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RESEARCH MEMORANDUM

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TIME-HISTORY DATA OF MANEUVERS PERFORMED BY AN F-86A AIRPLANE DURING SQUADRON OPERATIONAL TRAINING

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RESEARCH MEMORANDUM

TIME-HISTORY DATA OF MANEUVERS PERFORMED BY AN F-86A AIRPLANE DURING SQUADRON OPERATIONAL TRAINING

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SUMMARY

Preliminary results of one phase of a control-motion study program are presented in the form of plots of load factor and angular acceleration against indicated airspeed and of time histories of several measured quantities. The results were obtained from 197 maneuvers performed by an F-86A jet-fighter airplane during normal squadron operational training. Most of the tactical maneuvers of which the F-86A is capable were performed at pressure altitudes ranging from 0 to 32,000 feet and at indicated airspeeds ranging from 95 to 650 miles per hour.

INTRODUCTION

The present methods of determining tail-surface design loads require, among other things, a knowledge of the control-surface motion. In the usual methods, control-surface motions or load-factor variations with time are specified so as to obtain maximum design loads; however, the actual control motions and load-factor variations obtained in regular operational flying may differ appreciably from the specified variations.

In order to gain information on the actual control motion used in flight, the National Advisory Committee for Aeronautics in cooperation with the U. S. Air Force and the Bureau of Aeronautics is conducting a control-motion study program directed toward obtaining sample measurements on several fighter-type airplanes of rate, amounts, and combinations of control motions used by service pilots in carrying out regular operational missions. References 1 and 2 are the first papers written under this program. From the results obtained it may be possible to specify more practical design criteria for tail-surface loads based on actual critical control-surface motions. This procedure could result

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in weight saving, increase in performance and, in addition, the information obtained would be useful in the design of airplane control boost systems.

This paper concludes the collection of data on the F-86A airplane begun in reference 1. In order to expedite the presentation of the data, only a summary analysis is included to show maximum or critical values. The summary of the results of reference 1 are also included so that all of the available data on the F-86A may be displayed. A comparison with the results from the F2H-2 airplane of reference 2 is also included.

INSTRUMENTS

Standard NACA photographic instruments were used to record (1) the quantities defining flight conditions - that is, airspeed, altitude, slat position, and speed-brake position; (2) the imposed control-surface motions; and (3) the response of the airplane in terms of angular velocity, load factors, and the sideslip angle. The recorders were synchronized at 1-second intervals by means of a common timing circuit. The film capacity of the various instruments allowed 80 minutes of flight to be recorded. This amount of time was usually enough to record the complete flight. In order to relieve the pilot of any recording-instrument switching procedure, and thus assist in obtaining normal operations, a pressure switch was used to turn on automatically the recording instruments at an indicated airspeed of approximately 90 miles per hour. With the exception of the three-component accelerometer, which was in a fuselage access compartment above the wing, the recording instruments were mounted in the nose section.

A standard two-cell pressure recorder connected to the airplane service system was used to measure the altitude and airspeed. The service system employs a total-pressure tube located in the nose inlet and flush static-pressure orifices on both sides of the lower fuselage forward of the wing root. (See fig. 1.)

Microswitches were used on the right speed brake and slat to indicate the fully closed position of these surfaces. The control-surface angles were measured by transmitters installed at the control surfaces. The elevator, rudder, and stabilizer transmitters were installed inside the tail fairing to take measurements at the inner hinge. The transmitter for the right aileron was located externally on the wing at approximately the aileron midspan.

Angular velocities were recorded about three mutually perpendicular axes in which the reference fore-and-aft axis is the one commonly used

for leveling the airplane. (See fig. 1.) The load factors along these axes were recorded by an air-damped three-component accelerometer located in the fuselage 3.1 feet forward, 1.3 feet above, and 1.8 feet to the left of the measured center of gravity with full fuel.

Sideslip angle was measured during the first two flights by a vane mounted on a boom extending forward from the left wing. The measurement of sideslip angle was interrupted by mechanical difficulties and was not resumed until the last two flights, when the vane was mounted on the nose of the airplane.

The estimated accuracies of the recorded quantities based on instrument accuracy, the range and frequency of the instrument, and a reading accuracy of 0.01 inch are as follows:

	F-86A	F2H
Indicated airspeed, V_i, miles per hour	±5	
Pressure altitude, H_p, feet	±50	
Control position, degrees	±0.5	
Normal load factor	±0.1	±.05
Longitudinal and transverse load factor	±0.01	±.02
Rolling angular velocity, radians per second	±0.1	
Pitching and yawing angular velocity, radians per second	±0.02	
Sideslip angle, degrees	±0.3	

All the recording instruments were damped to about 0.65 of critical damping. The natural frequencies of the elements in the three-component accelerometer were selected to give the best compromise value which would minimize the magnitudes of extraneous vibratory accelerations and still give a correct response to the maneuver accelerations.

In order to expedite the presentation of time-history results, all the instruments were adjusted to specified sensitivities and the film drums were adjusted so that they ran at the same constant speed. Thus, in many cases, it was possible to trace the record lines directly onto the data sheets. Those records on which either the film speed had deviated from the selected standard, or in which it was desired to change the sensitivity for the purpose of showing the data better, were processed on a special photographic enlarger which made it possible either to shrink or expand either the vertical or horizontal dimension of the film independently of each other. By means of this device the details of the film records are more accurately reproduced in time-history form.

AIRPLANE AND TESTS

The F-86A airplane used in these tests was essentially the same as the airplane used in reference 1. The external appearance and the weight

and balance of the airplane was altered as little as possible by the addition of the instrumentation. A three-view drawing of the F-86A airplane is given in figure 1 and its characteristics are given in table I. The moments of inertia given in table I are estimated values made in accordance with the latest information available.

The tests were conducted during the months of February to April 1951 and consisted of seventeen normal operational-training flights and two requested flights in which the pilot was instructed to do specific maneuvers. The operational flights included familiarization, aerobatics, bombing runs, dog fights, and an engine-test flight. The maneuvers performed during operational flights consisted of turns, dives and diving pull-outs, pull-ups, slow rolls, barrel rolls, loops, Immelman turns, lazy eights, wing-overs, and stalls. The airplane was flown at altitudes ranging from 0 to 32,000 feet and at airspeeds ranging from 95 to 650 miles per hour.

Five pilots participated in the tests during which the airplane was flown for approximately 11 hours of recorded time in which were included approximately 3 hours of maneuver time. No attempt was made in any way to specify either the type or the severity of the maneuvers. Since the pilots were not to be identified with the results, they were instructed to handle the airplane normally and were assured that the instrumentation would not restrict them in any way.

METHOD AND RESULTS

The results of this flight program are presented in figures 2 to 229. All the maneuvers performed during the operational flights plus three landings are presented in figures 2 to 201 as time histories of the measured quantities. The maneuvers performed during the two requested flights are presented in figures 202 to 224. Data from these two flights, however, are not included in analysis figures 225 to 229.

A comparison between the normal load factors obtained in these tests and the operational V-n diagram for the F-86A is presented in figure 225. The maximum transverse load factors and the corresponding indicated airspeeds are presented in figure 226. The variation of maximum pitching, rolling, and yawing angular acceleration with indicated airspeed is shown in figures 227, 228, and 229, respectively. Data from reference 1 are also included in figures 225 and 227 to 229 in order to make them more complete.

All the maneuvers performed during the 19 flights are presented in figures 2 to 224 as time histories of the measured quantities. Included in the legend of the time-history figures is a classification of the type

of maneuver, estimated airplane weight, and estimated flight center-of-gravity location. The classification of the maneuvers was of necessity done in a general sense since it was sometimes difficult to determine from the flight records exactly the type of maneuver performed. Some of the standard maneuvers are defined in references 3 and 4. The in-flight airplane weight and center-of-gravity location were estimated on the basis of the total amount of fuel used and the total time of the flight including warm-up, taxying, and actual flight.

In the time histories, load factors associated with forces acting up, forward, and to the left are positive. Nose up, nose right, and right wing down are positive for the pitching, yawing, and rolling angular velocities which are given in radians per second. No corrections have been made to the load factors for the effect of angular velocities or angular accelerations due to the displacement of the accelerometer from the center of gravity.

The airspeed used is an indicated airspeed which is defined as the reading of a differential pressure airspeed indicator, calibrated in accordance with the accepted standard adiabatic formula to indicate true airspeed for standard sea-level conditions only (uncorrected for instrument and installation errors) and the altitude is the NACA standard pressure altitude. The control positions shown in the time-history figures were measured with respect to the neutral position of the surfaces except for the stabilizer position which was measured with respect to the zero position of the cockpit indicator. Only the right aileron position was measured.

The sideslip angle shown in the time histories is the angle between the airplane longitudinal axis and the relative wind. Right sideslip indicates that the relative wind is from a direction to the right of the airplane's longitudinal axis. Periods during which the right wing slat and speed brake were open are indicated in the time histories by arrowed lines.

The time histories are arranged in this paper according to the maneuver classification shown in table II. The load factors shown in figures 225 and 226 are maximum values taken from the time histories. The V-n envelope shown in figure 225 by the dashed and solid lines are, respectively, the limit envelope and the operational limitations for the test airplane as specified by Air Force technical orders. The load-factor test points shown in figure 225 were selected from the time histories so as to give the fullest envelope, and the values shown are without corrections for angular velocity or angular acceleration since the corrections were found to be small. The maximum transverse load factors shown in figure 226 are corrected only for the effects of rolling angular velocities and accelerations.

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The maximum angular accelerations shown in figures 227, 228, and 229 were obtained from the slope of the appropriate angular velocity curve in the time histories. The accelerations selected were the maximum values occurring in each portion of the curves where there existed values of accelerations larger than a threshold value of approximately 0.1 radian per second per second for pitch and yaw and 0.5 radian per second per second for roll.

DISCUSSION

Although this investigation was limited to relatively few hours of actual flying, the data obtained represent a cross section of the maneuvers performed during operational training and include a majority of the tactical maneuvers used.

The highest positive value of normal load factor measured on this airplane was about 5.5 which occurred in an inclined loop and in several pull-ups. (See figs. 34, 44, and 81.) However, values of about 6 were measured in pull-ups on the airplane of reference 1. (See fig. 225.) The largest negative normal load factor measured, -0.2, was associated with the recovery from a pull-up. (See fig. 14.) It can be seen in figure 225 that the operational limits for combinations of load factor, airspeed, and altitude were not exceeded in any significant amount except in the low airspeed range from 100 to 150 miles per hour. Those values of the load factor which exceed the solid boundaries in this speed range are, however, generally associated with large values of the pitching velocity. (See figs. 28, 29, 35, and 38.) This result is not unexpected since it is known that the lifting capacity of a wing is increased at higher rates of pitching velocity.

The largest rates and amounts of elevator movements measured occurred during landings and maneuvers such as Immelman turns, loops, stalls, turns, and recovery from dives. The largest positive elevator movements occurred in loops, stalls, split-S, turns, and landings. (See figs. 29, 50, 198, and 201.) At least two pull-ups were made using the stabilizer. (See figs. 14 and 21.) The largest negative elevator movements occurred in push-downs, split-S maneuvers, dives, and turns. (See figs. 21, 51, 54, and 121.) The largest negative rates of elevator movement occurred in split-S maneuvers, turns, stalls, and landings. (See figs. 51, 123, and 199.)

The largest positive pitching acceleration obtained in these tests was 1.2 radians per second per second and occurred in a sharp right turn (see fig. 132) at an indicated airspeed of 330 miles per hour. The greatest negative pitching acceleration, -1.33 radians per second per second, occurred during the same sharp right turn at an indicated

airspeed of 320 miles per hour. A maximum value of -1.55 radians per second per second was obtained during a rapid recovery from a pull-up on the airplane of reference 1. (See fig. 227.)

The maximum rolling accelerations obtained in these tests occurred at about 400 miles per hour indicated airspeed, and amounted to +5.3 and -7.5 radians per second per second. Maximum rolling accelerations decreased above and below 400 miles per hour indicated airspeed. The maximum rolling velocity, 2.4 radians per second, occurred in a barrel roll (fig. 80) at an altitude of approximately 20,000 feet and at an indicated airspeed of 307 miles per hour. This maximum is somewhat larger than the maximum, 1.7 at 300 knots, obtained in reference 2 for a straight-wing fighter airplane with an average flight weight of approximately 16,000 pounds.

The maximum positive yawing acceleration in the operational tests (fig. 229) occurred at about 350 miles per hour in a gentle climbing turn and was 0.6 radian per second per second. The maximum negative yawing accelerations were also about 0.6 radians per second per second, and were obtained at 325 and 525 miles per hour in a barrel roll and right turn, respectively.

The maximum transverse load factors measured were 0.35 and -0.54; both of these values occurred during barrel rolls. (See fig. 81.) However, when the angular velocity and acceleration corrections are applied to these values, the maximum transverse load factors become 0.24 and -0.44. An examination of figure 226 shows that lesser values of the maximum transverse load factor occur much more frequently.

From examination of the time-history figures for a given maneuver classification it may be seen that, in general, the barrel rolls incorporated moderate elevator movements, small rudder movements and moderate to large aileron movements which were often made at high rates. All three angular velocities were in most cases high, but in any particular barrel roll any one of the three may have deviated greatly from the amount normally found in the maneuver. Angular accelerations were usually high, but in most cases, the normal load factors were small.

The more severe dive pull-outs involved movements of the stabilizer, speed brake, and the elevator. The amount of elevator required to execute the recovery from the dive was, in some cases, considerably reduced by the use of the stabilizer and by the opening of the speed brakes. As the normal load factor approached the limit value of 6, high rates of elevator movement were used to prevent exceeding the operational limit.

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The chandelles were performed at high speeds often with high normal load factors. The control motion rates and amounts were moderate and no excessive angular velocities or accelerations occurred in the maneuver.

The turns were performed at various normal load factors up to a maximum value of about 4. Large aileron displacements and rates of movement were used in some of the turns and in some of the high load factor turns, high elevator rates were also used.

The split-S maneuvers were initiated at low airspeeds and usually the speed brakes remained open throughout the maneuver. Normal load factors of about 4 were obtained during the pull-out at the end of the maneuver. Large aileron movements and high rates of aileron and elevator movement were encountered in the maneuver.

The loops involved large airspeed and altitude variations, but only moderate load factors were imposed on the airplane. Aileron and rudder displacements were usually small except in the cases where, at the top of the loop, the airplane approached the stall; then, moderate amounts of aileron and rudder were used to hold the airplane in the maneuver. Large elevator displacements were encountered but movement rates were usually low.

The Immelman turns were initiated at various airspeeds and the maximum normal load factors encountered in the maneuver depended somewhat on the initial airspeed. In the more severe Immelman maneuver, the operational normal load factor limit was in several cases closely approached. Moderate to large aileron displacements were used in the half-roll recovery, but rolling velocities were usually low.

The landings in the cases recorded involved large elevator displacements and rates of movement, moderate to large amounts of stabilizer movement, and small to moderate amounts of rudder motion. High aileron movement rates were often used at the beginning of the turn for the final approach.

A comparison of the summary figures of reference 2 and those of this paper shows that for both airplanes the main concentration of points of maximum angular acceleration occurred in approximately the same airspeed range. The comparison also shows that these test conducted with an F-86A airplane obtained higher maximum values of pitching and rolling acceleration and approximately the same maximum values of yawing acceleration and normal load factor as were obtained with the F2H-2 airplane reported in reference 2.

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2. Huss, Carl R., Andrews, William H., and Hamer, Harold A.: Time-History Data of Maneuvers Performed by a McDonnell F2H-2 Airplane during Squadron Operational Training. NACA RM L52B29, 1952.

3. National Advisory Committee for Aeronautics: Nomenclature for Aeronautics. NACA Rep. 474, 1933.

4. Cram, Jack R., and Brimm, Daniel J., Jr.: Part Three - Restricted Commerical Flight Course. Civil Pilot Training Manual, C.A. Bull. No. 23, CAA, U.S. Dept. Commerce, Sept. 1940.

TABLE I

DIMENSIONS AND CHARACTERISTICS OF F-86A AIRPLANE

Wing:	
Total area (including flaps, slats, and 49.92 sq ft covered by fuselage), sq ft	287.90
Span, ft	37.12
Aspect ratio	4.785
Taper ratio	0.513
Mean aerodynamic chord (wing station 98.71 measured normal to center line), in.	97.03
Sweepback of 0.25-chord line, deg	35.23
Incidence of root chord (wing station 0), deg	1.0
Incidence of tip chord (wing station 220.8), deg	-1.0
Dihedral, deg	3.0
Root airfoil section (normal to 0.25-chord line)	NACA 0012-64 (Modified)
Tip airfoil section (normal to 0.25-chord line)	NACA 0011-64 (Modified)
Aileron area (each), sq ft	18.6
Aileron static control limits, deg	±15
Distance from reference datum (nose) to leading edge of mean aerodynamic chord, in.	164.26
Horizontal tail:	
Total area (includes 1.20 sq ft covered by fuselage), sq ft	34.99
Span, ft	12.75
Mean aerodynamic chord (horizontal-tail station 33.54 in.), in.	34.71
Sweepback of 0.25-chord line, deg	34.59
Dihedral, deg	10.0
Airfoil section (parallel to center line)	NACA 0010-64
Tail length ($0.25\bar{c}_w$ to $0.25\bar{c}_t$), in.	217.5
Elevator area (each), sq ft	5.05
Elevator static control limits (from neutral position), deg -	
Up	35
Down	17.5
Stabilizer control limits (from neutral position), deg -	
L.E. up	1.25
L.E. down	10
Vertical tail:	
Total area (includes 0.93 sq ft covered by fuselage, excludes 3.96 sq ft dorsal fin), sq ft	33.44
Span (uncovered), ft	7.52
Height from ground, ft	14.74
Sweepback of 0.25-chord line, deg	35.0
Rudder area, sq ft	8.1
Rudder static control limits, deg	±27.5
Fuselage:	
Total length, in.	412.41
Maximum width, in.	60.0
Maximum depth, in.	60.75
Fineness ratio	6.59
Speed brake area (effective frontal area, both sides), sq ft	8.6
Power plant	General Electric J-47
Airplane serial number	AF49-1285
Measured airplane weight (full fuel), lb	14,223
Measured airplane center-of-gravity position (full fuel, gear down), percent M.A.C.	20.75
Airplane design gross weight for stress analysis (rockets in), lb	13,395
Approximate moments of inertia about reference axes through center of gravity of airplane (weight 13,395 lb, gear up, rockets in), slug-ft^2:	
Pitch	27,930
Yaw	33,430
Roll	7,880

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TABLE II

MANEUVER CLASSIFICATION

	Figure
Operational maneuvers:	
Lazy eights	2 to 6
Chandelles	7 to 8
Dive and pull-outs	9 to 26
Loops	27 to 36
Immelman turns	37 to 44
Wing-overs	45 to 48
Split-S	49 to 55
Barrel rolls	56 to 93
Turns	94 to 194
Fishtails	195
Stalls	196 to 198
Landings	199 to 201
Requested maneuvers:	
Sideslips	202 to 212
Fishtails	213 to 216
Barrel rolls	217 to 220
Turns	221 to 224



[redacted]

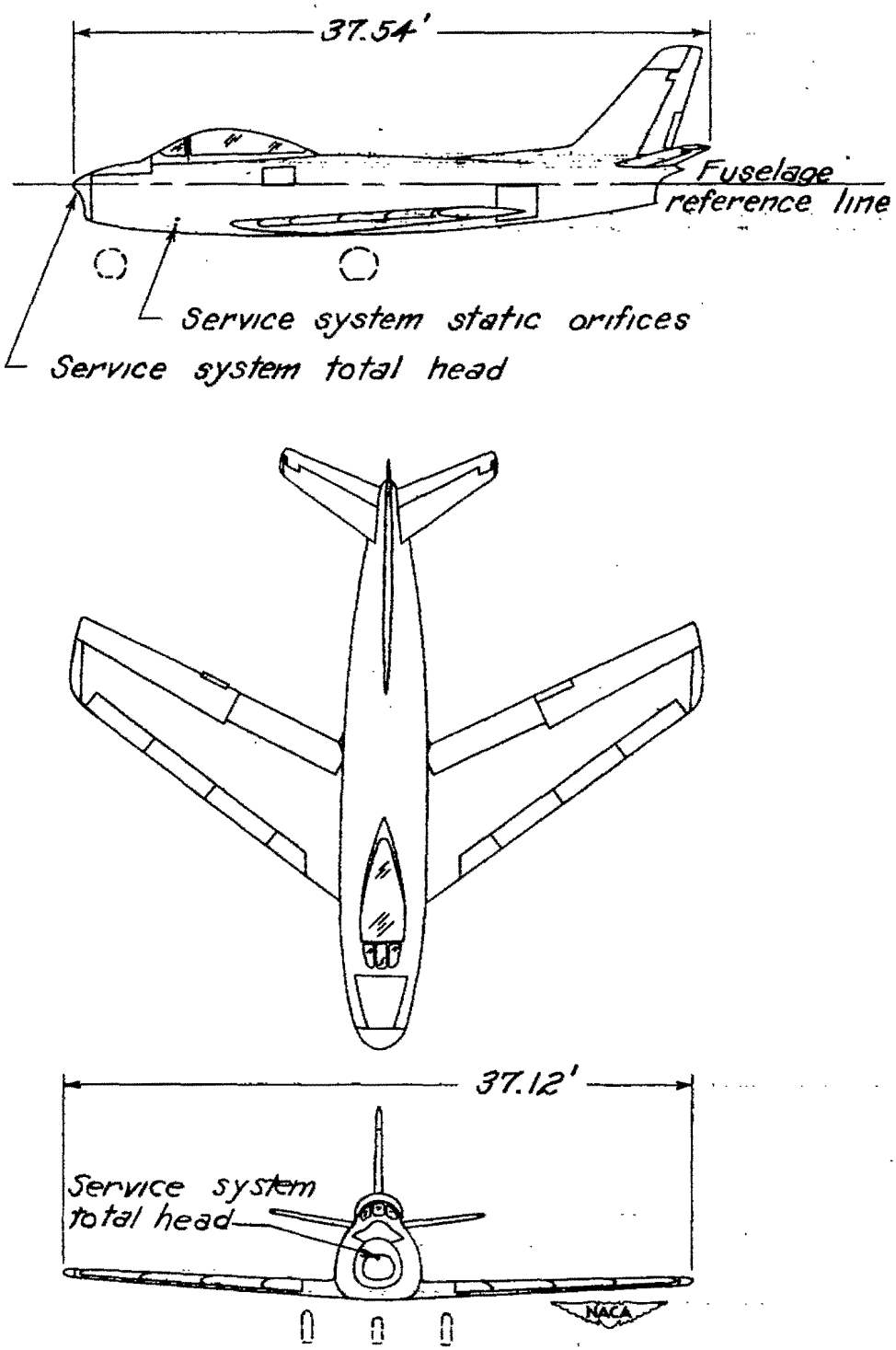


Figure 1- Three-view drawing of test airplane.

