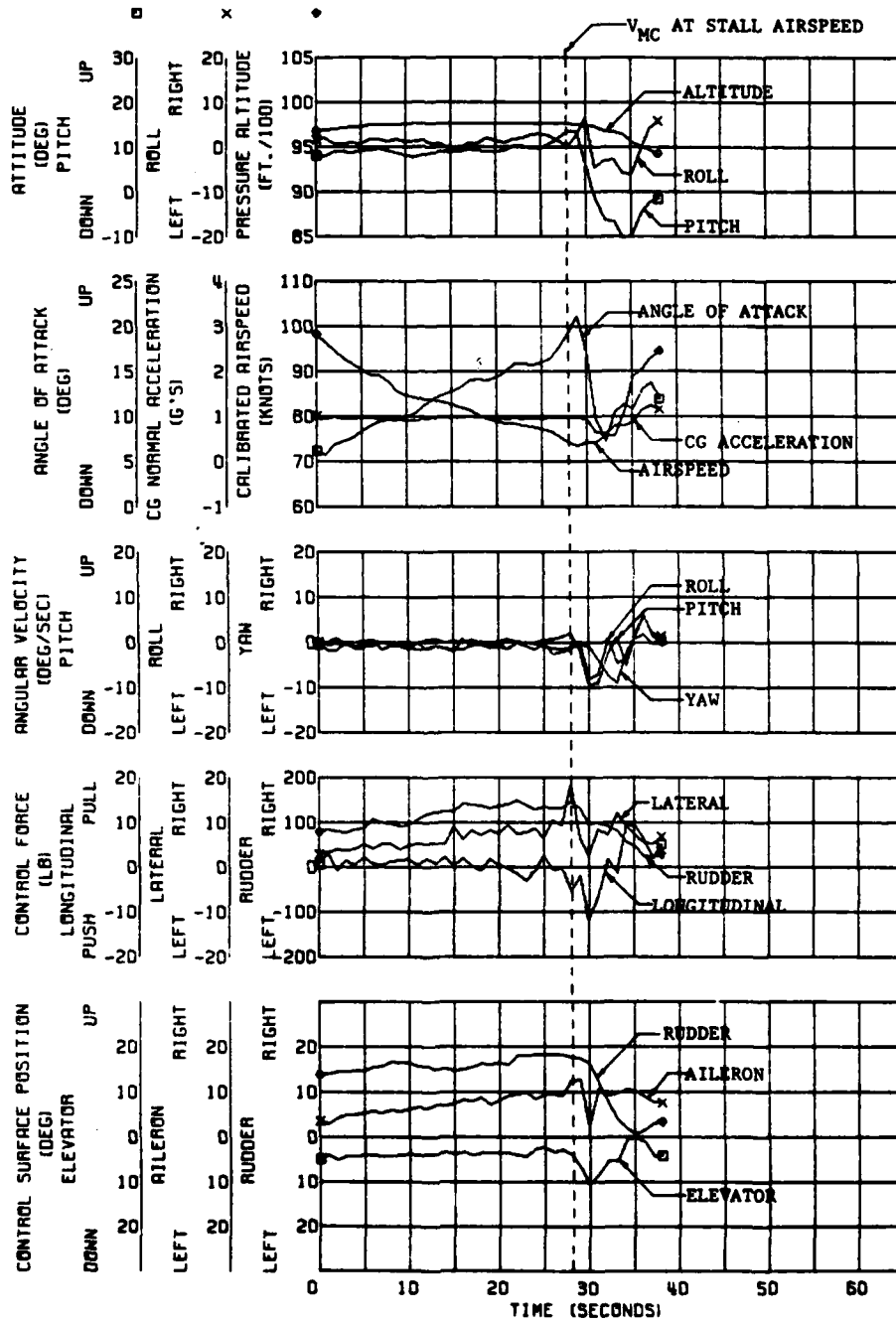




FIGURE NO. 54  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 3

LEFT PROP FEATHERED

CONFIGURATION CR  
GROSS WEIGHT = 18,200 LBS  
CG 30.1 PERCENT MAC  
LAT. CG MOMENT = 65,825 IN-LB

TRIM CAL. AIRSPEED = 151 KTS  
FREE AIR TEMP = 0.0 DEG C

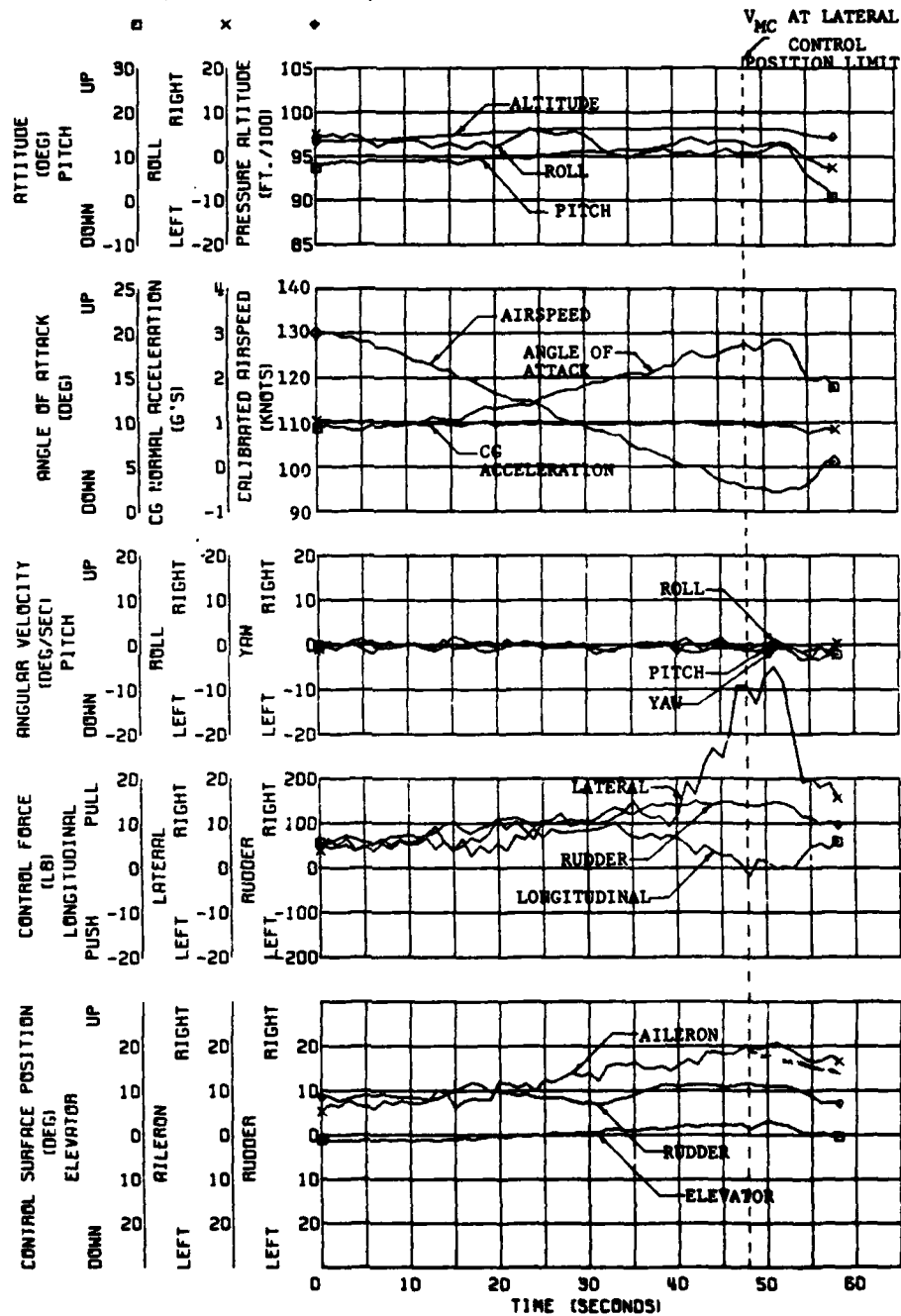


FIGURE NO. 55  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

DV-1D(C) USA S/N 68-15932  
WING STORE CONFIGURATION 3

LEFT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT = 17,550 LBS  
CG 30.0 PERCENT MAC  
LAT. CG MOMENT = 65,825 IN-LB

RECOMMENDED TAKEOFF TRIM  
FARE AIR TEMP = 0.5 DEG C

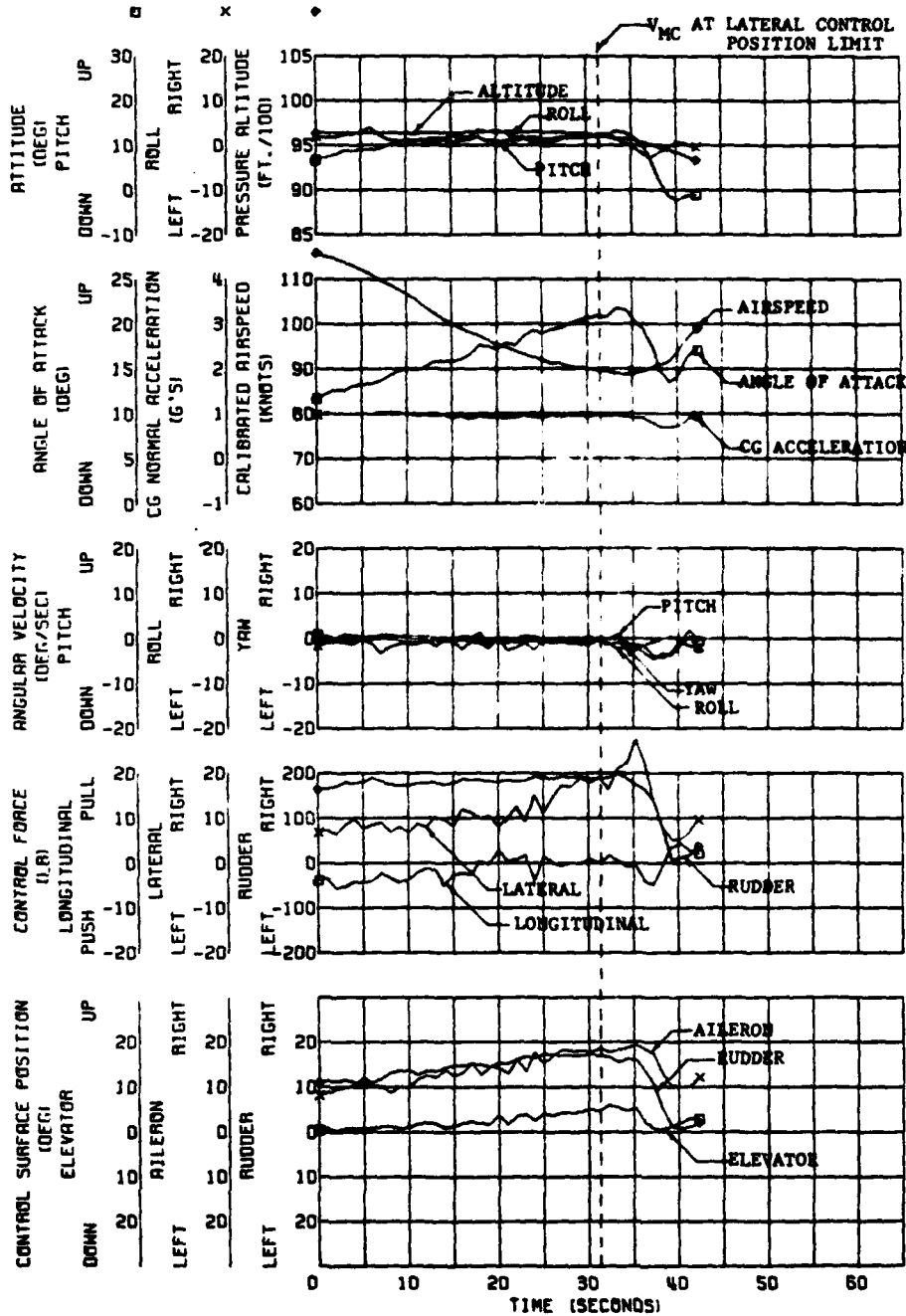


FIGURE NO. 56  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 4

LEFT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT = 17,700 LBS  
CG 28.0 PERCENT MAC  
LAT. CG MOMENT = -31,418 IN-LB