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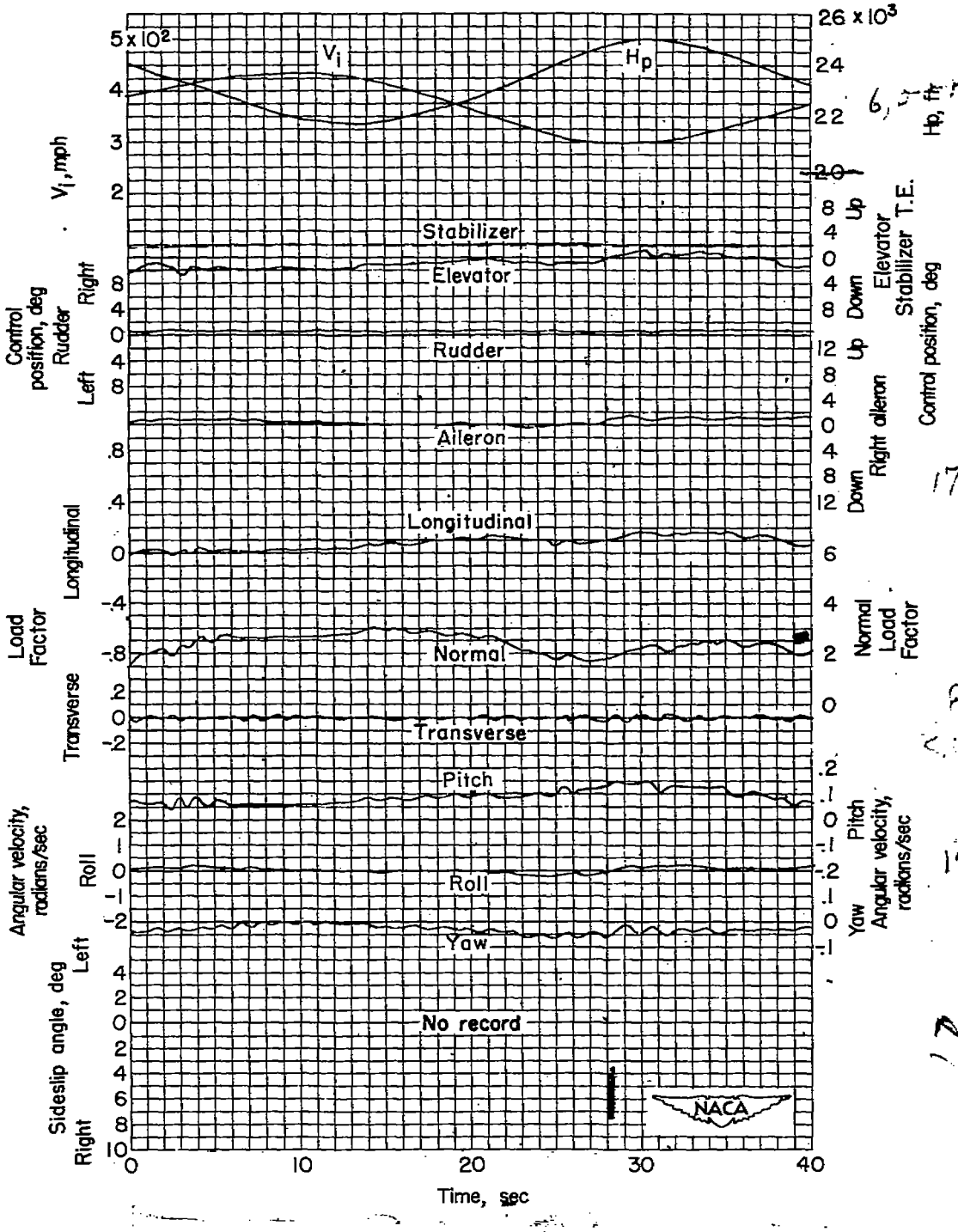


Figure 2.- Lazy eight. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

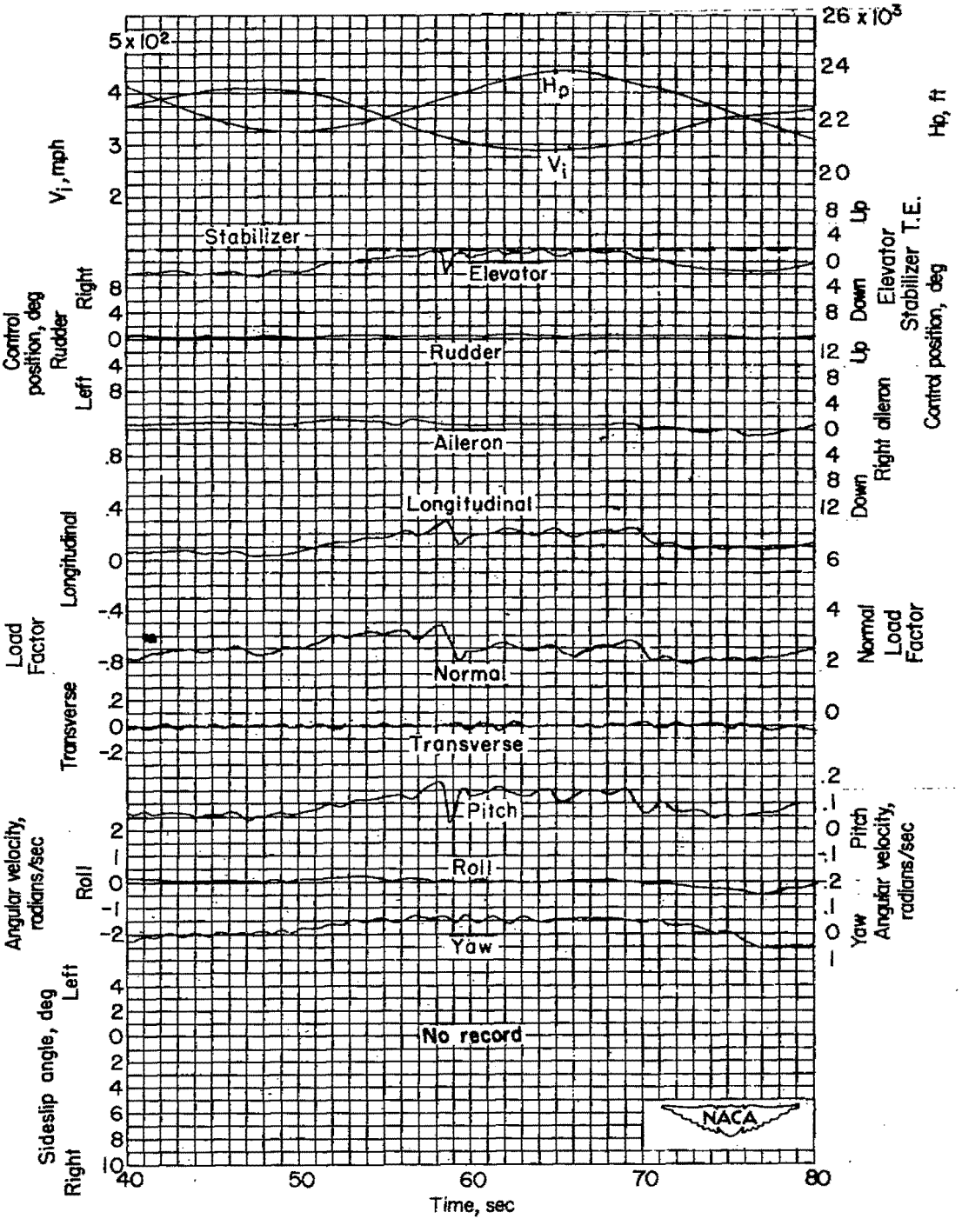


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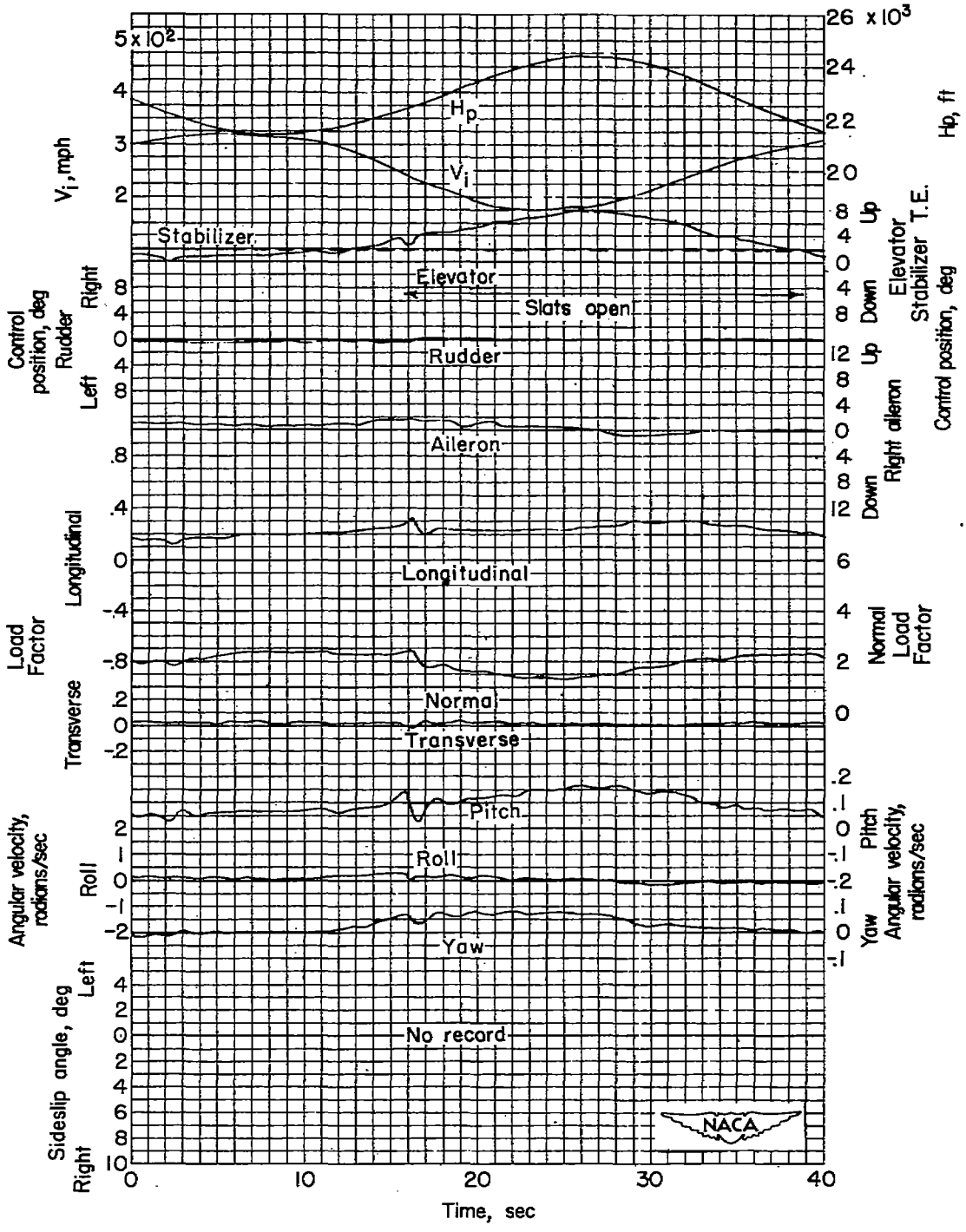


Figure 3.- Three loops of a lazy eight. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

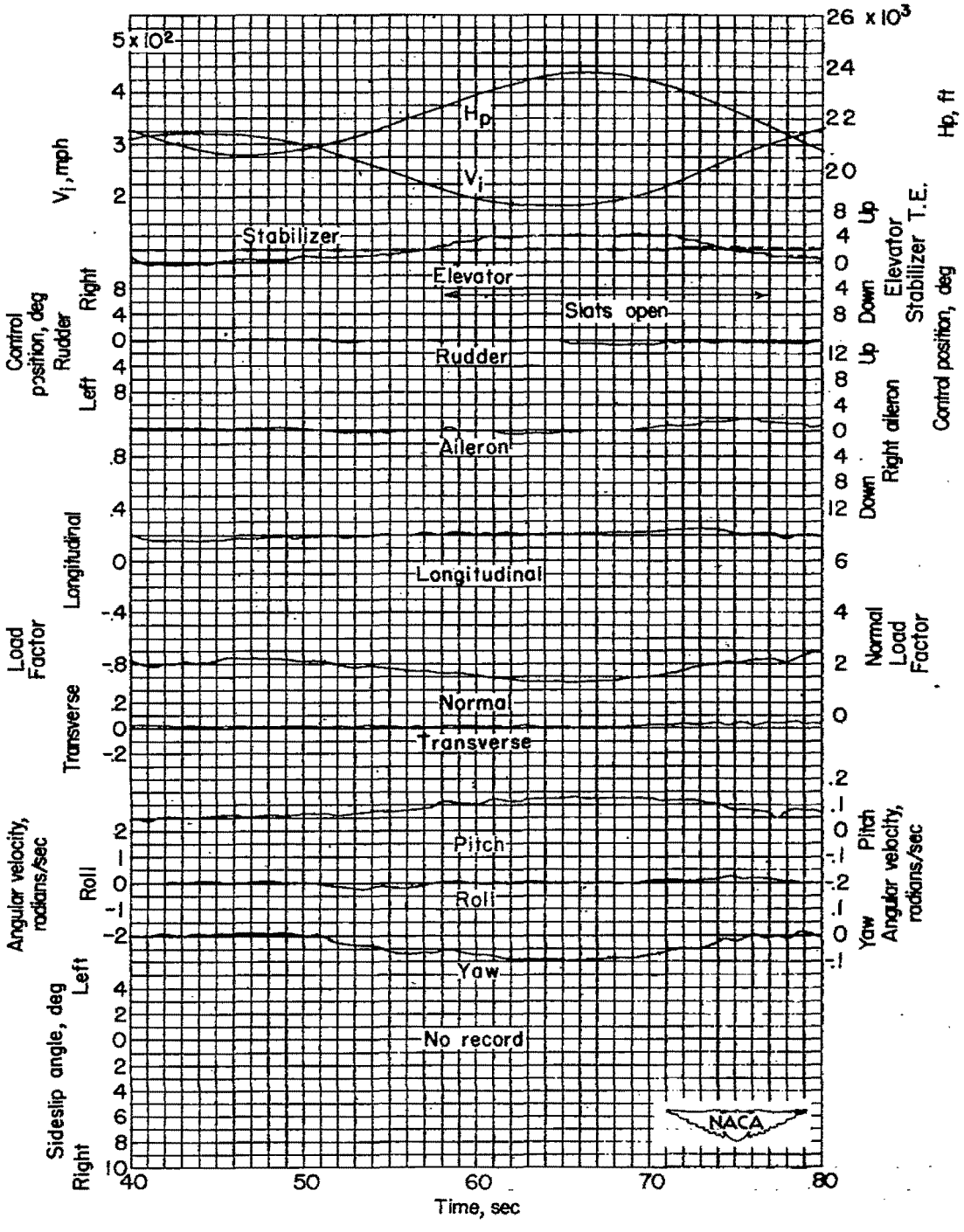


Figure 3.- Continued.

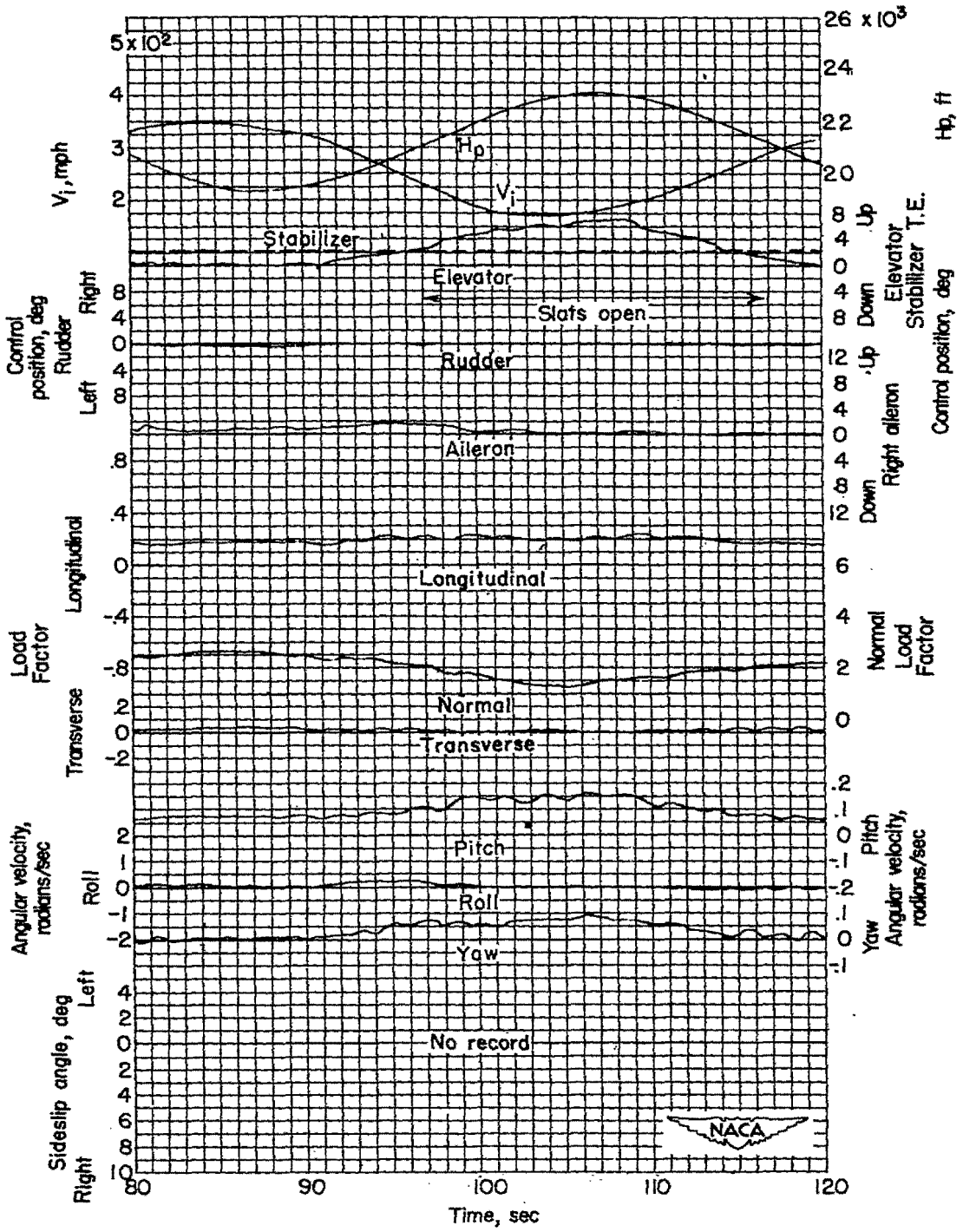


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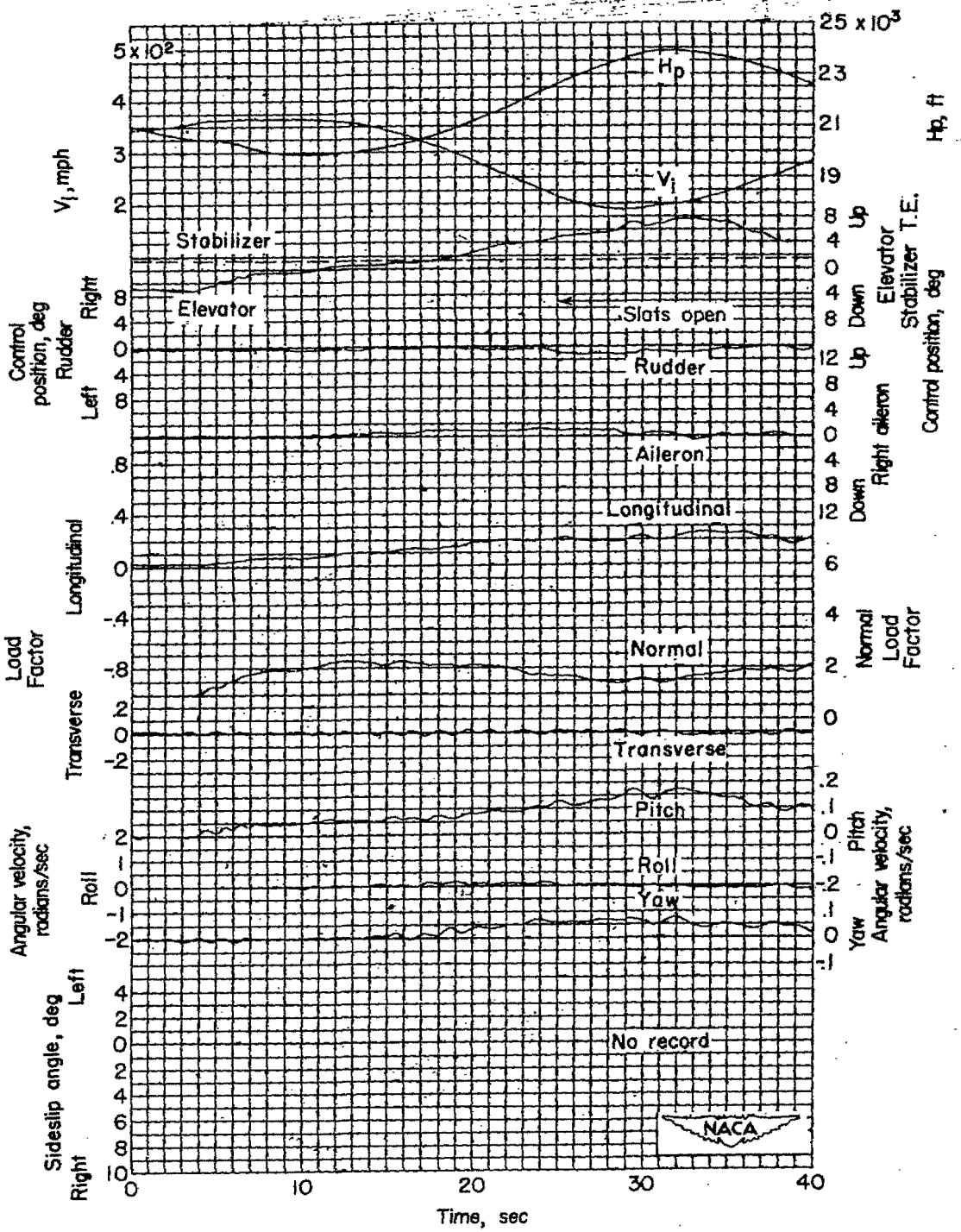