RECOMMENDED TAKEOFF TRIM  
FREE AIR TEMP = 1.0 DEG C

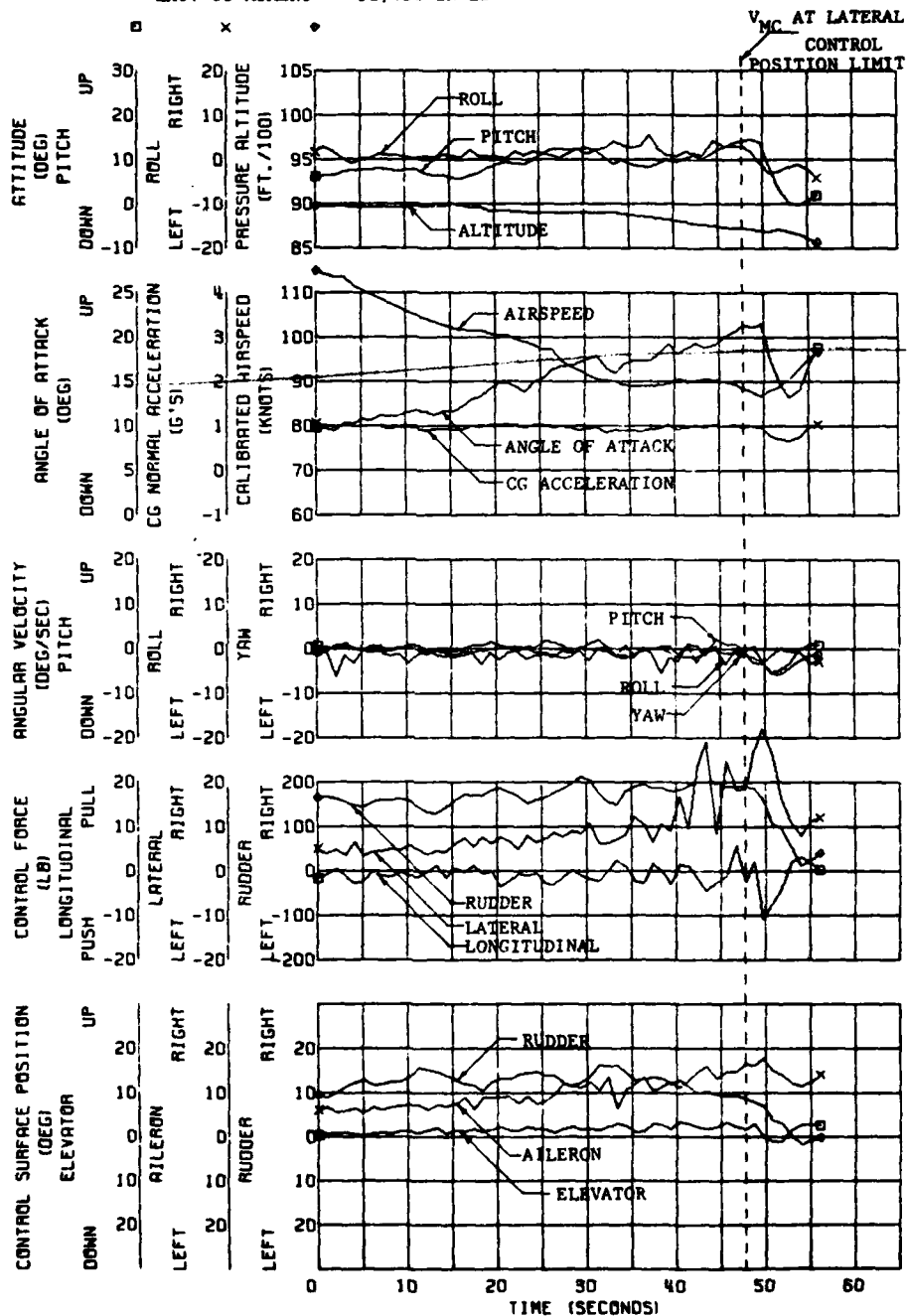


FIGURE NO. 57  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 4

LEFT PROP FEATHERED

CONFIGURATION PA  
GROSS WEIGHT = 17,180 LBS  
CG 28.0 PERCENT MAC  
LAT. CG MOMENT = -31,418 IN-LB

TRIM CAL. AIRSPEED = 132 KTS  
FREE AIR TEMP = 0.5 DEG C

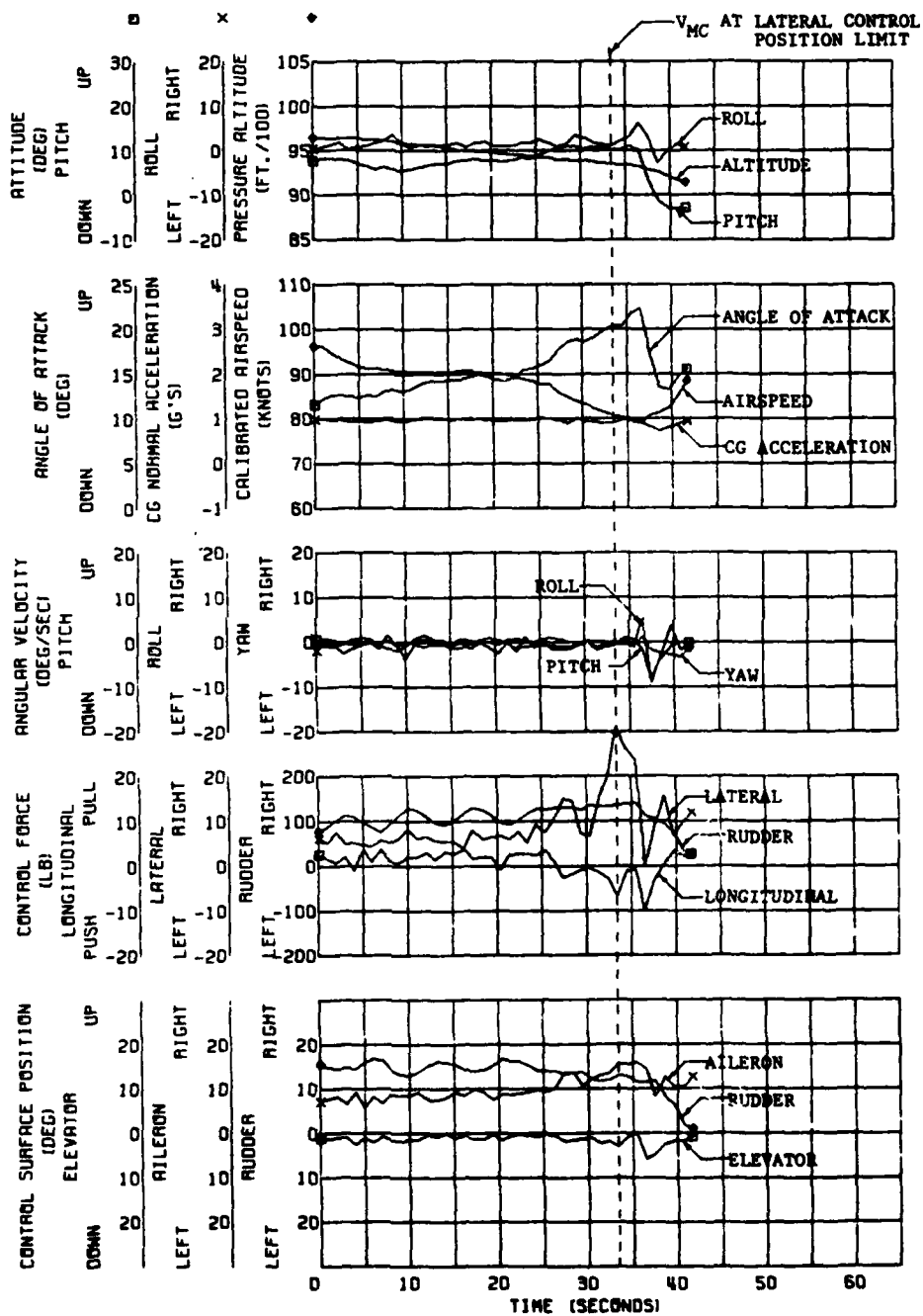


FIGURE NO. 58  
 SINGLE ENGINE MINIMUM CONTROL AIRSPEED  
 OV-10(C) USA S/N 68-15932  
 WING STORE CONFIGURATION 5

LEFT PROP FEATHERED

CONFIGURATION CR  
 GROSS WEIGHT = 18,200 LBS  
 CG 28.2 PERCENT MAC  