Figure 4.- Lazy eight. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

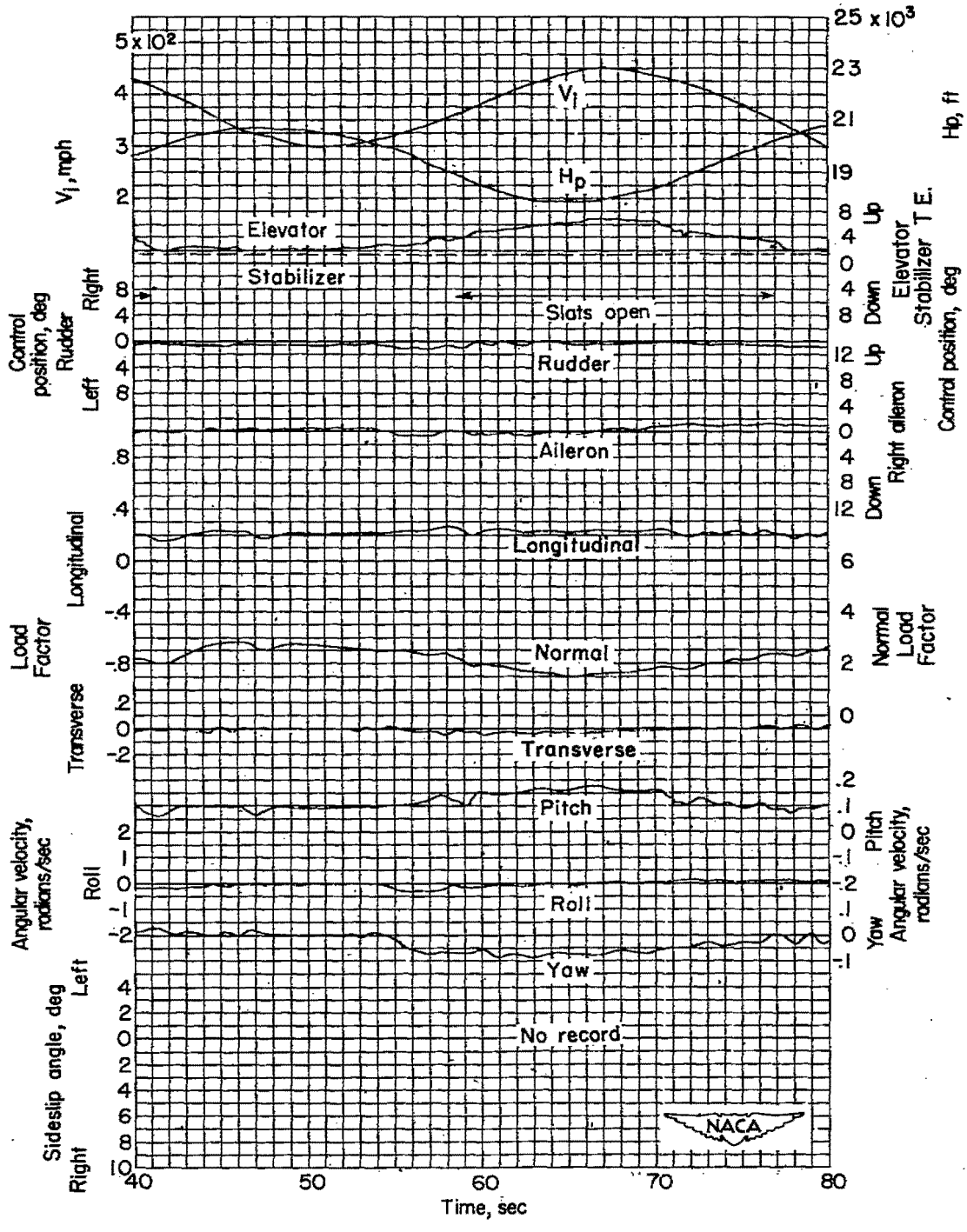


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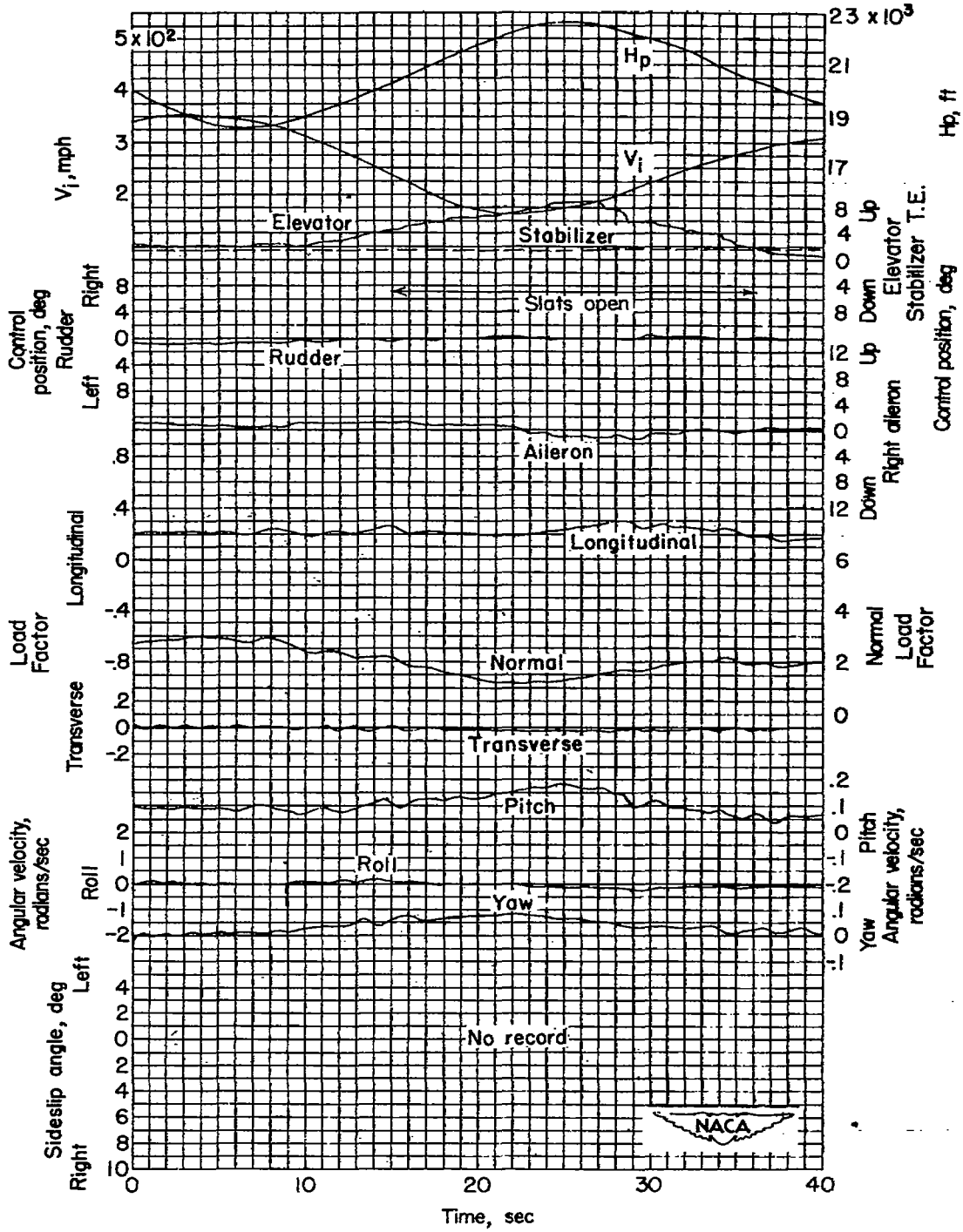


Figure 5.- Lazy eight. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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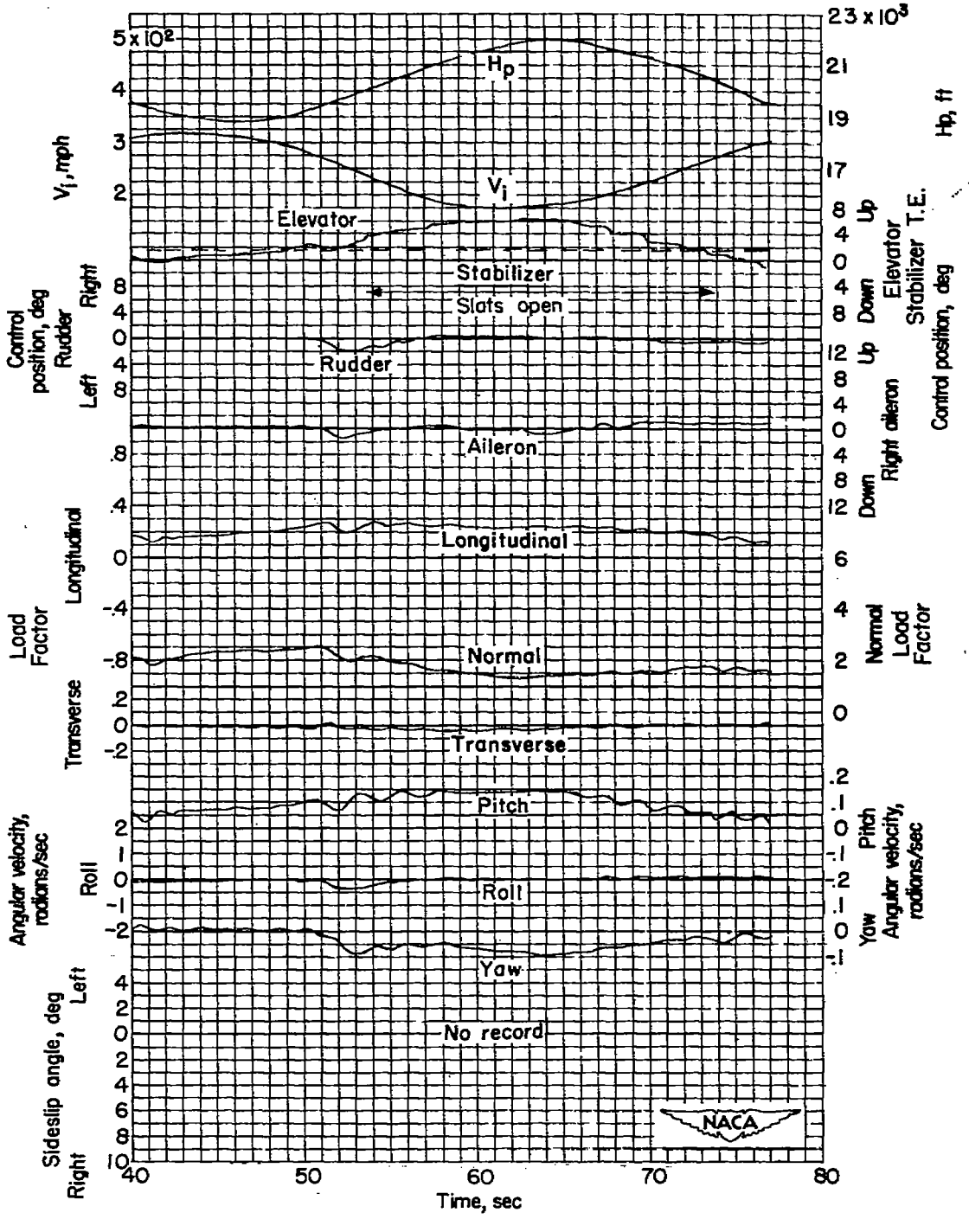


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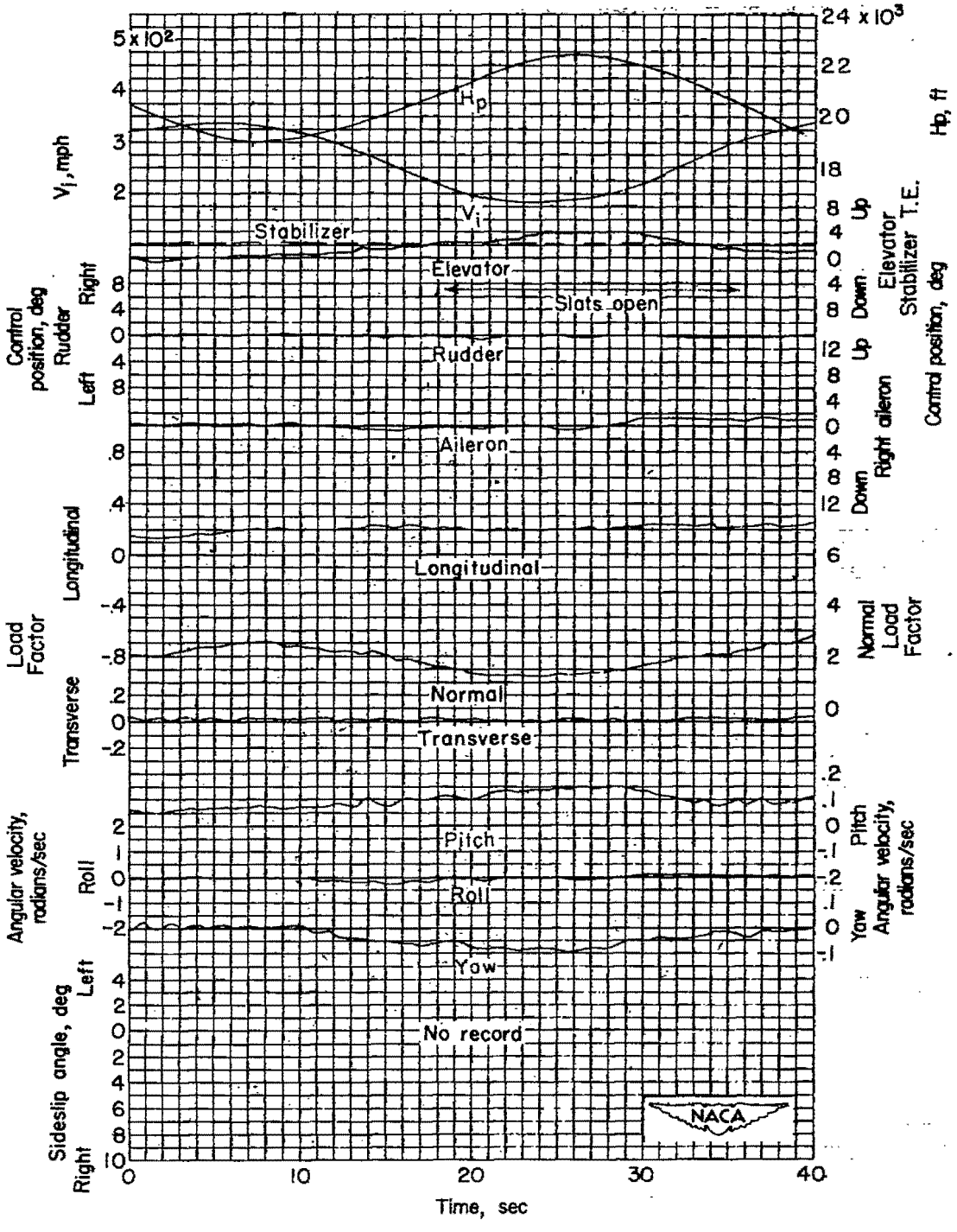


Figure 6.- Lazy eight and barrel roll. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

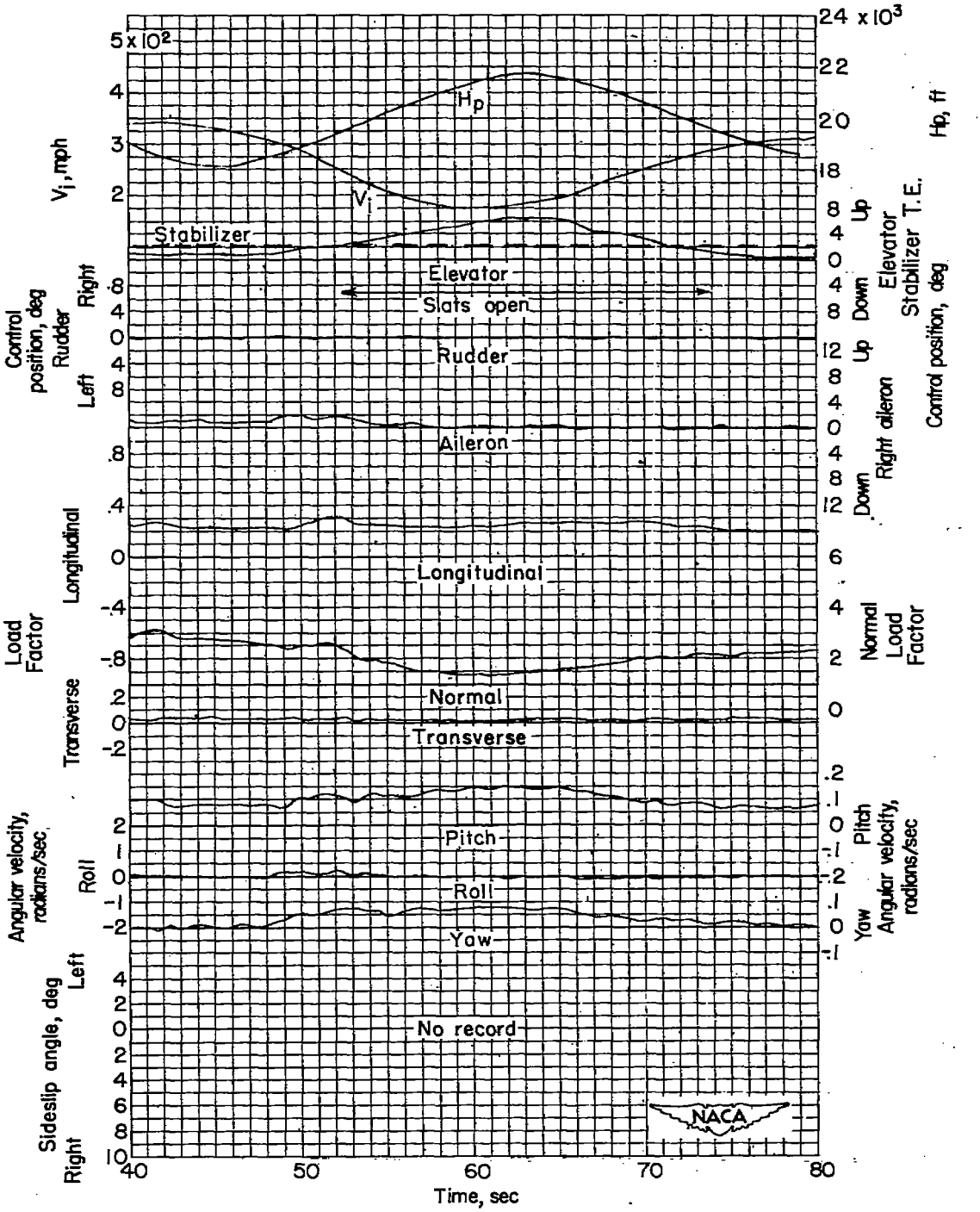


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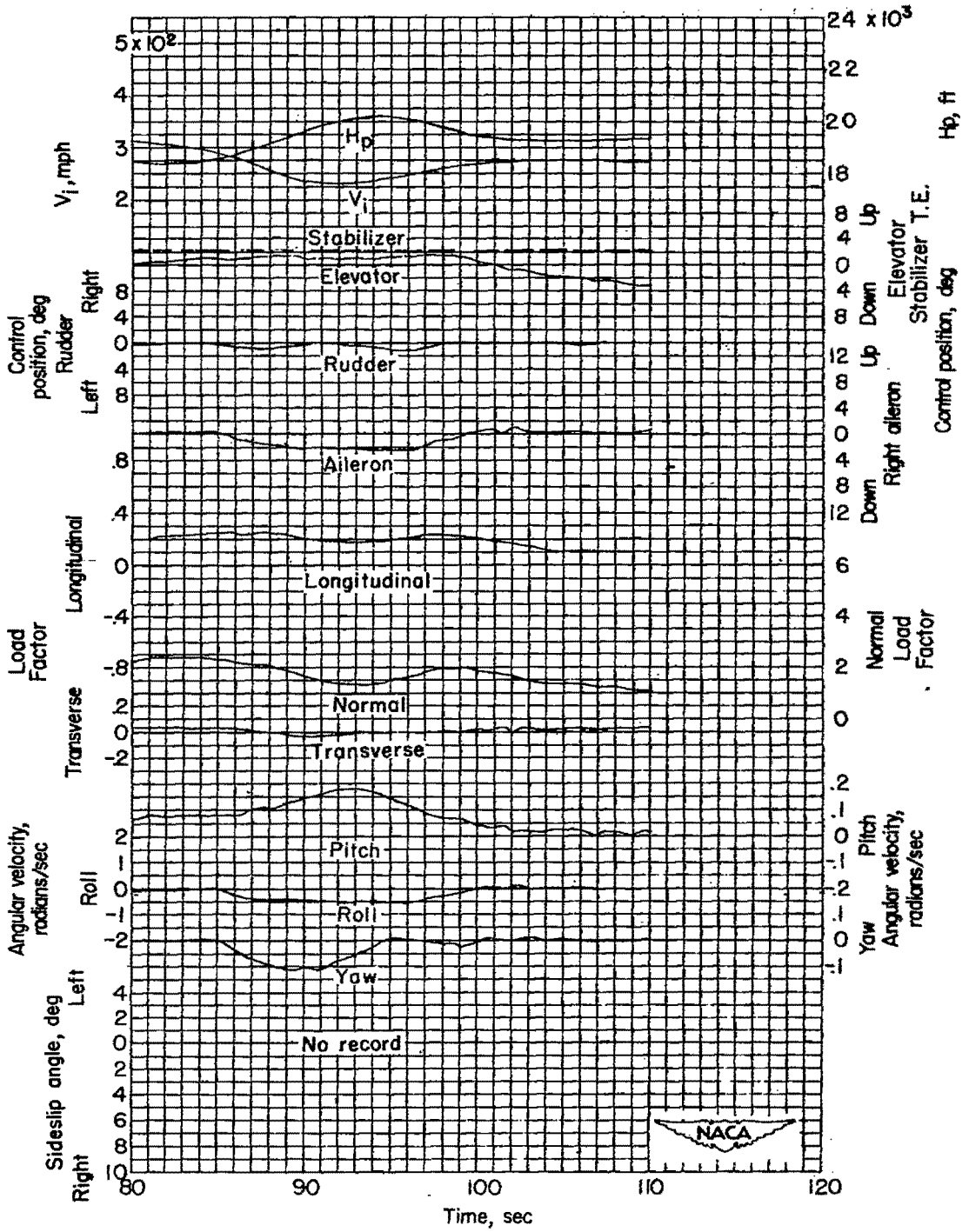