 LAT. CG MOMENT = 135,048 IN-LB

TRIM CAL. AIRSPEED = 137 KTS  
 FREE AIR TEMP = -5.0 DEG C

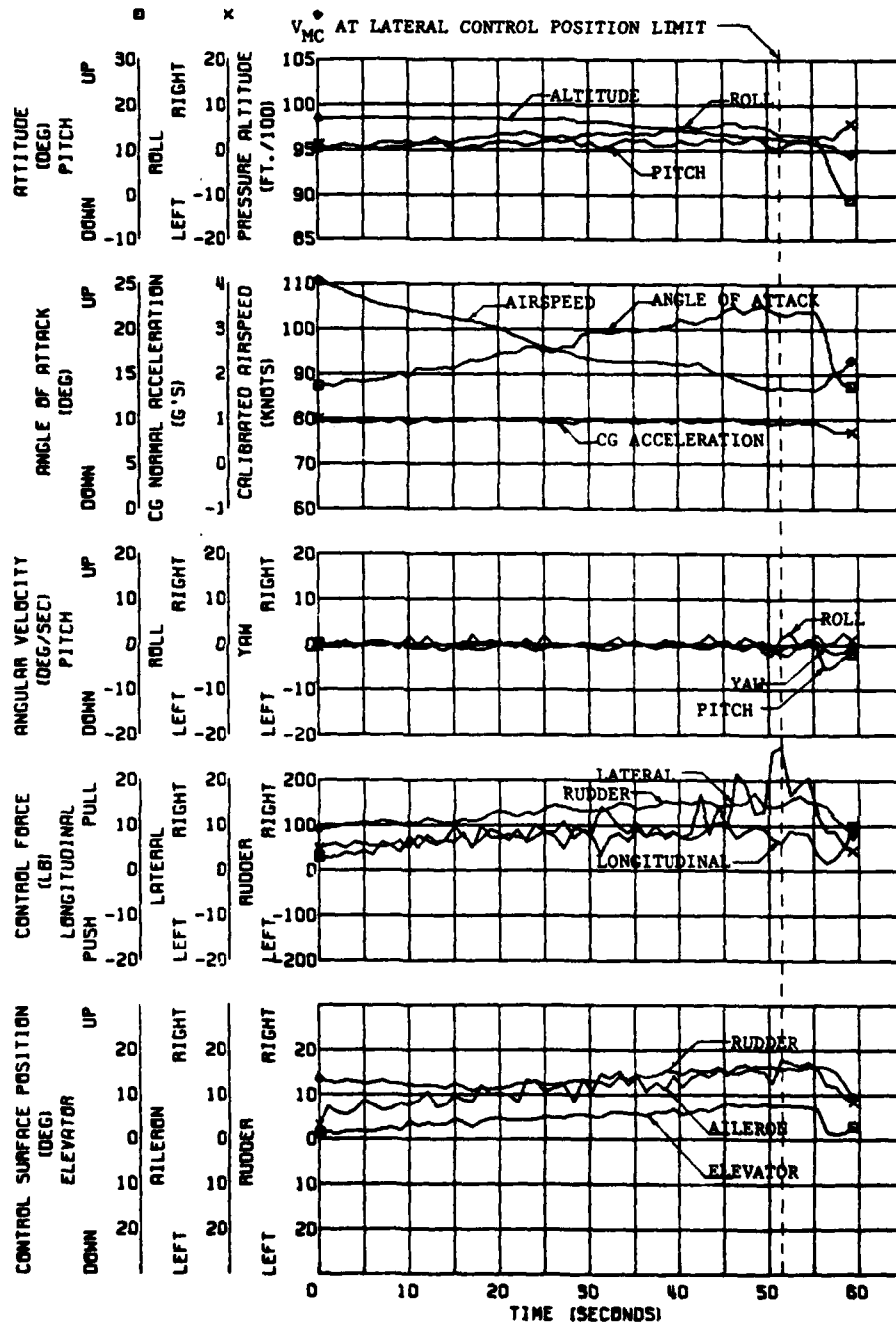


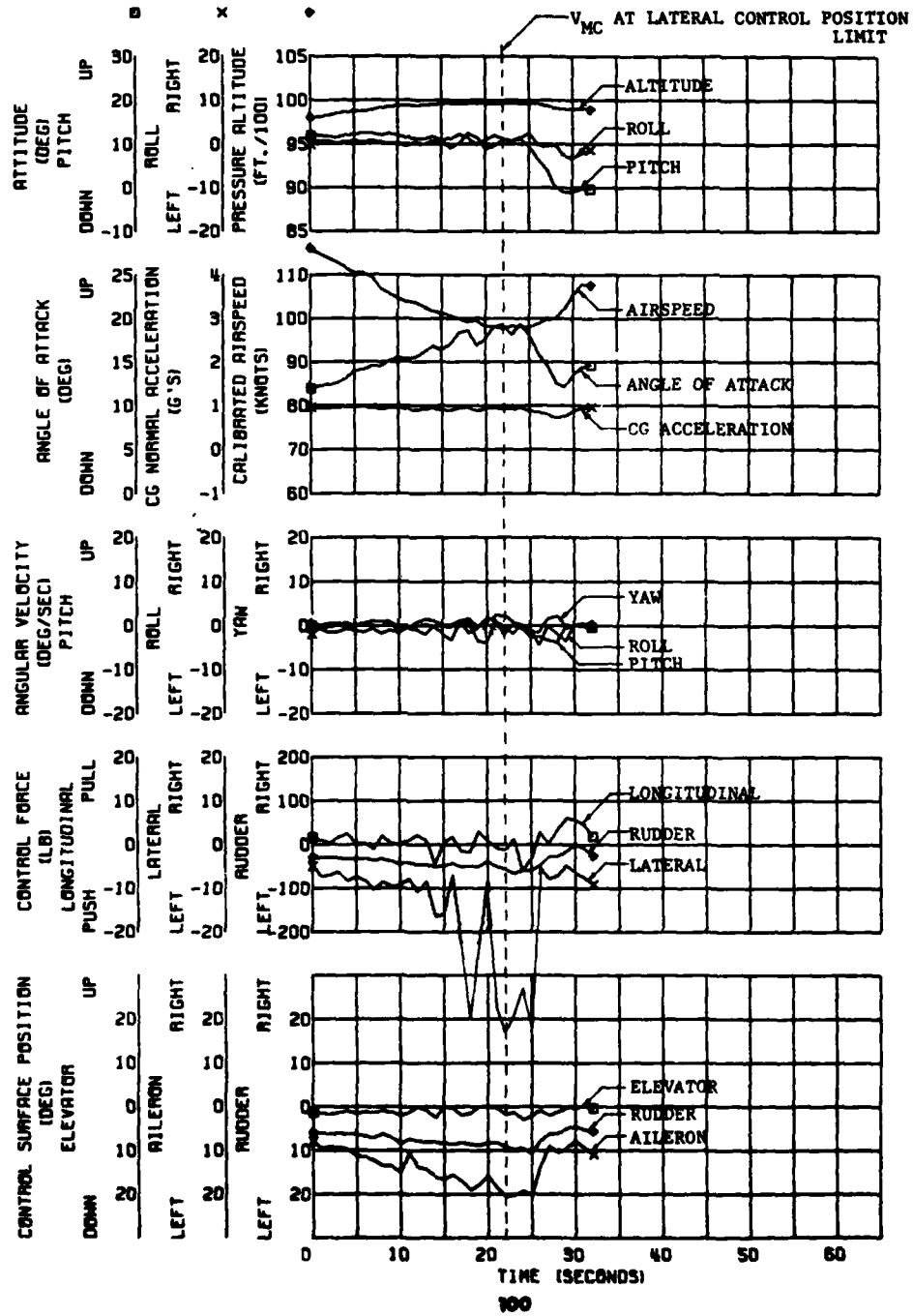
FIGURE NO. 59  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OY-10(C) USA S/N 68-15932  
WING STONE CONFIGURATION 5