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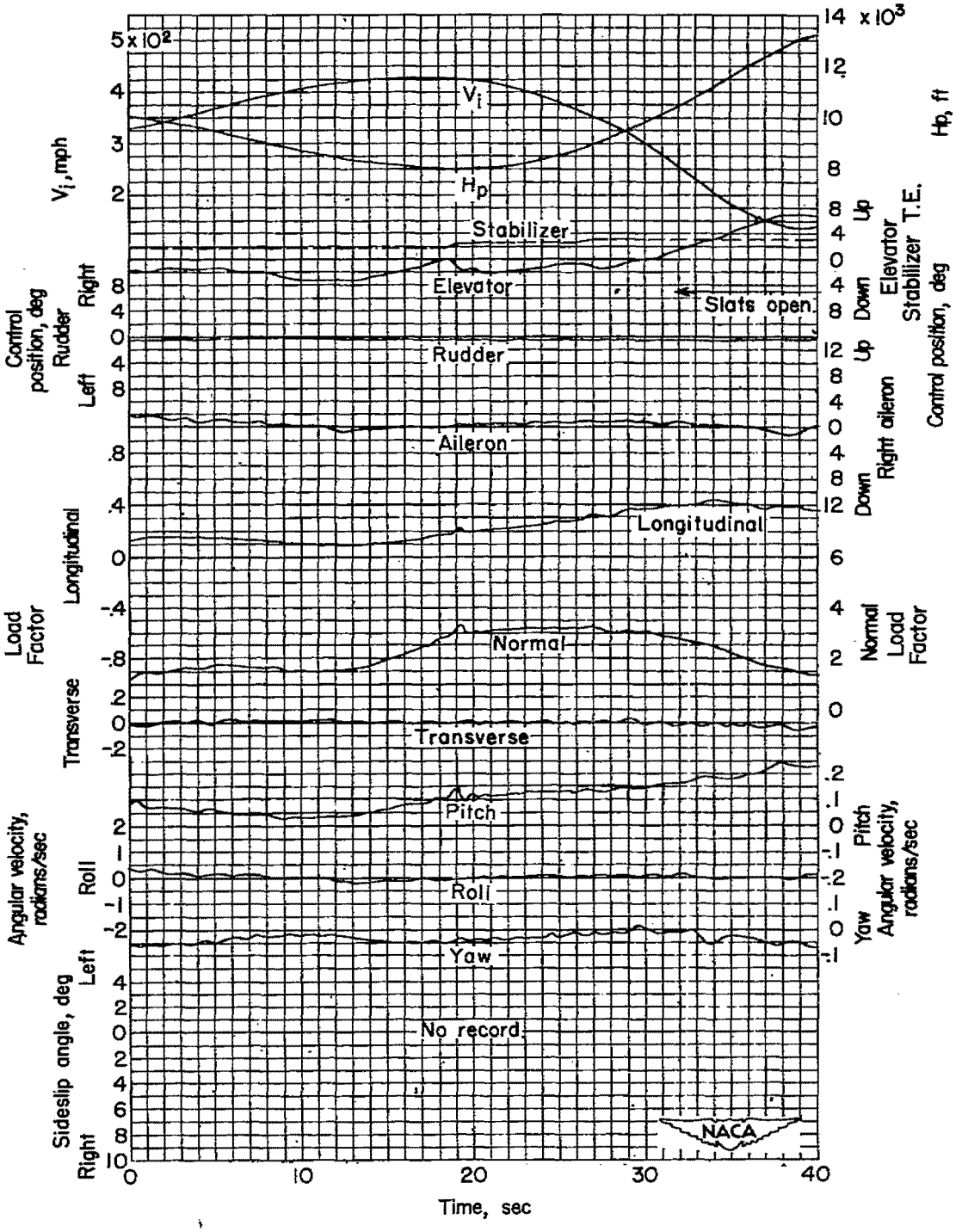


Figure 7.- Chandelle followed by a right turn. Airplane weight, 12,950 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

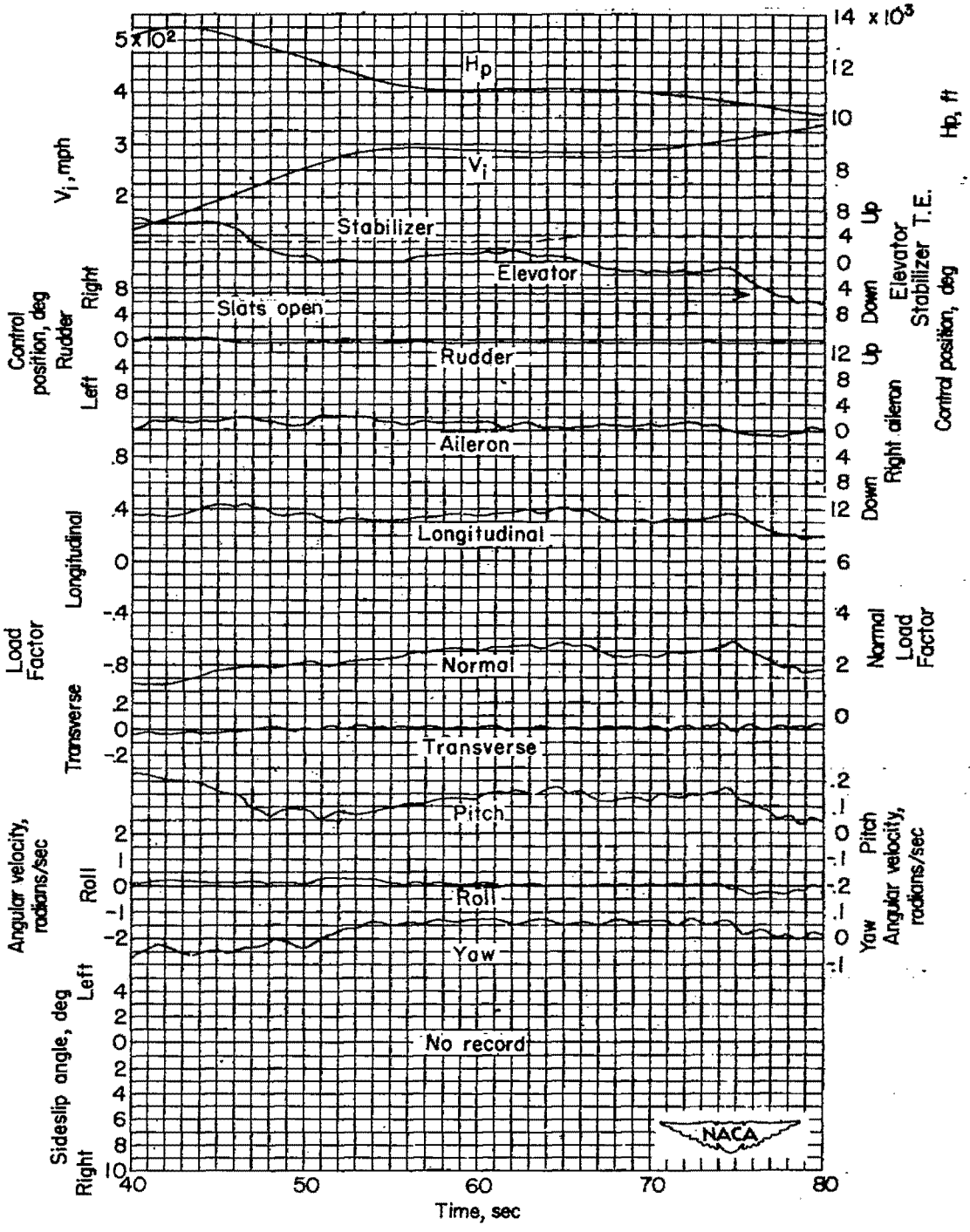


Figure 7.- Concluded.

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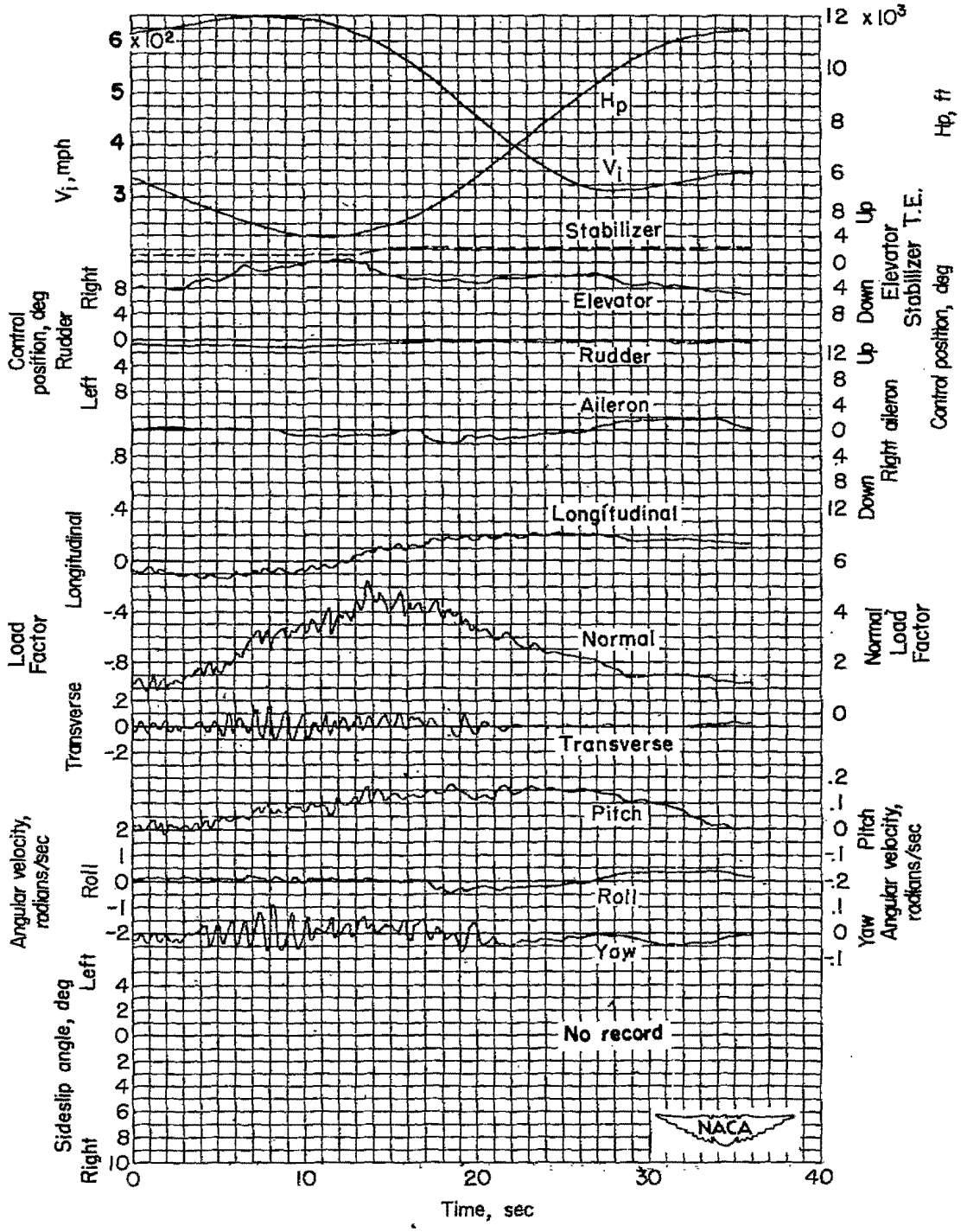


Figure 8.- Chandelle. Airplane weight, 13,600 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

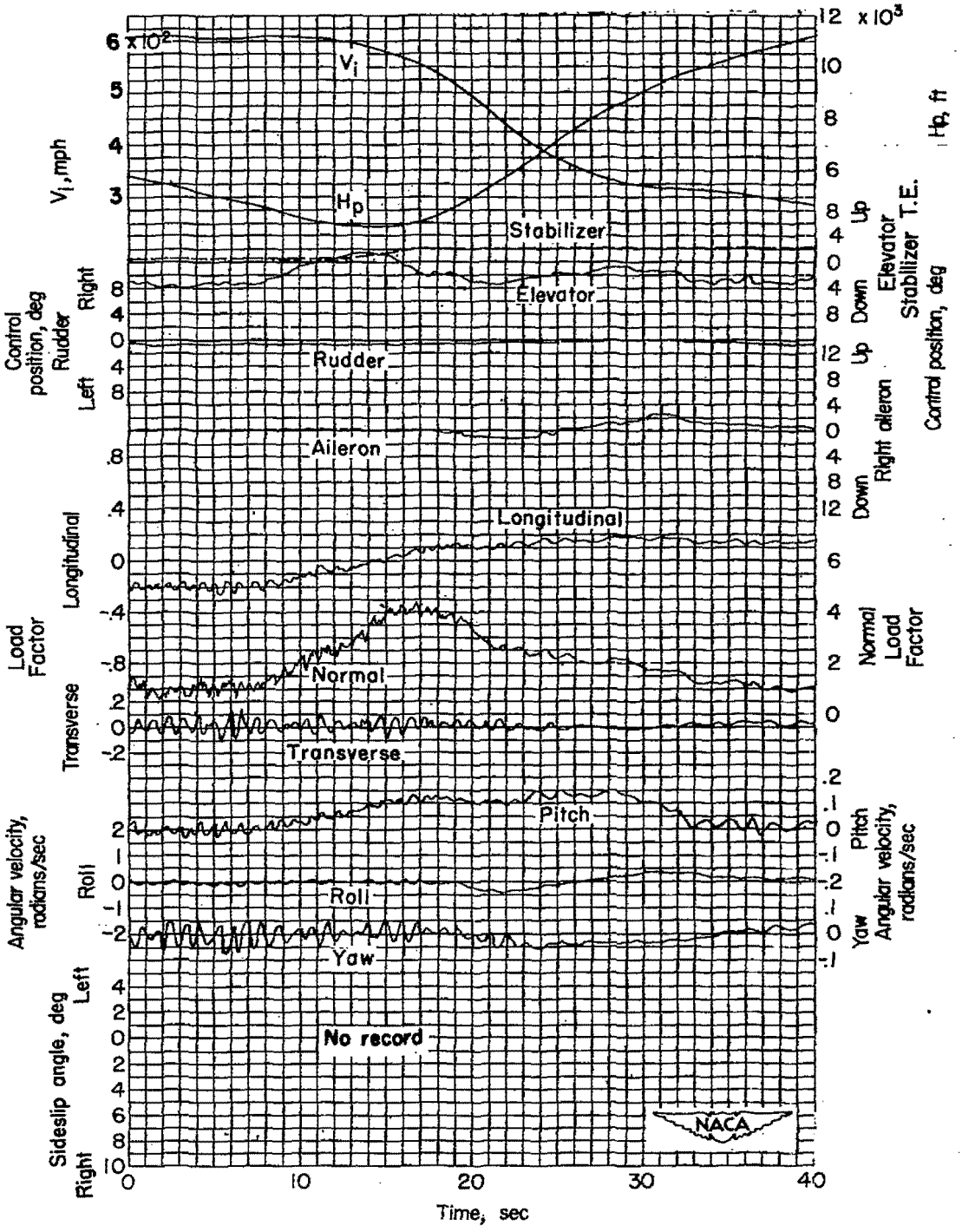


Figure 9.- Dive and pull-out followed by a climbing left turn. Airplane weight, 13,950 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

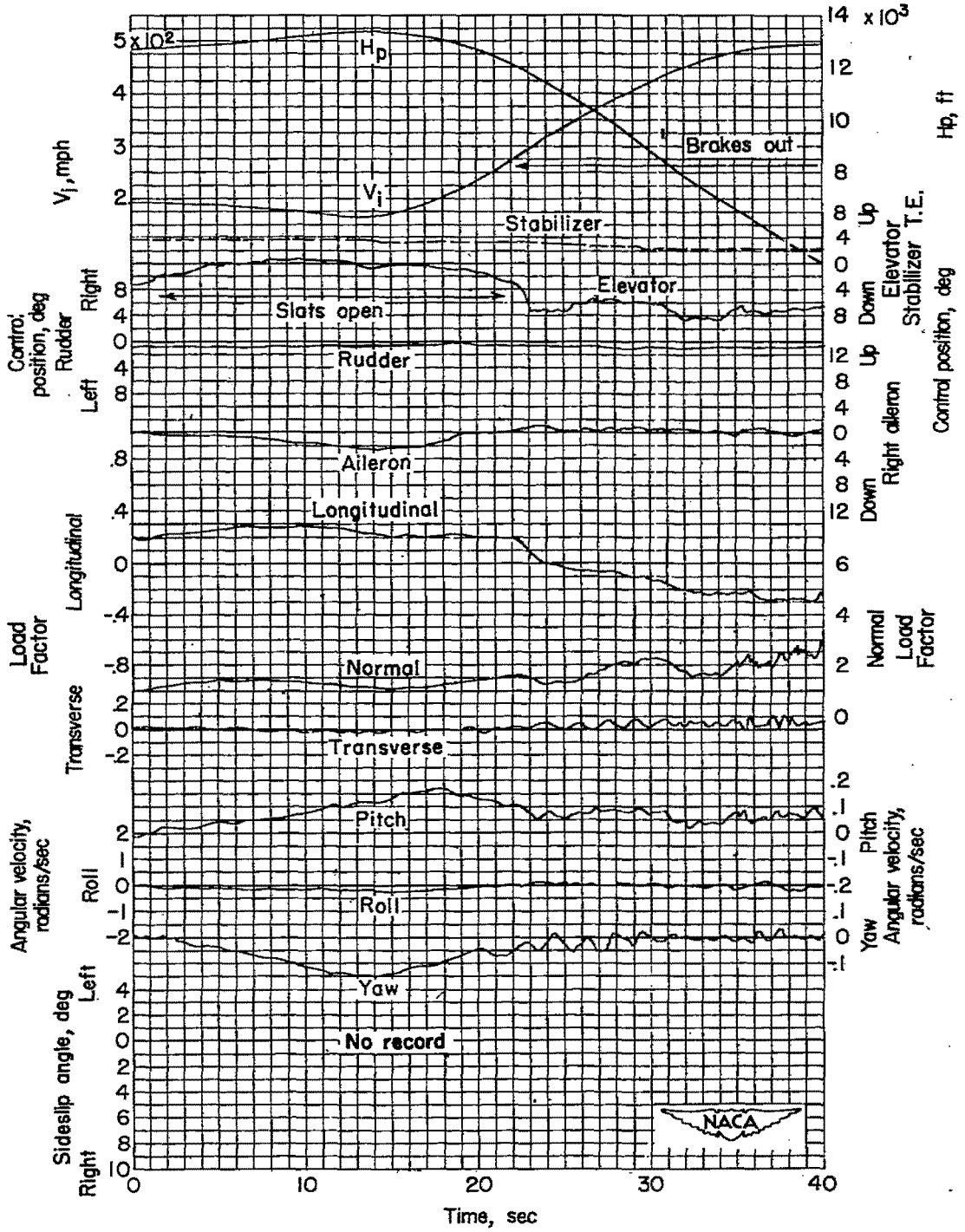


Figure 10.- Turn entry into a dive, pull-out, and climbing right turn. Airplane weight, 13,450 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

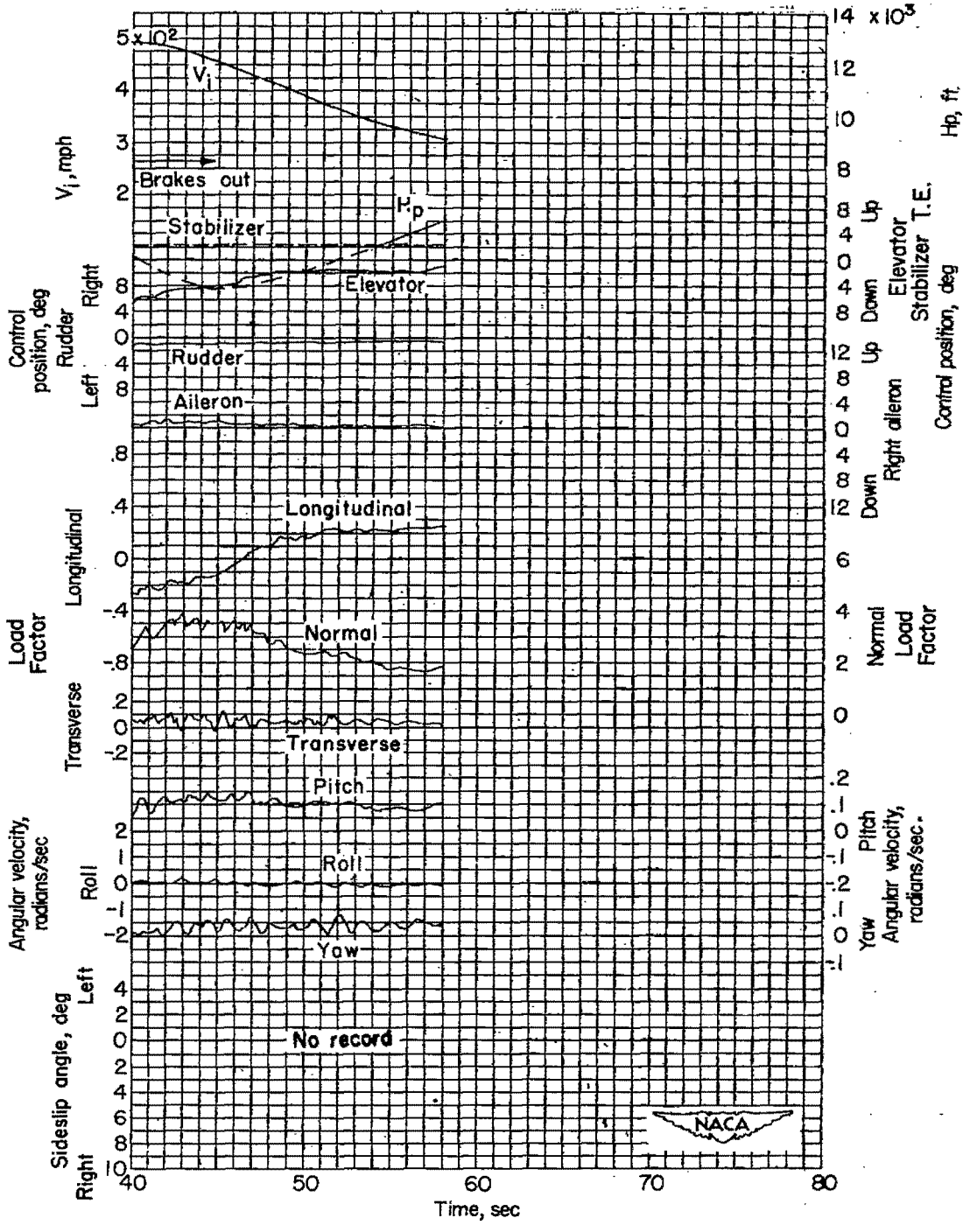


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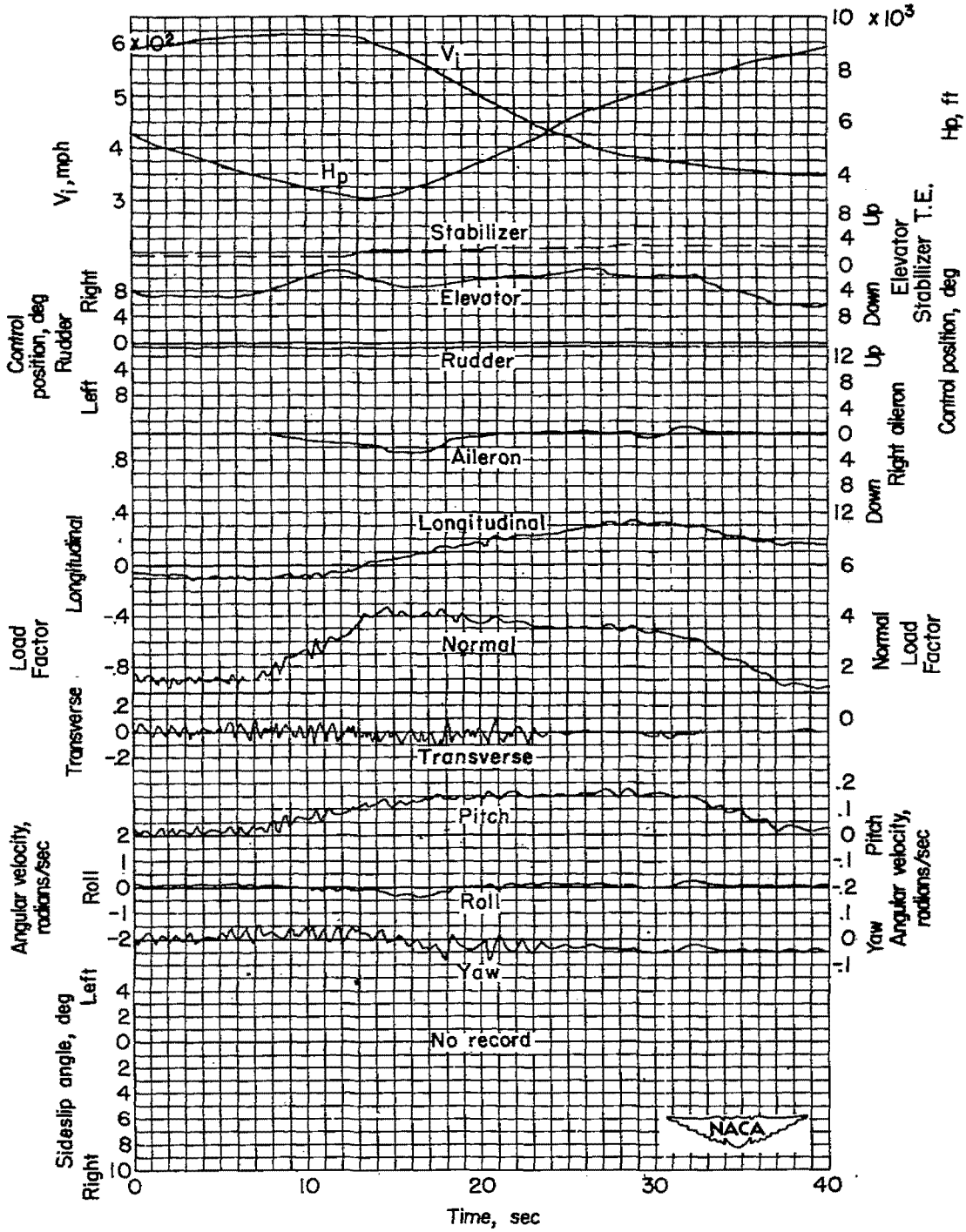


Figure 11.- Dive and pull-out followed by a climbing left turn. Airplane weight, 13,600 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

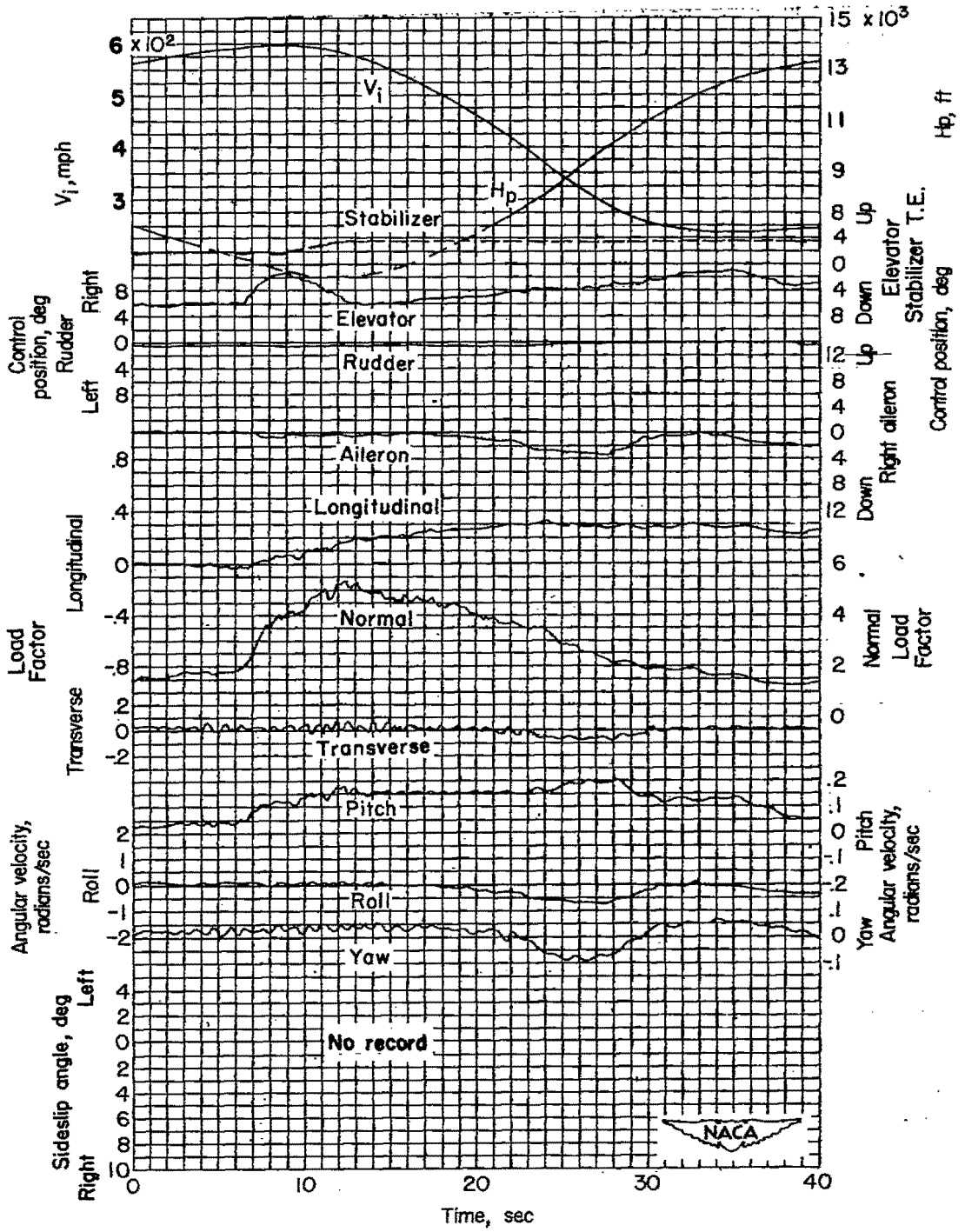


Figure 12.- Dive and pull-out, followed by a rolling climb and turn entry into a dive. Airplane weight, 13,750 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

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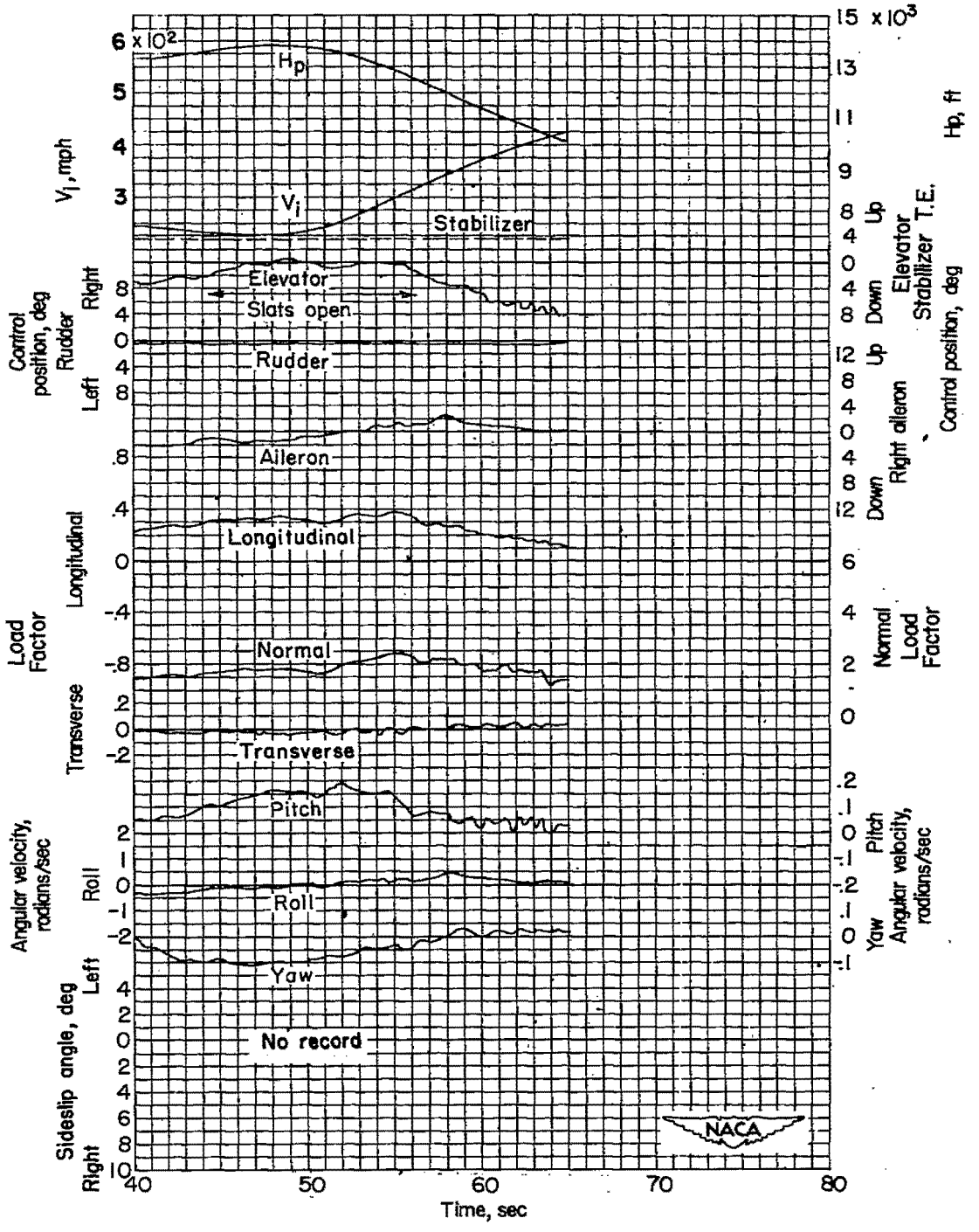


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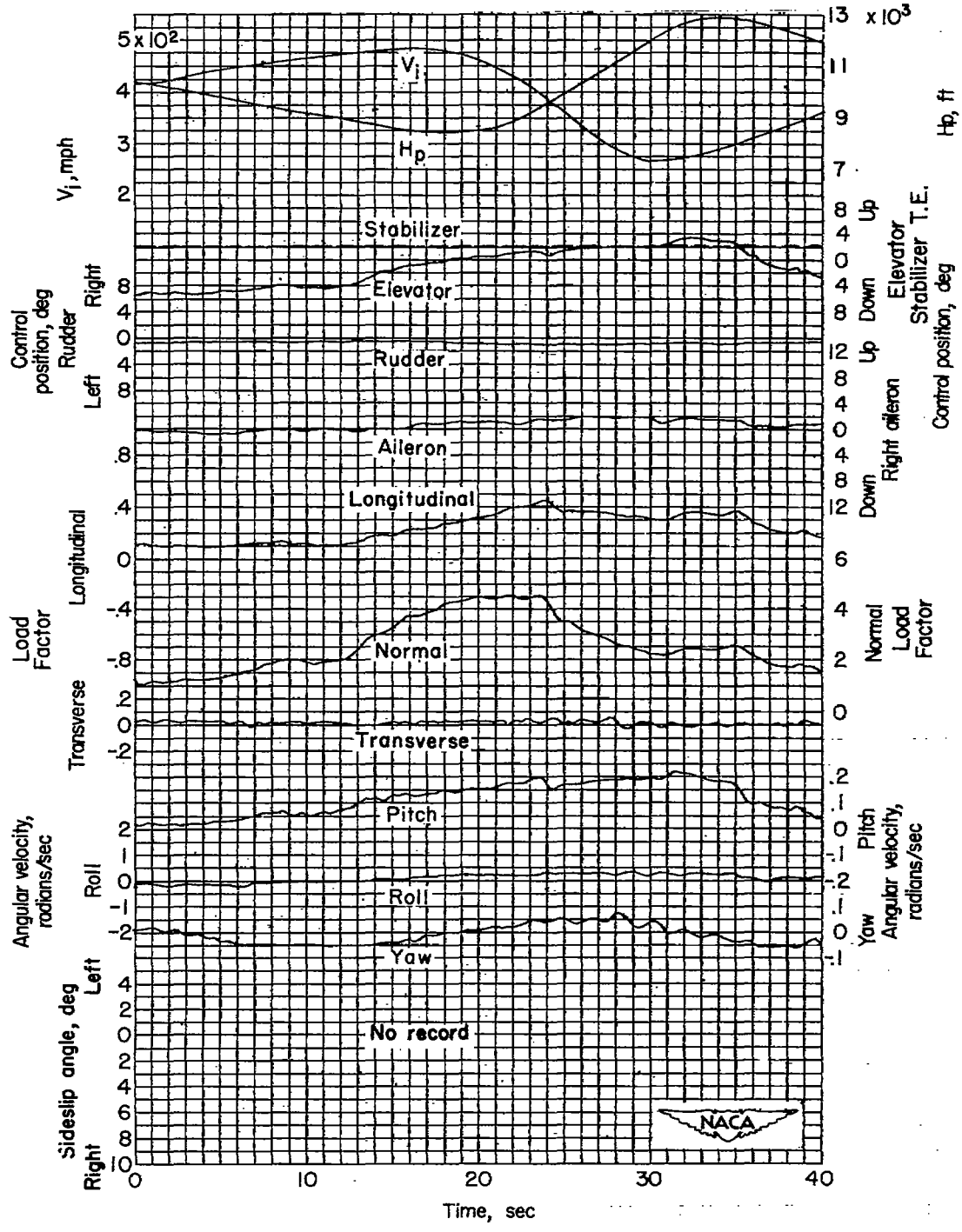


Figure 13.- Dive and pull-out, followed by a rolling climb and turn entry into a dive. Airplane weight, 13,850 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

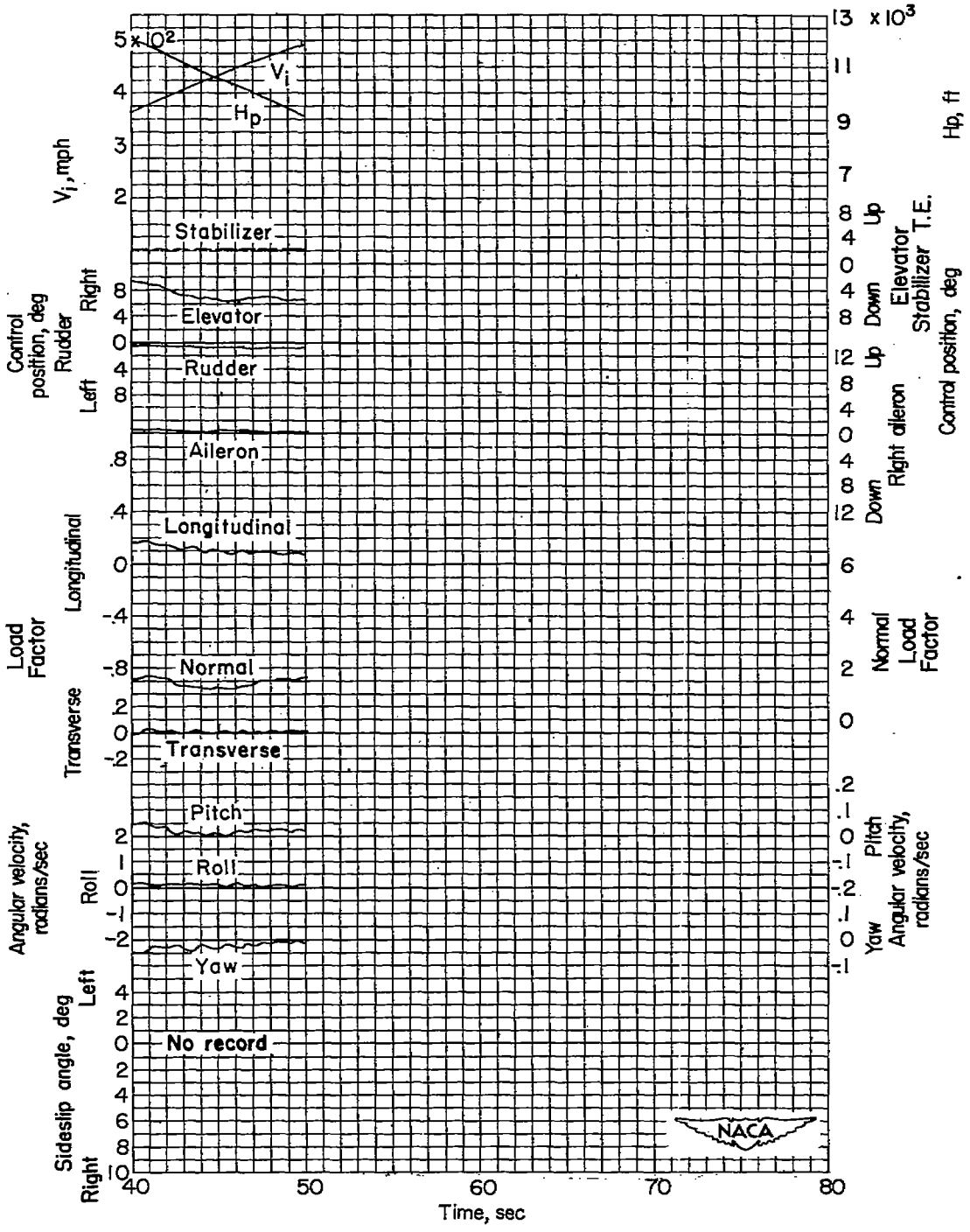


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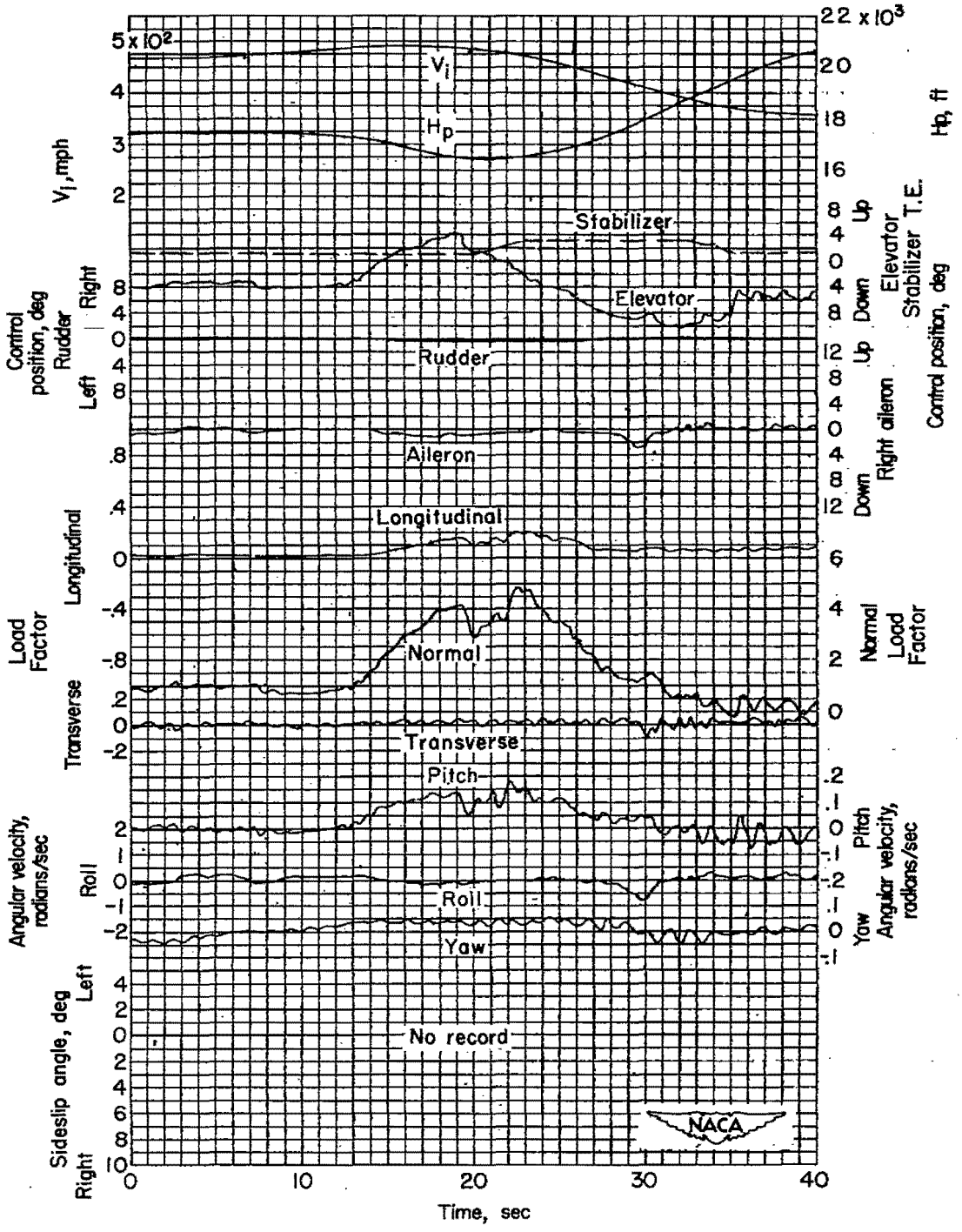


Figure 14.- Dive, pull-out, and climb. Airplane weight, ~~14,100~~ 13,739 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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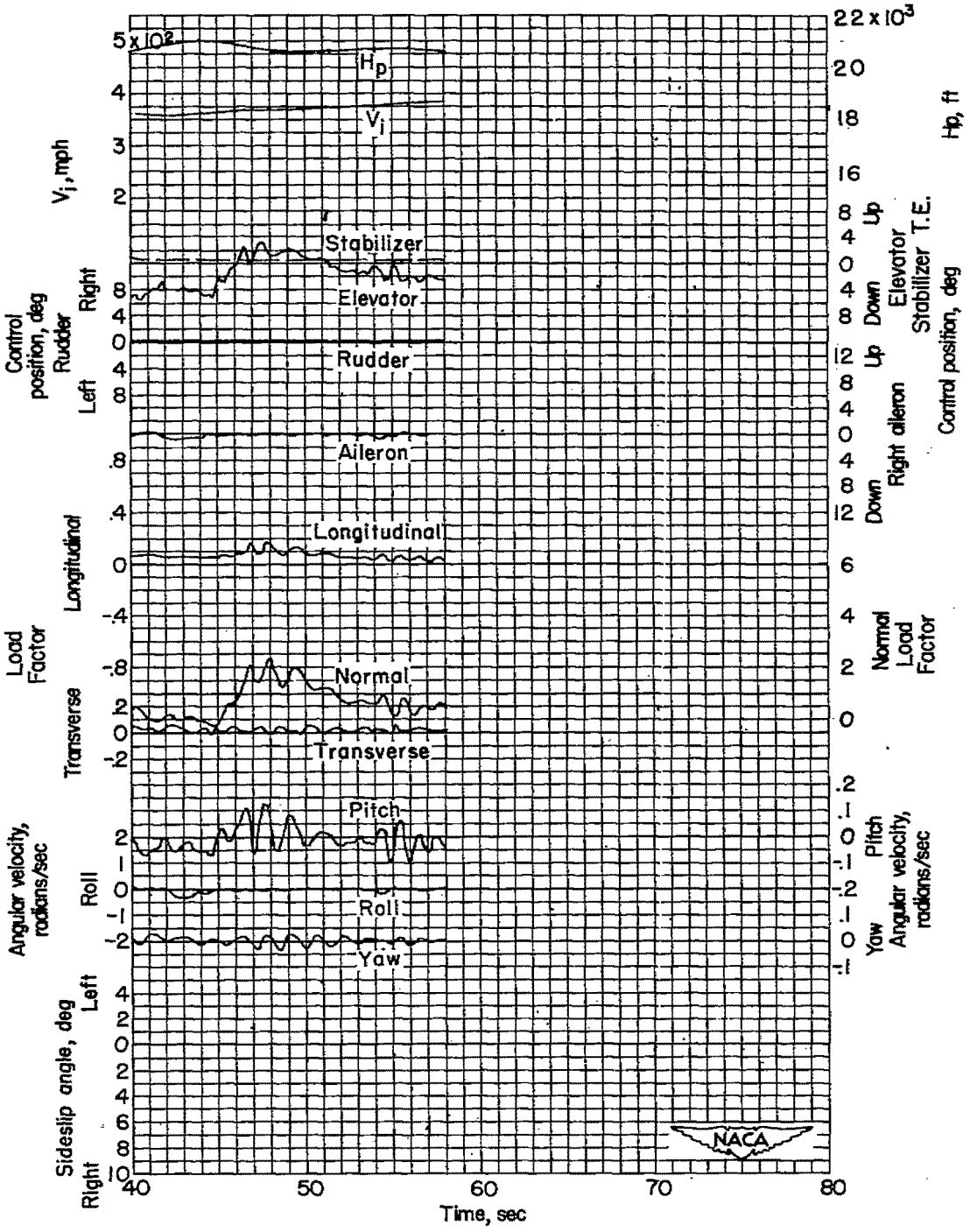