RIGHT PROP FEATHERED

CONFIGURATION CR  
GROSS WEIGHT = 18,040 LBS  
CG 28.2 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN-LB

TRIM CAL. AIRSPEED = 147 KTS  
FREE AIR TEMP = 5.0 DEG C



TIME (SECONDS)

100

FIGURE NO. 60  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 88-15932  
WING STORE CONFIGURATION 5

LEFT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT = 17,830 LBS  
CG 28.0 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN-LB

RECOMMENDED TAKEOFF TRIM  
FREE AIR TEMP = -3.5 DEG C

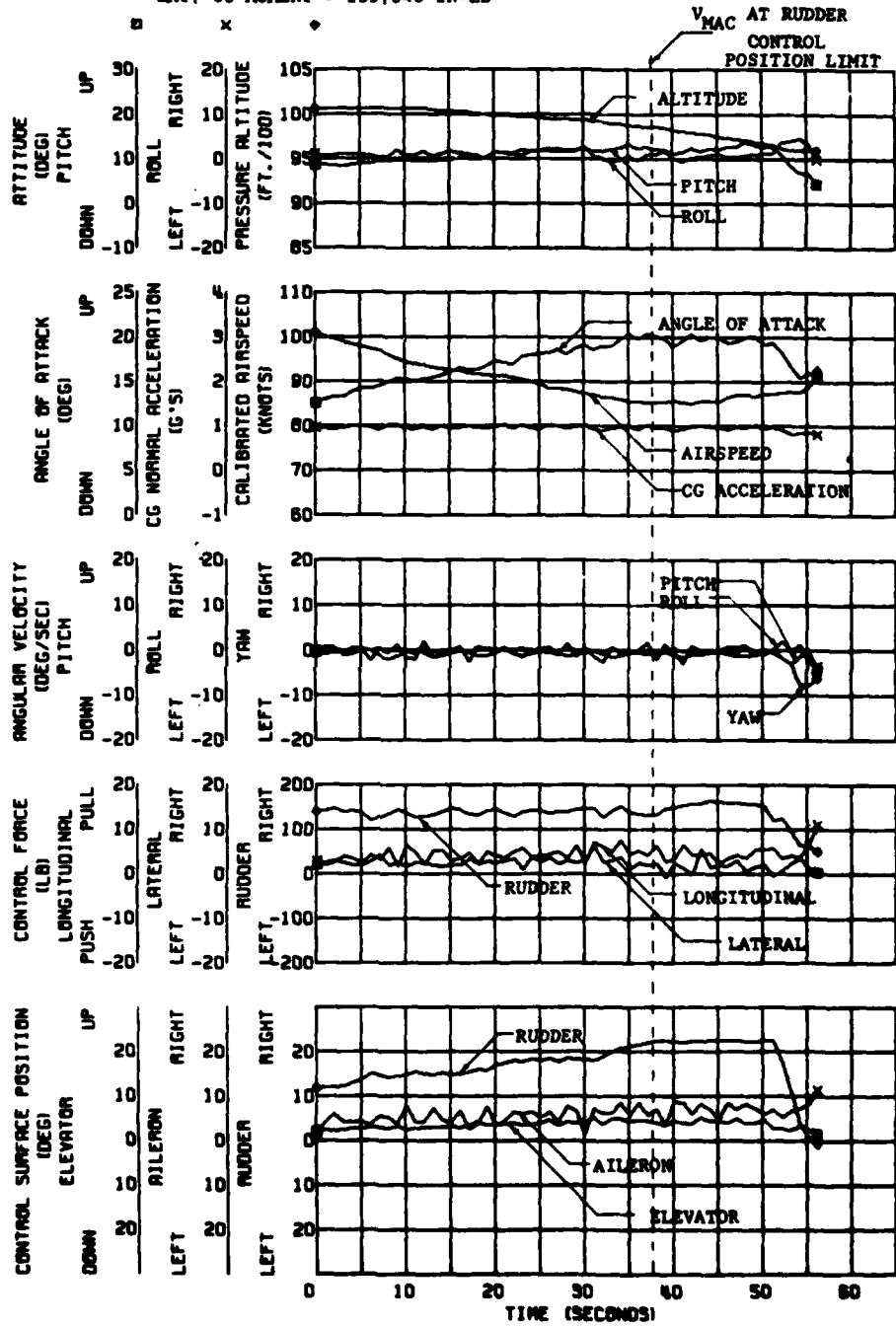


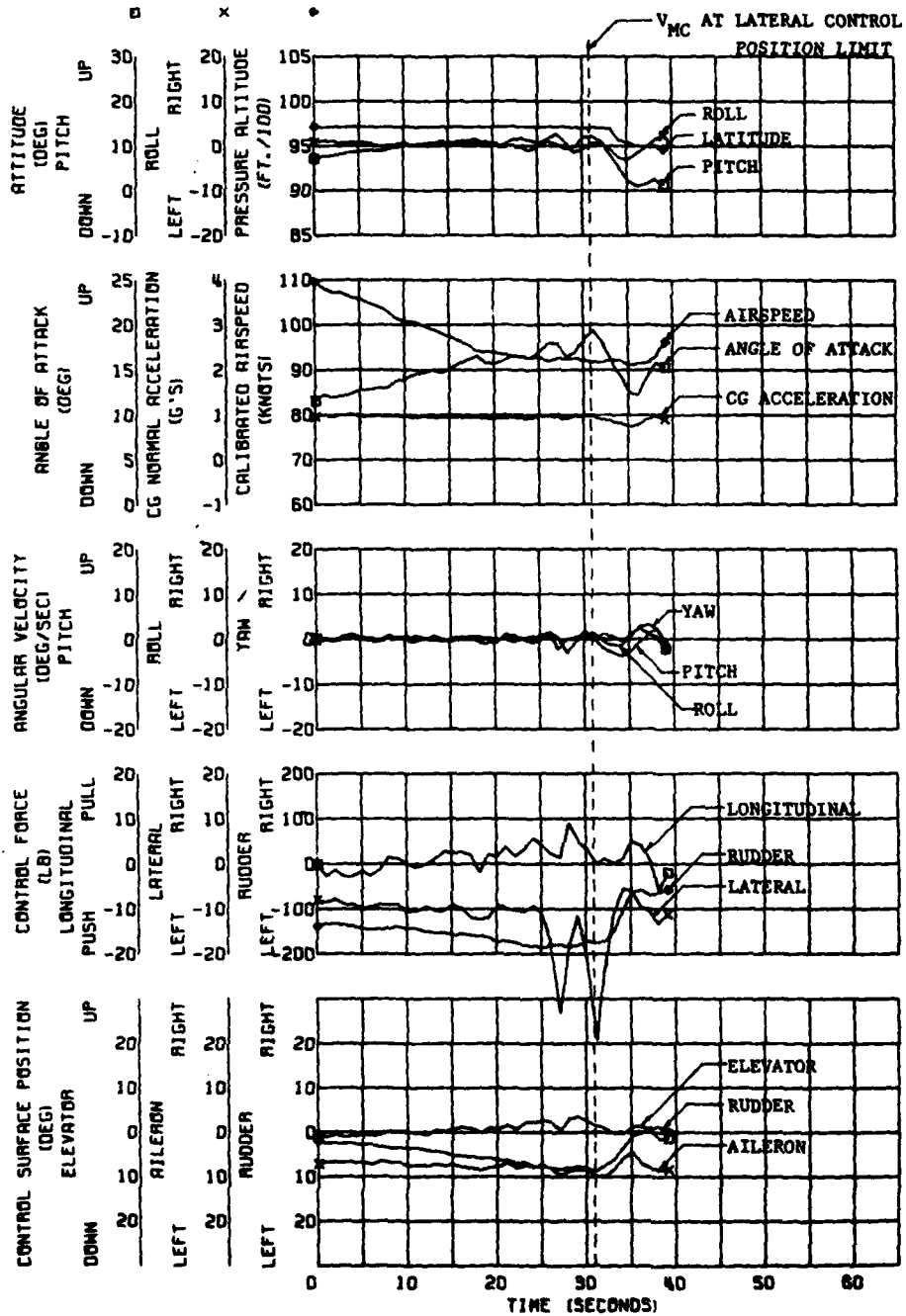
FIGURE NO. 61  
SINGLE ENGINE MINIMUM CONTROL AIRSPEED

OV-10(C) USA S/N 68-15932  
WING STORE CONFIGURATION 5

RIGHT PROP FEATHERED

CONFIGURATION TO  
GROSS WEIGHT = 17,505 LBS  
CG 28.1 PERCENT MAC  
LAT. CG MOMENT = 135,048 IN-LB

RECOMMENDED TAKEOFF TRIM  
FREE AIR TEMP = -5.0 DEG C





## **APPENDIX F. RECOMMENDED CHANGES TO OPERATOR'S MANUAL**

Recommended changes to the operator's manual as listed in this report have been submitted on DA Form 2028, as shown on the following pages.

|  |   |                   |
|--|---|-------------------|
| <b>RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS</b><br>For use of this form, see AR 316-1; the proponent agency is the US Army Adjutant General Center. | Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).   | DATE<br>23 Nov 77 |
|  | TO: (Forward to proponent of publication or form) (Include ZIP Code)<br>Commanding General<br>USATSARCOM<br>Attn: DRSTS-MT<br>P.O. Box 209, St. Louis, MO 63166 |                   |