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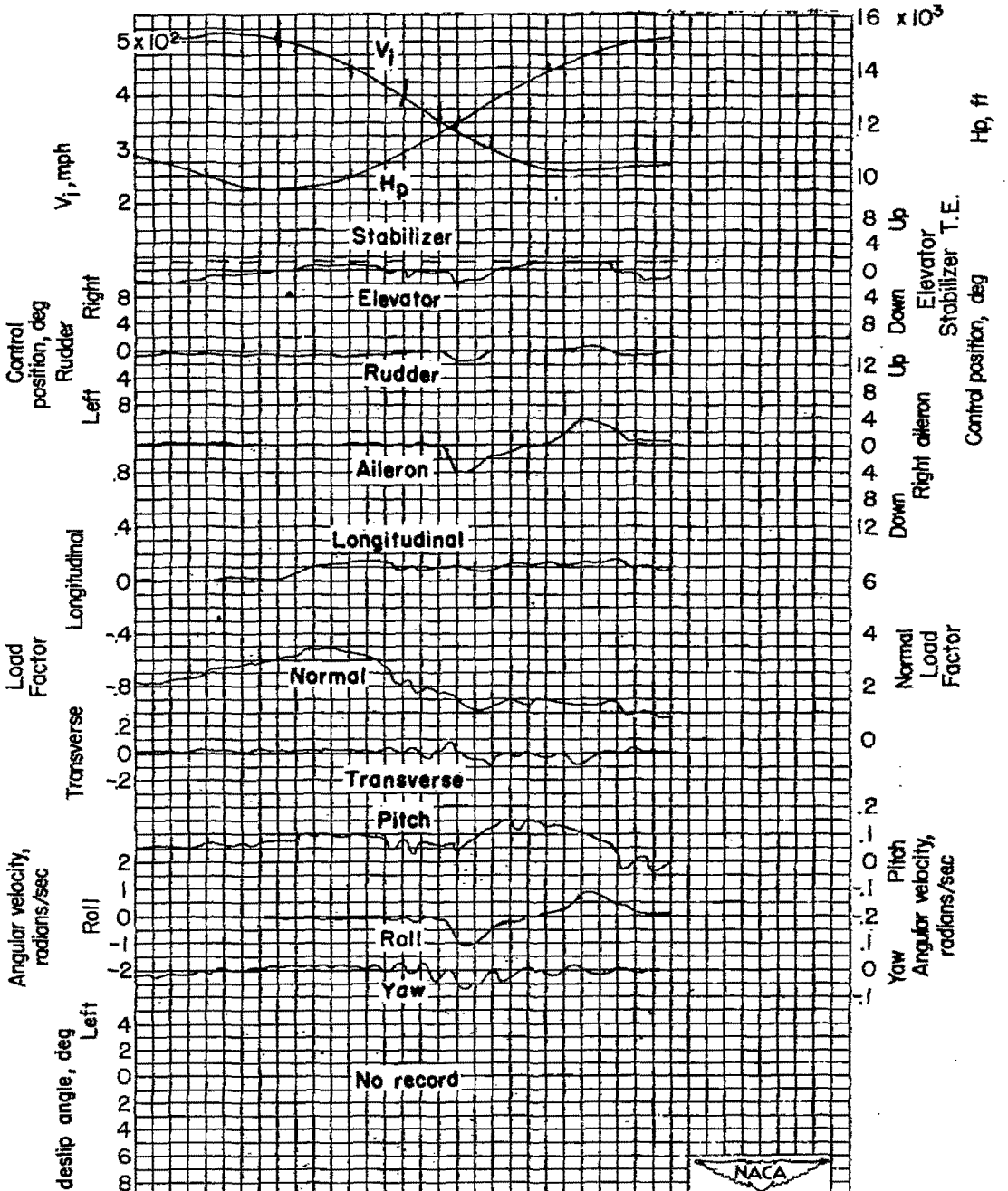


Figure 15.- Dive, pull-out, and left and right half-rolls. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

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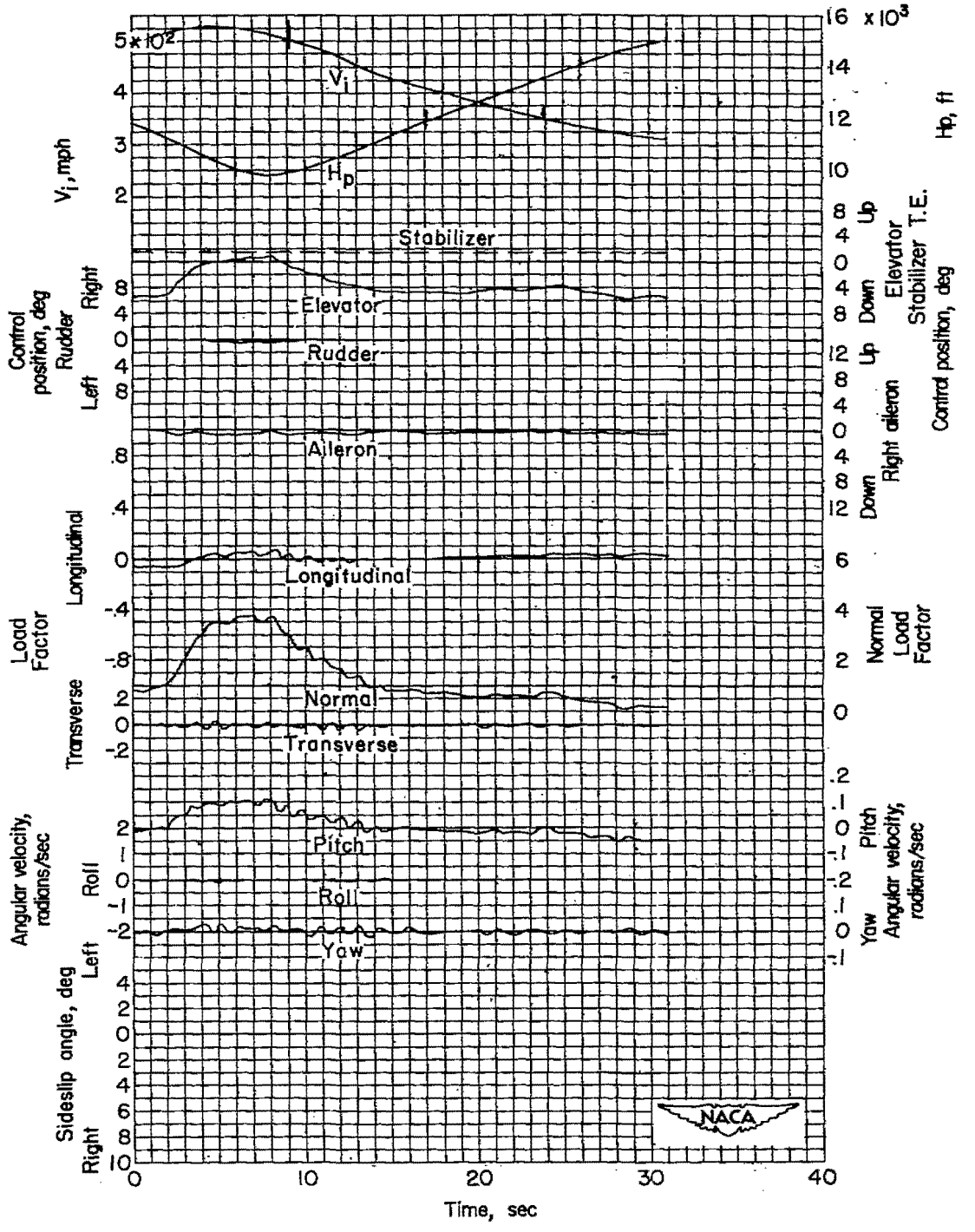


Figure 16.- Dive and pull-out. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

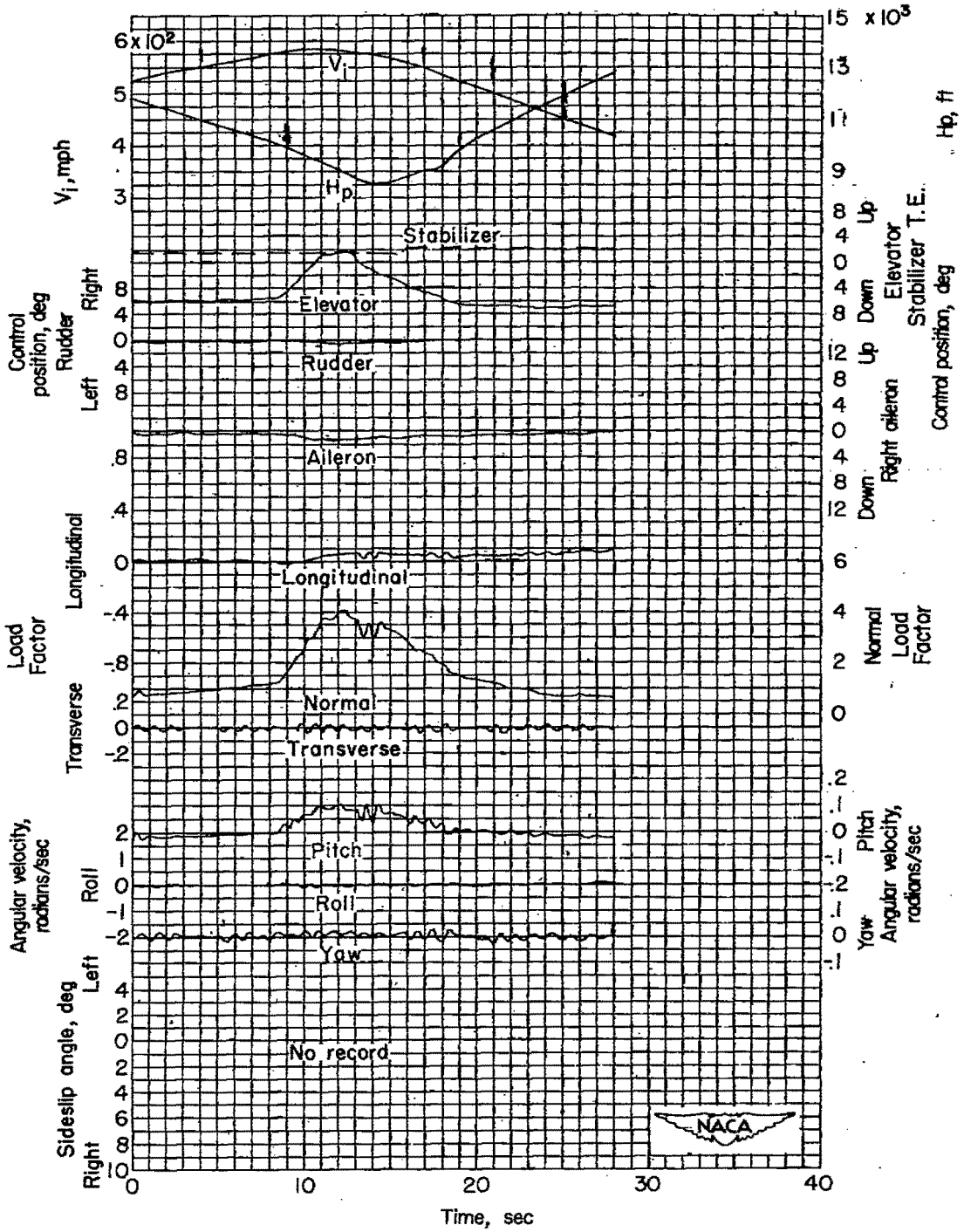


Figure 17.- Dive and pull-out. Airplane weight, 13,650 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

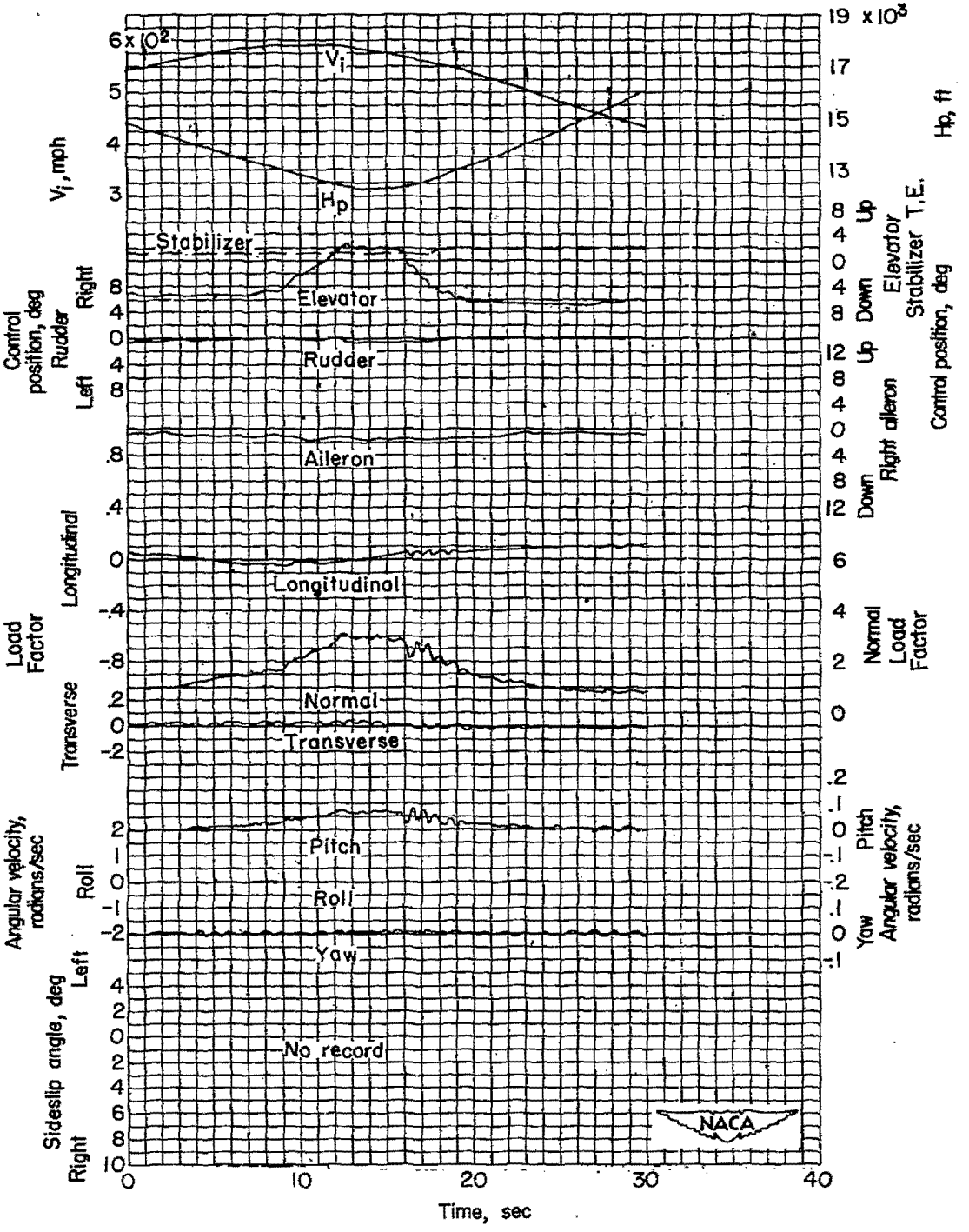


Figure 18.- Dive and pull-out. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

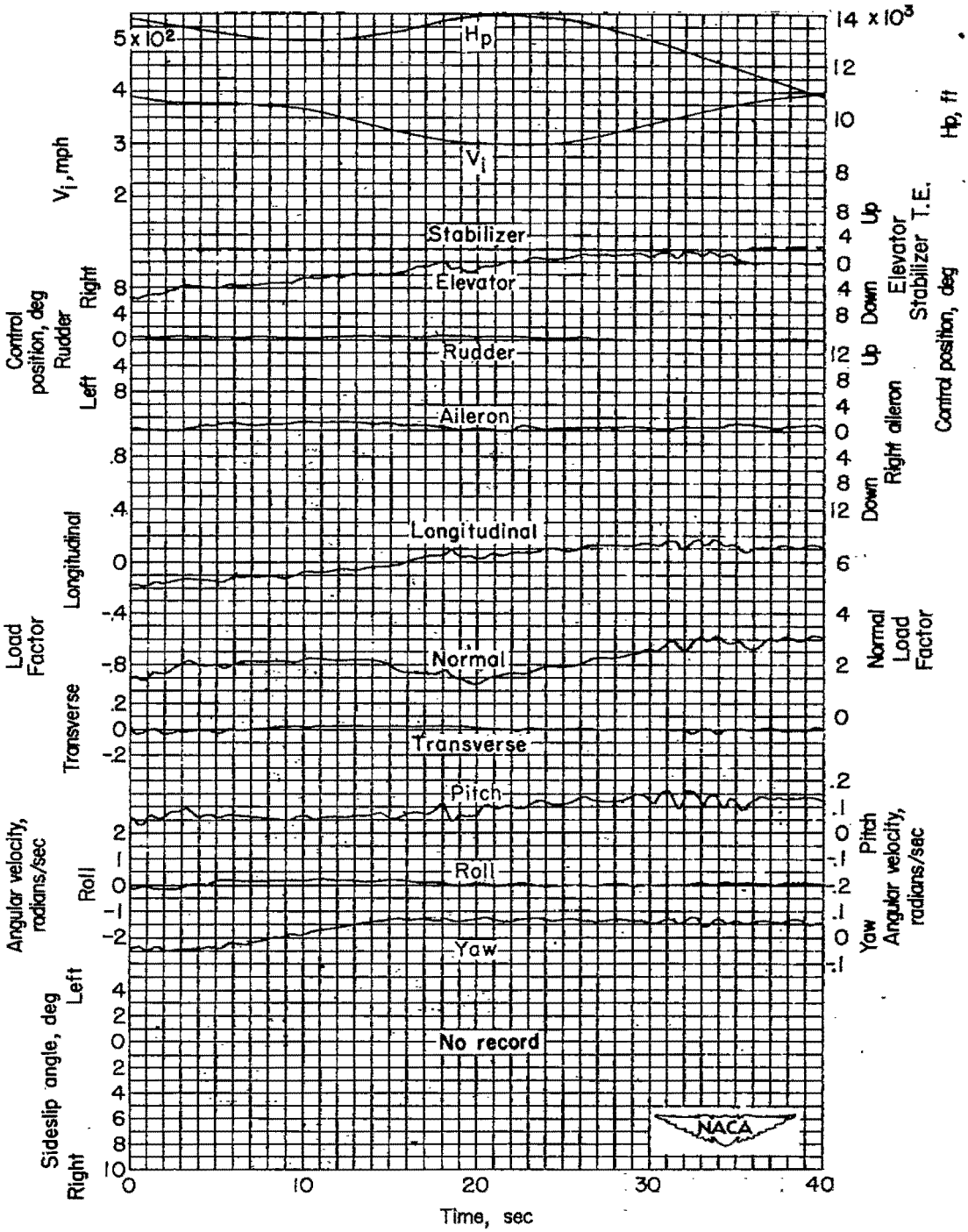


Figure 19.- Pull-up and turn entry into a dive. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

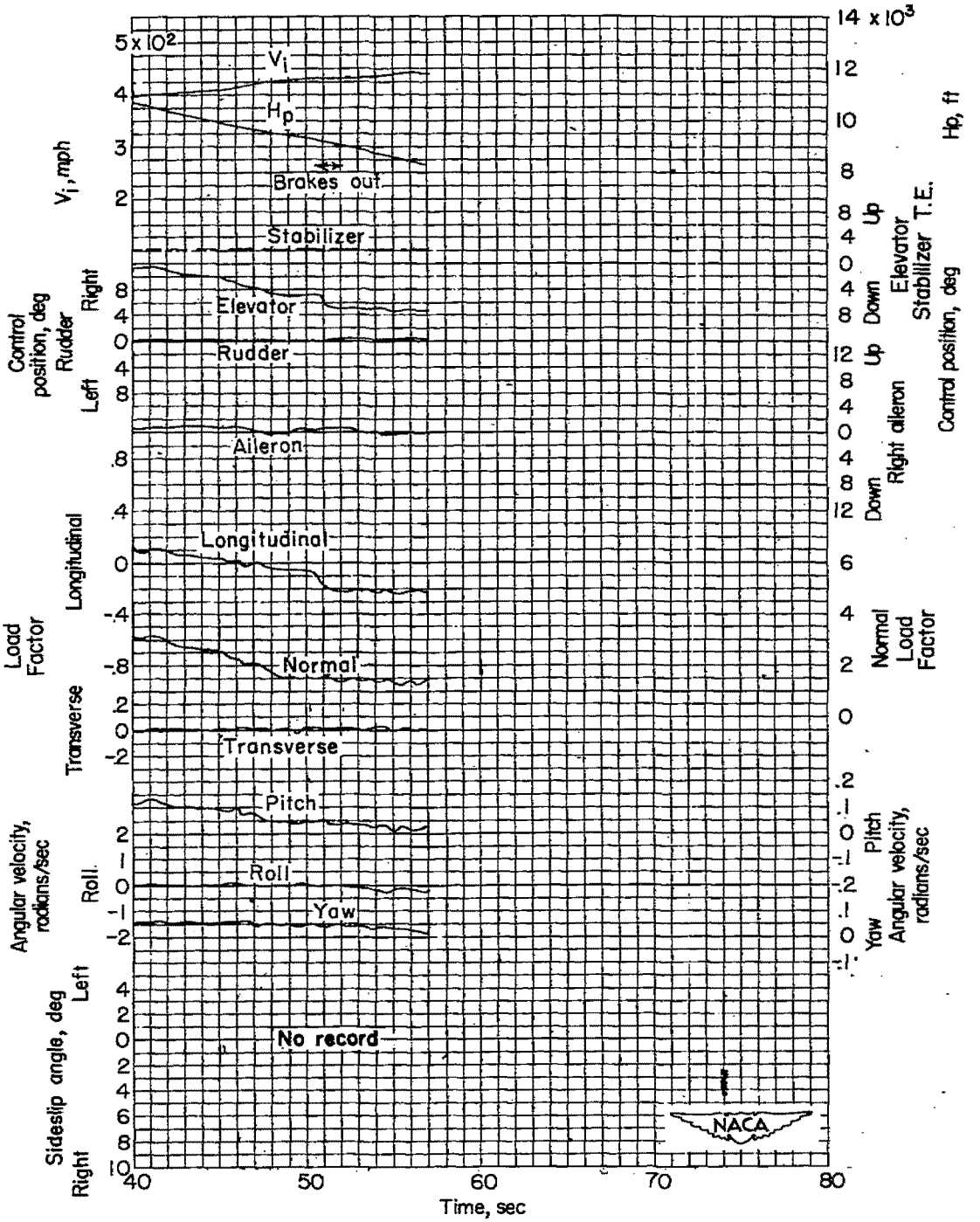


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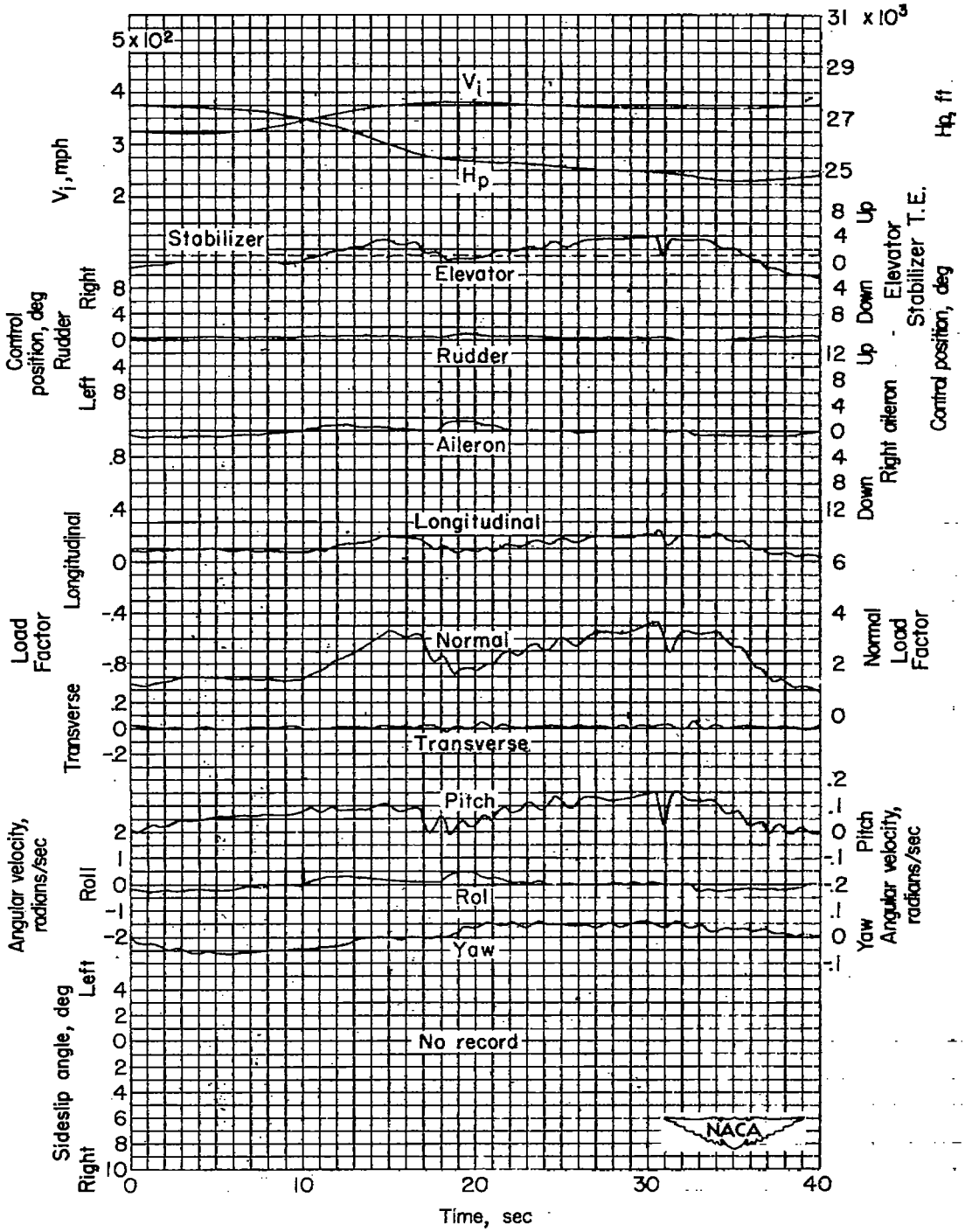


Figure 20.- Turn entry into a dive, pull-out, and sharp right turn. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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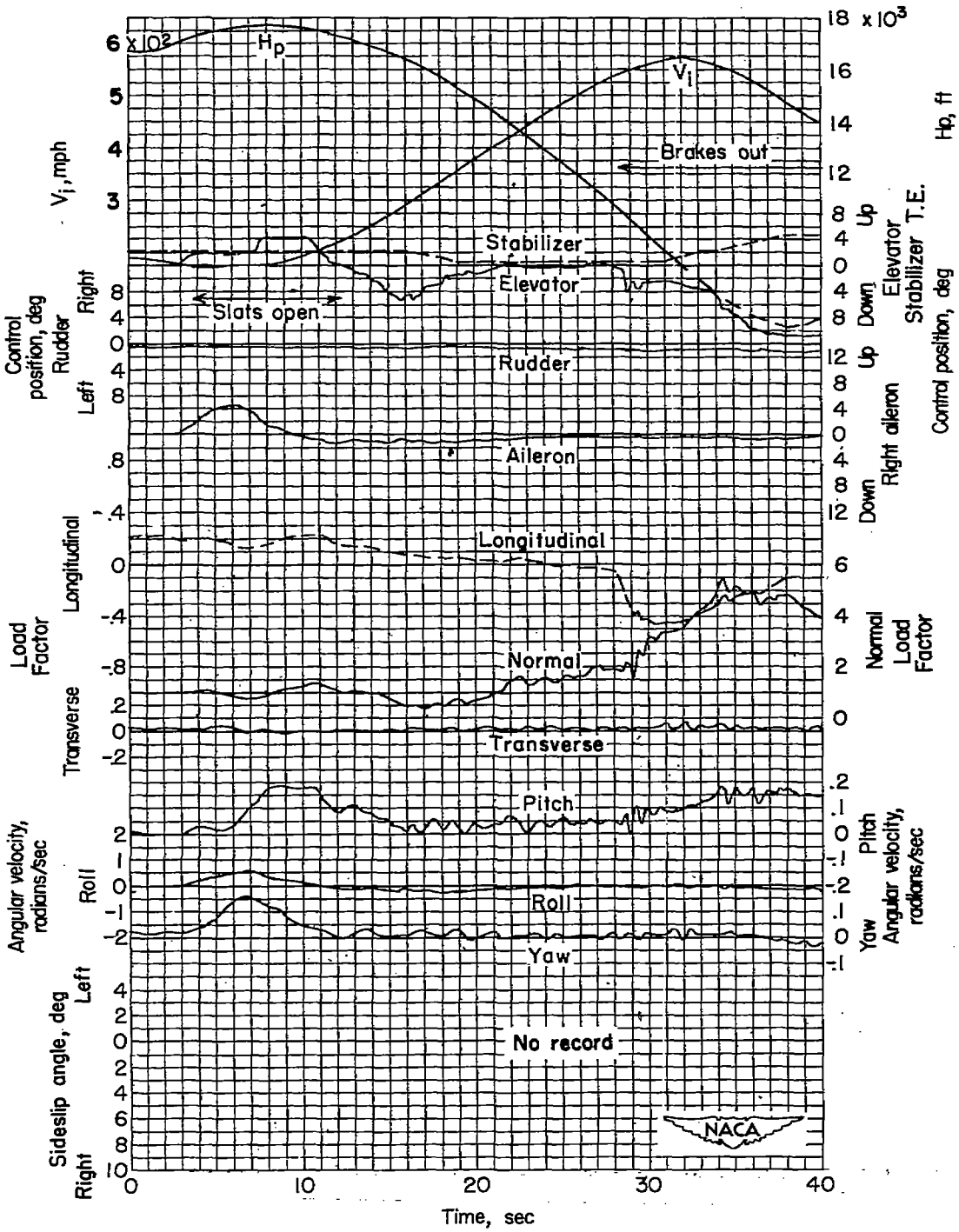


Figure 21.- Turn entry into a dive, pull-out, and climbing left turn. Airplane weight, 13,500 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

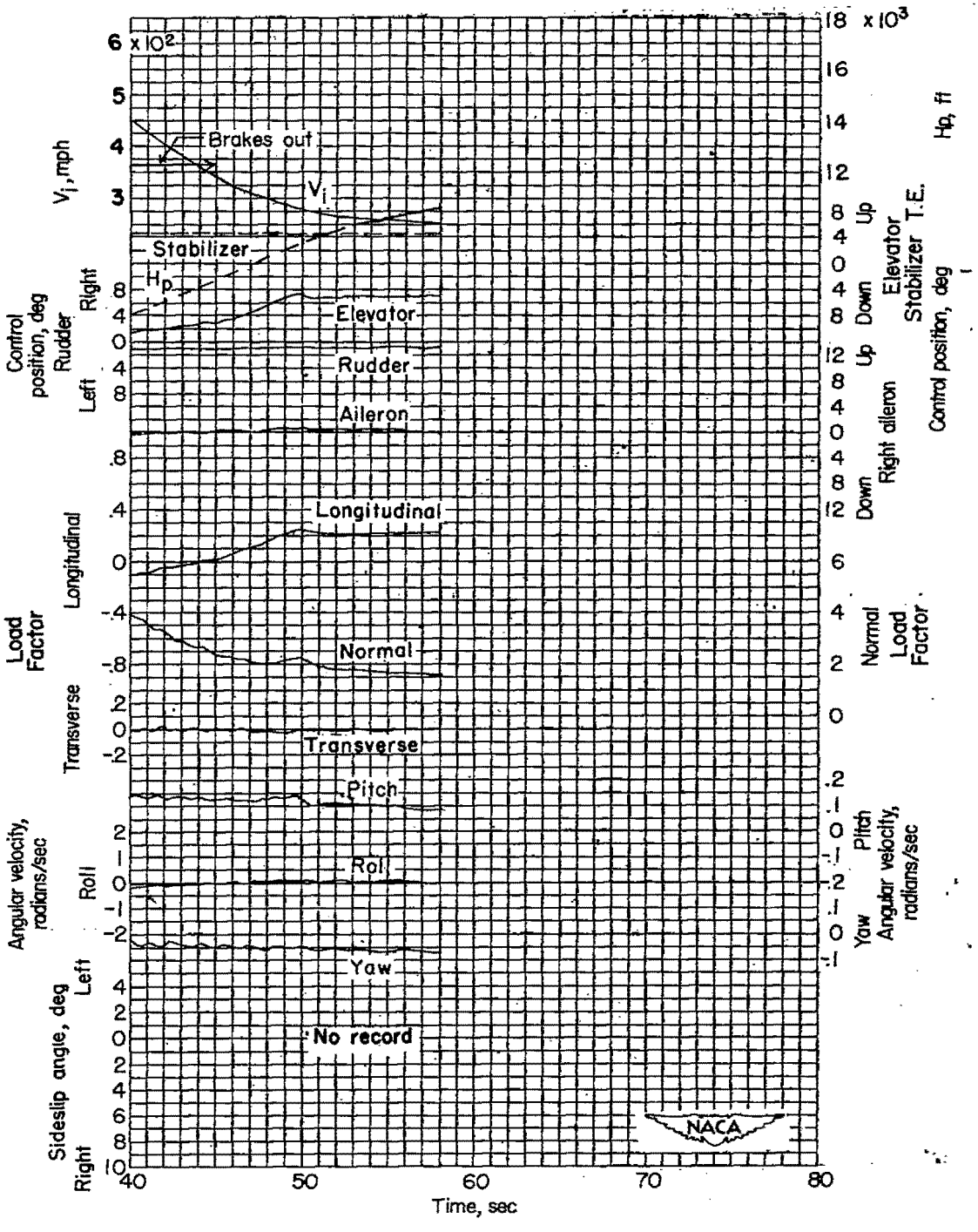


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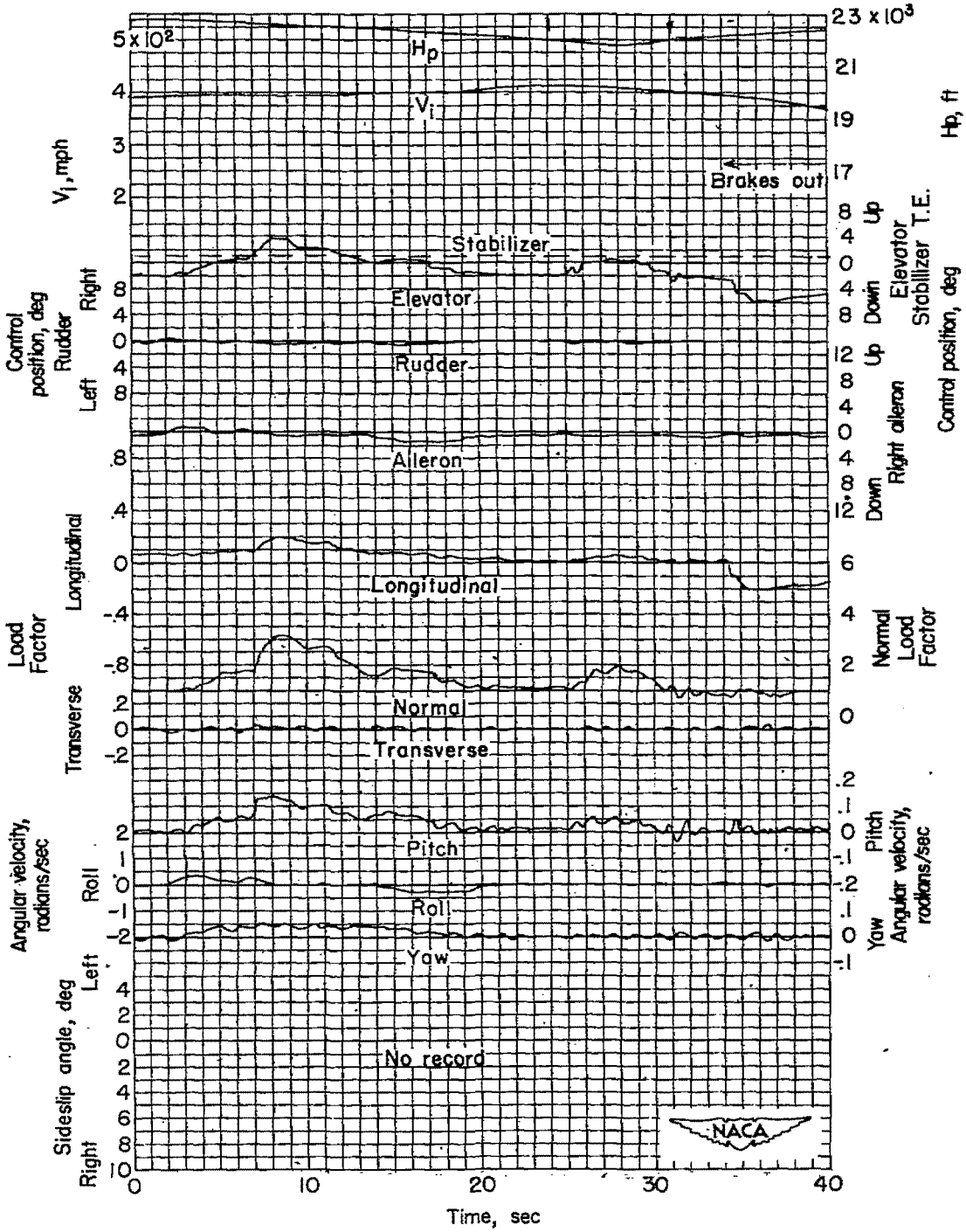


Figure 22.- Turn entry into a dive and pull-out. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

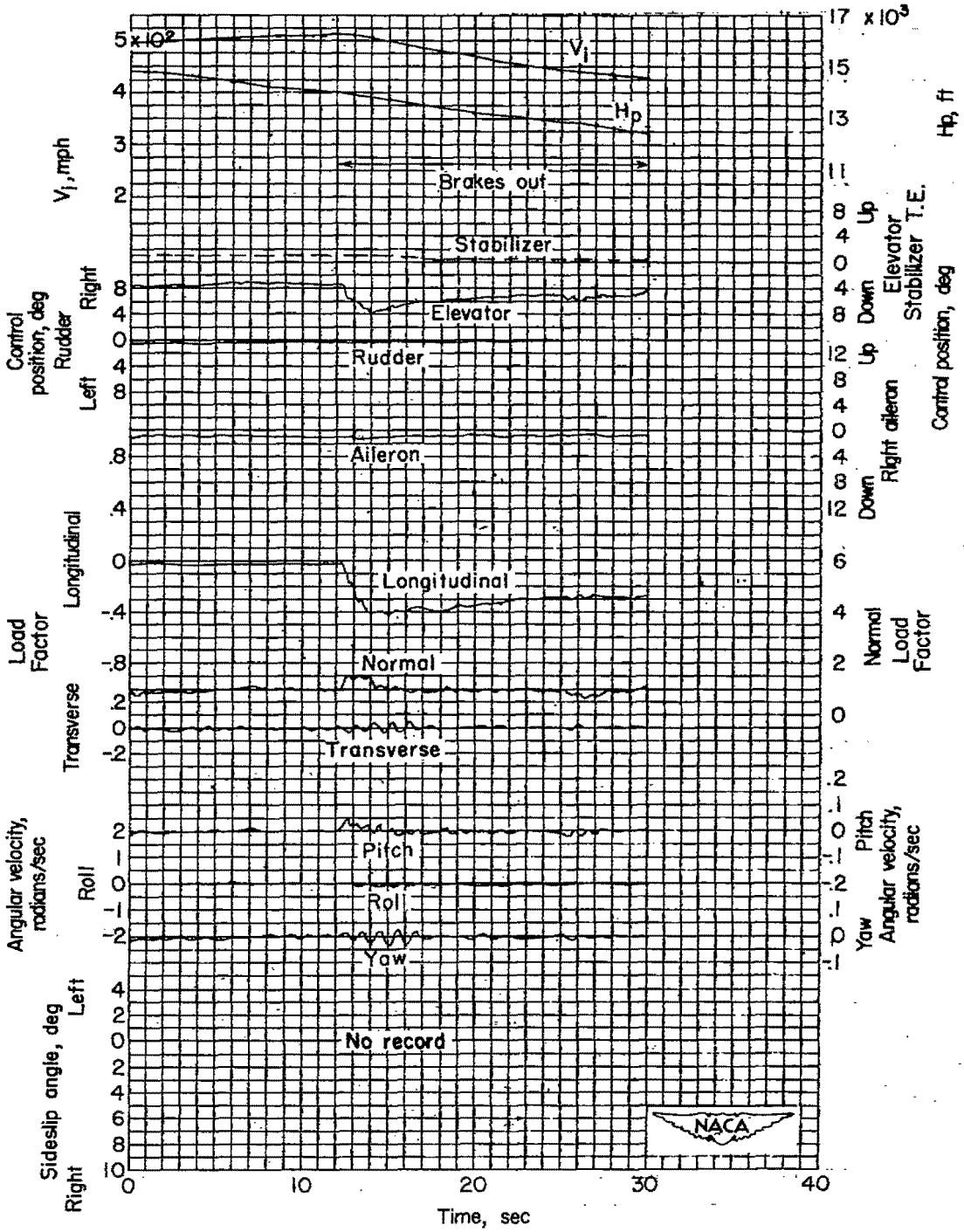


Figure 23.- Dive. Airplane weight, 12,400 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

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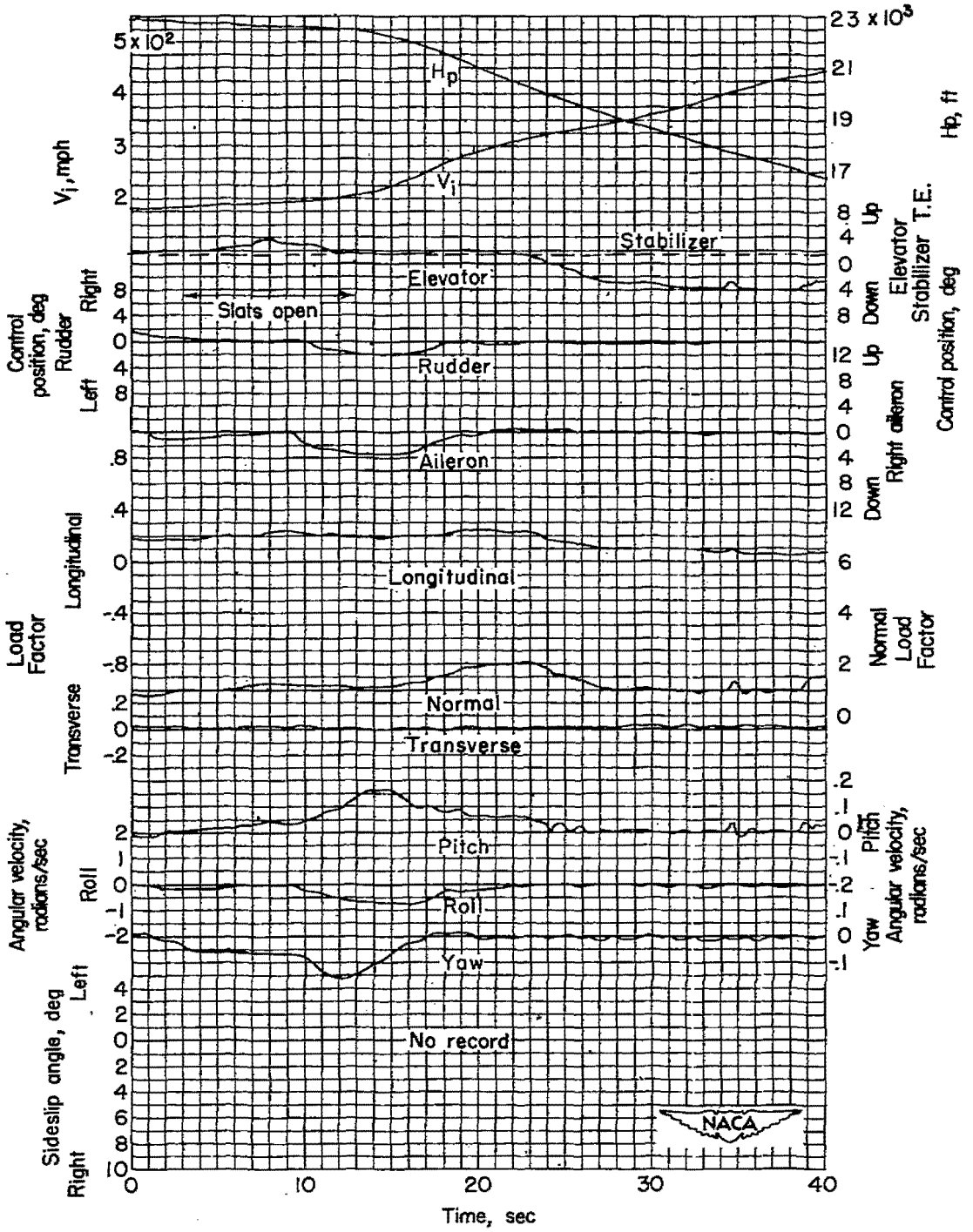