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**PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS**

|  |                     |   |
|--|---------------------|---|
| PUBLICATION/FORM NUMBER<br>TM 55-1510-204-10/5 | DATE<br>29 Aug 1975 | TITLE<br>Operator's Manual OV-10 Aircraft |
|--|---------------------|---|

| ITEM NO. | PAGE NO. | PARA-GRAPH | LINE NO.* | FIGURE NO. | TABLE NO. | RECOMMENDED CHANGES AND REASON<br>(Exact wording of recommended change must be given)   |
|----------|----------|------------|-----------|------------|-----------|---|
| 1        | 4-3      | 4-25       | 2         |            |           | <p>To impress upon the pilot that if maximum power is required to maintain controlled flight the propeller control lever should be in the maximum RPM position the following note should be added to Chapter 4 of the Operator's Manual.</p> <p align="center"><u>NOTE</u></p> <p>If maximum power available is required to maintain flight the operating propeller lever should be set at MAX RPM.</p> |

\*Reference to line numbers within the paragraph or subparagraph.

|   |   |  |
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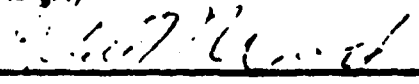
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**PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS**

| PUBLICATION NUMBER |          |          |                                    | DATE      |        |        | TITLE              |    |
|--------------------|----------|----------|------------------------------------|-----------|--------|--------|--------------------|----|
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|                    |          |          |                                    |           |        |        |                    |    |

**PART III - REMARKS** (Any general remarks or recommendations or suggestions for improvement of publications. Additional blank sheets may be used if more space is needed.)

This information obtained during flight testing of the OV-10/RV-10 airplane conducted at the Grumman flight test facility by USAAEFA.

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**RECOMMENDED CHANGES TO PUBLICATIONS**

For use of this form, see AR 316-1; the proponent agency to The Adjutant General's Office.

Use Part II (reverse side) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).

DATE

23 NOV 77

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USATSARCOM

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USAAEFA

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**PART I - ALL PUBLICATIONS EXCEPT RPSTL AND SC/SM**

PUBLICATION NUMBER

TM 55-1510-204-10/5

DATE

29 AUG 1975

TITLE

Operator's Manual OV-10 Aircraft

| ITEM NO. | PAGE NO. | PARA-GRAPH | LINE NO.* | FIGURE NO. | TABLE NO. | RECOMMENDED CHANGES AND REASON<br>(Exact wording of recommended change must be given)  |
|----------|----------|------------|-----------|------------|-----------|--|
| 1        | 14-15    |            |           | 14-10      |           | <p>The following note should be added to Figure 14-10 to impress on the pilot that lateral control authority may be limited when operating with high asymmetric wing store loading.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>When landing or taking off in a crosswind with asymmetric wing stores, it is recommended that, when feasible, the aircraft be positioned such that the heavy wing is upwind.</p>     |
| 2        | 3-25     | 2-54       | 5         |            |           | <p>The following note should be added to the before takeoff check to reduce lateral control forces observed during takeoff with high asymmetric wing store loading.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>With heavy right wing loading configurations, the recommended lateral trim for takeoff may vary from 5° right aileron to 3° left aileron, depending on the severity of the unbalanced condition.</p> |
| 3        |          |            |           | 12-2       |           | <p>Nowhere in Chapter 12 is the reason for two aft CG limits explained. The following Note should be added to the Center of Gravity Table.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>Aft cg limit without SLAR is 31% MAC<br/>Aft cg limit with SLAR is 29.3% MAC</p>  |

\* Reference to line numbers within the paragraph or subparagraph.

TYPED NAME, GRADE, OR TITLE

ROBERT N. WARD

MAJ, TC

350-6223 or 6224

SIGNATURE


DA FORM 2028  
DEC 68

REPLACES DA FORM 2028, 1 APR 64, AND DA FORM 1086, 1 DEC 68, WHICH WILL BE USED.

|   |   |                          |
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**PART II - REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS**

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| PUBLICATION NUMBER | DATE | TITLE |
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|          |          |          |                                    |           |        |        |                    |    |
|          |          |          |                                    |           |        |        |                    |    |

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| US Army Electronics Command (AMSEL-VL-D)  | 1  |
| US Army Forces Command (AFOP-AV)  | 1  |
| US Army Armament Command (SARRI-LW)   | 2  |
| US Army Missile Command (DRSMI-QT)  | 1  |
| Director. Research & Technology Laboratories/Ames   | 2  |
| Research & Technology Laboratory/Aeromechanics  | 2  |
| Research & Technology Laboratory/Propulsion   | 2  |
| Research & Technology Laboratory/Structures   | 2  |
| US Army Air Mobility Laboratory, Applied Technology Lab   | 1  |
| Human Engineering Laboratory (DRXHE-HE)   | 1  |
| US Army Aeromedical Research Laboratory   | 1  |
| US Army Infantry School (ATSH-TSM-BH)   | 1  |
| US Army Aviation Center (ATZQ-D-MT)   | 3  |
| US Army Aviation Test Board (ATZQ-OT-C)   | 2  |
| US Army Aviation School (ATZQ-AS, ATST-CTD-DPS)   | 3  |
| US Army Aircraft Development Test Activity (PROV) (STEBG-CO-T,<br>STEBG-PO, STEBG-MT)                     | 5  |
| US Army Agency for Aviation Safety (IGAR-TA, IGAR-Library)  | 2  |
| US Army Maintenance Management Center (DRXMD-EA)  | 1  |
| US Army Transportation School (ATSP-CD-MS)  | 1  |
| US Army Logistics Management Center   | 1  |
| US Army Foreign Science and Technology Center (AMXST-WS4)   | 1  |