Figure 24.- Roll entry into a dive. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

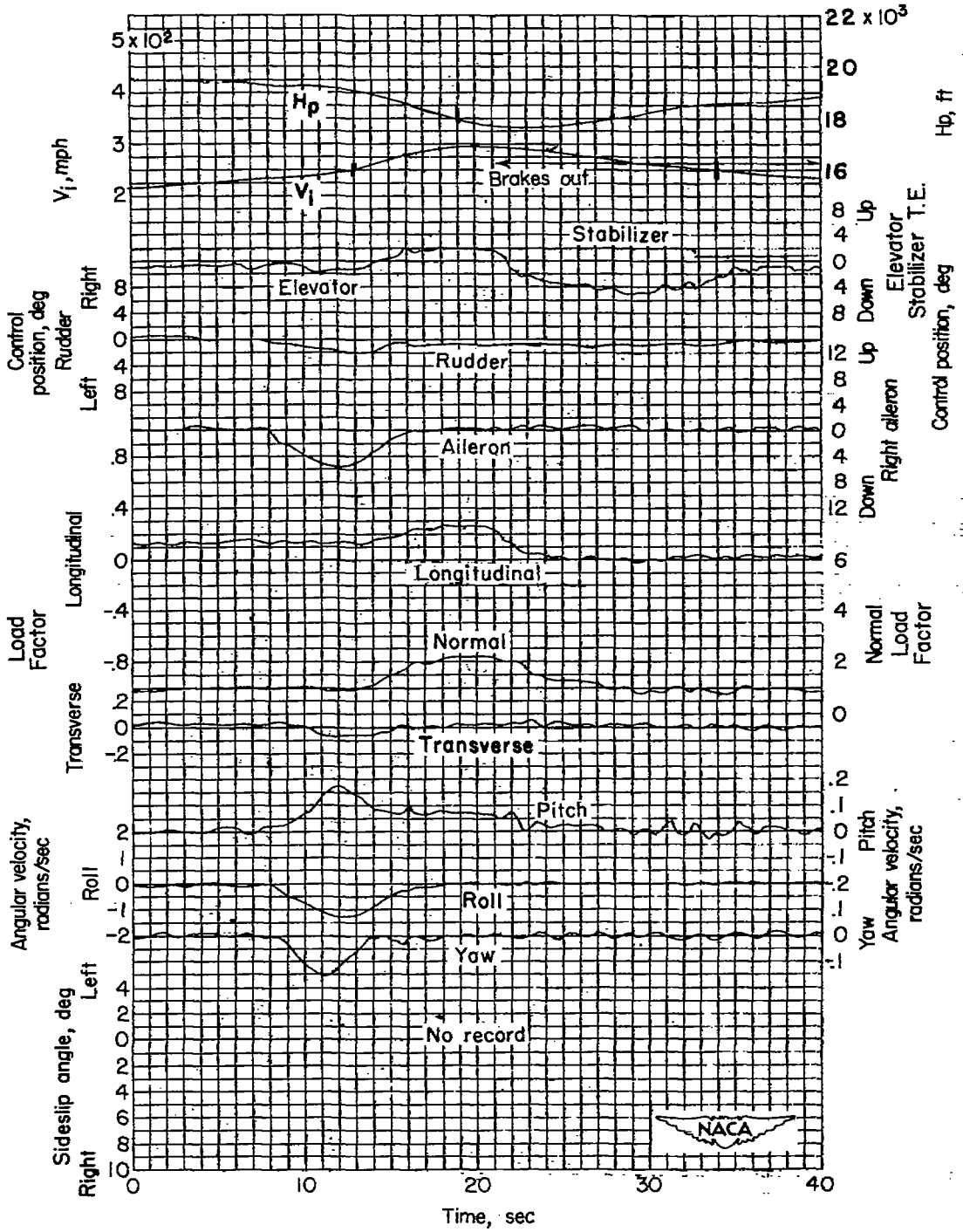


Figure 25.- Roll entry into a dive and pull-out. Airplane weight, 13,550 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

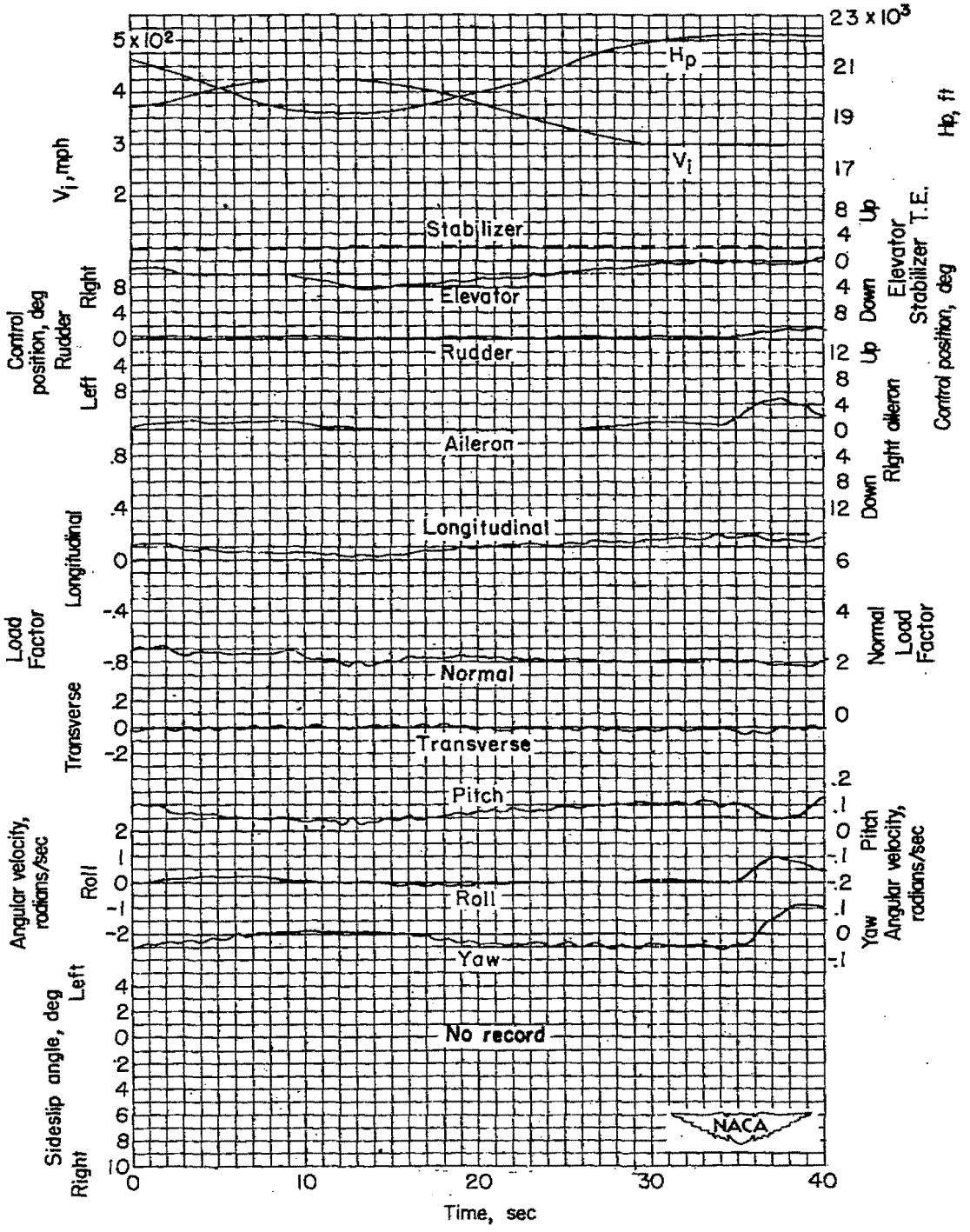


Figure 26.- Pull-up into a climbing turn, roll entry into a dive, pull-out and slow roll. Airplane weight, 13,150 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

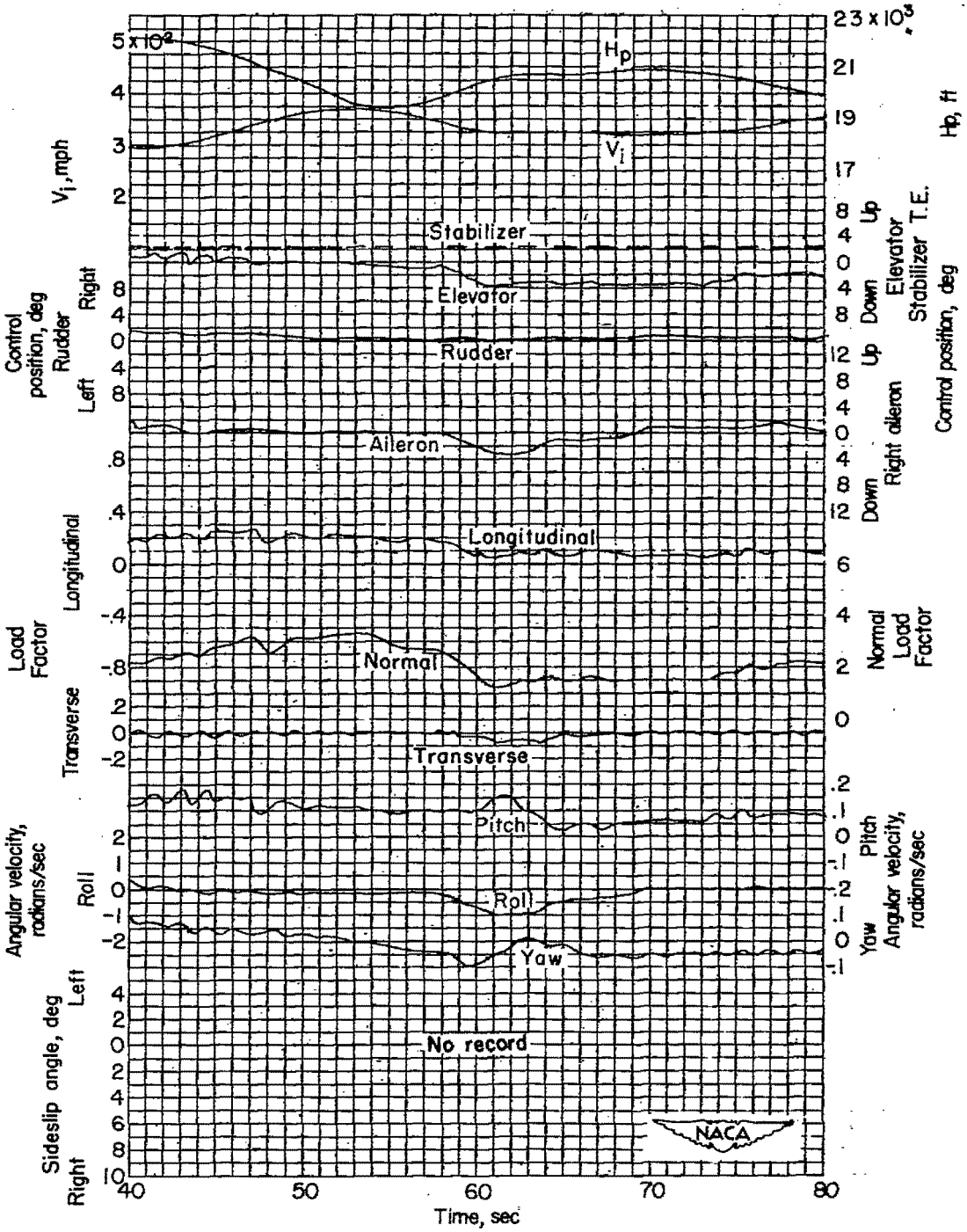


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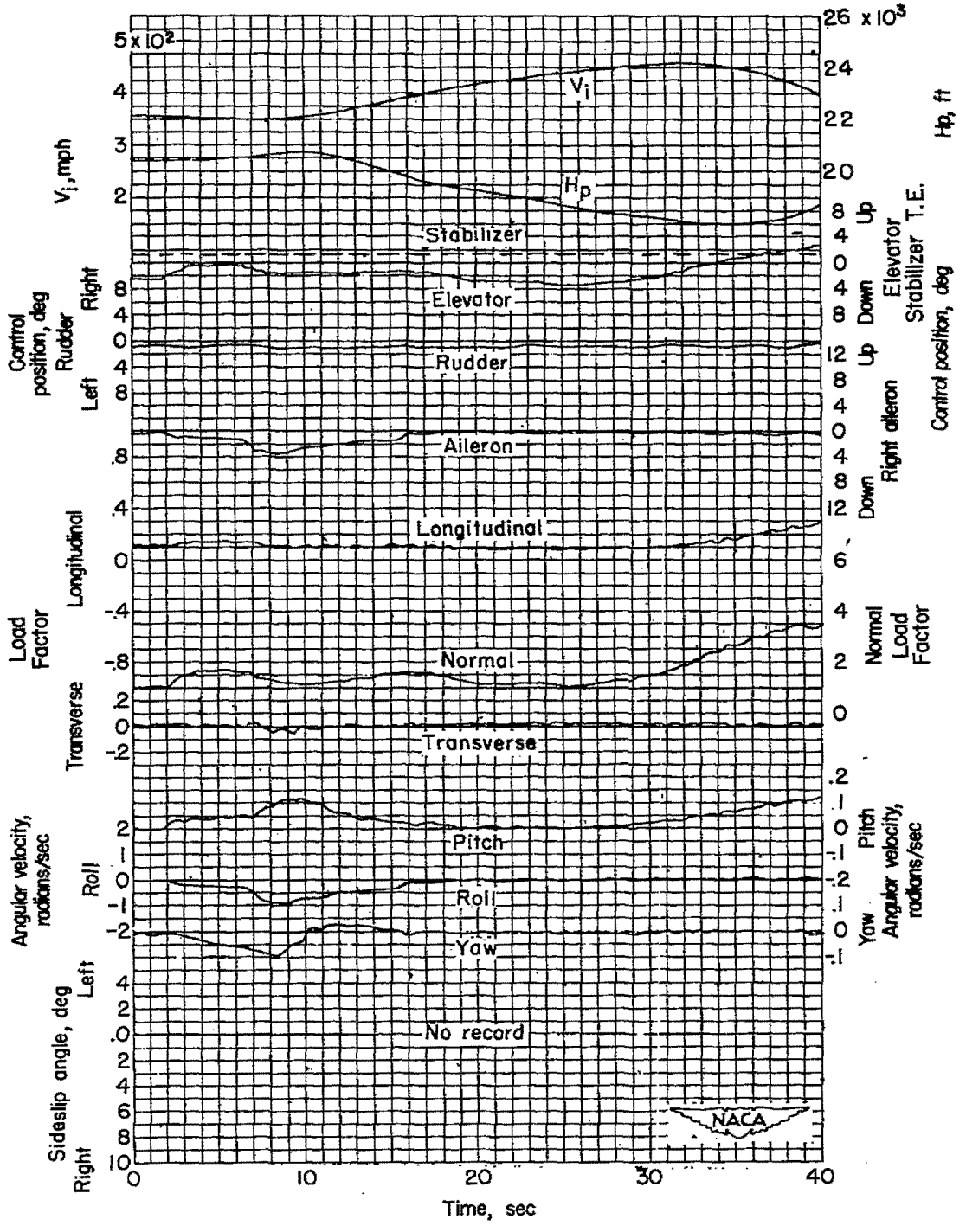


Figure 27.- Roll entry into a dive and pull-up into a loop. Airplane weight, 13,750 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

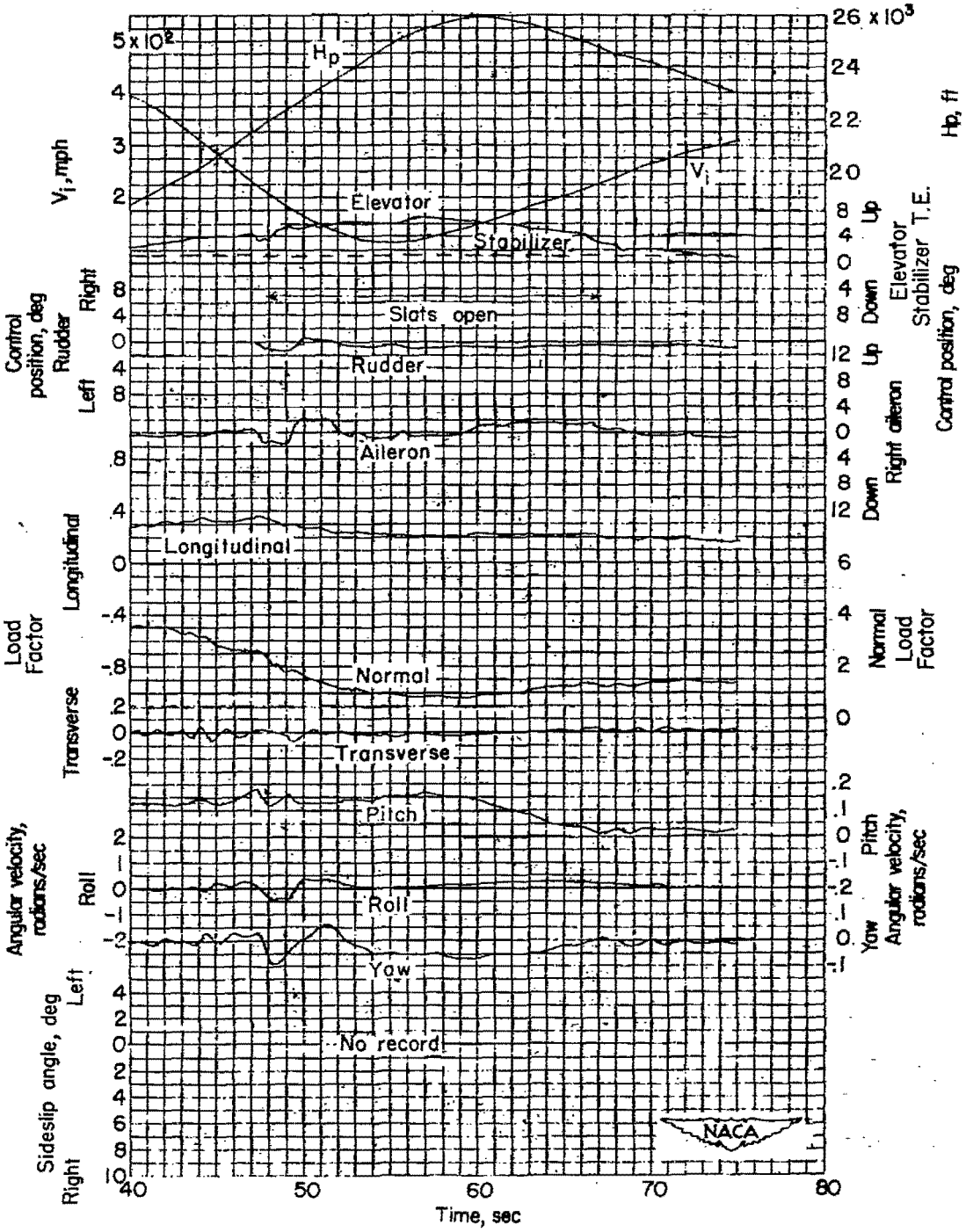


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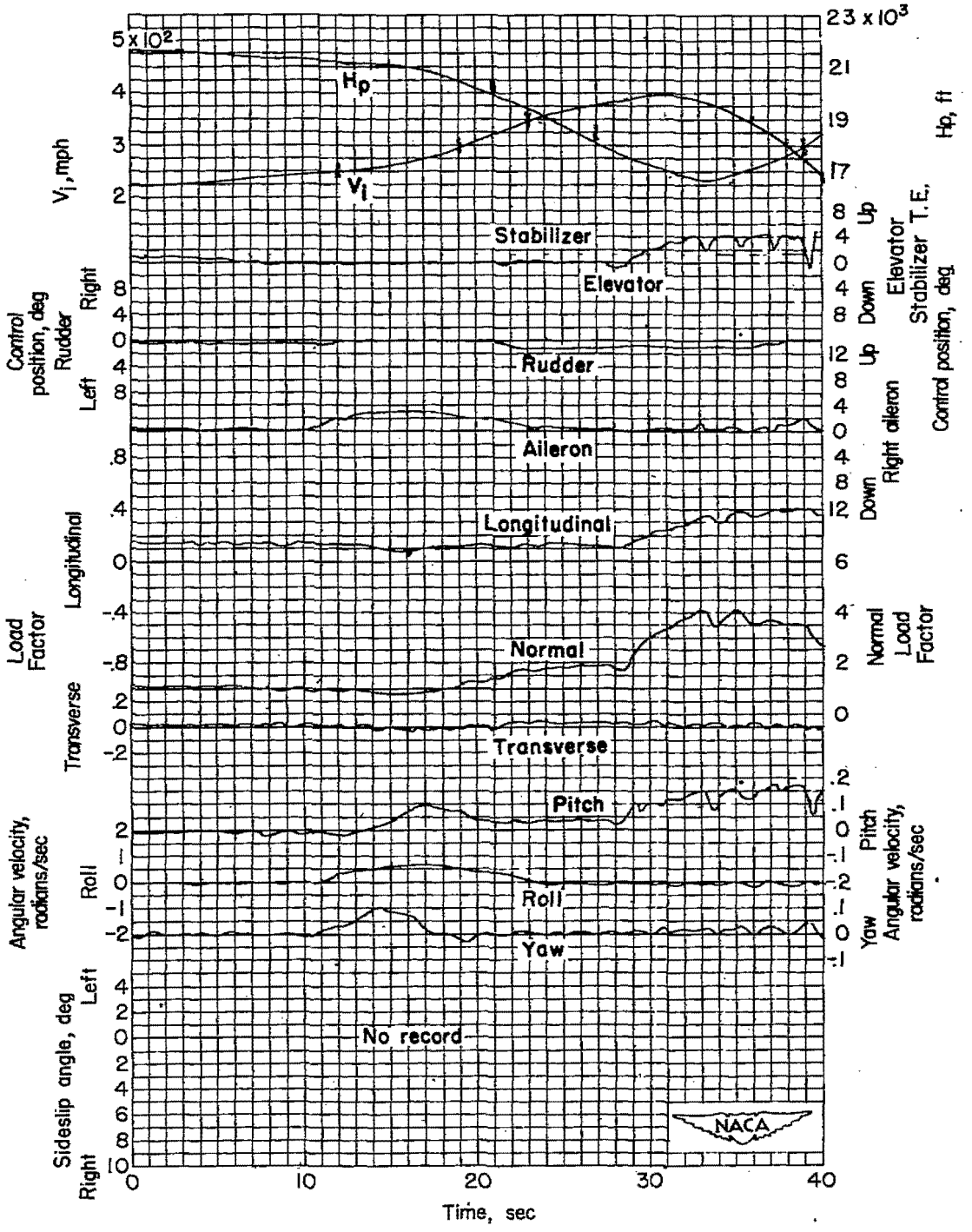


Figure 28.- Roll entry into a dive and pull-up into a loop. Airplane weight, 13,200 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

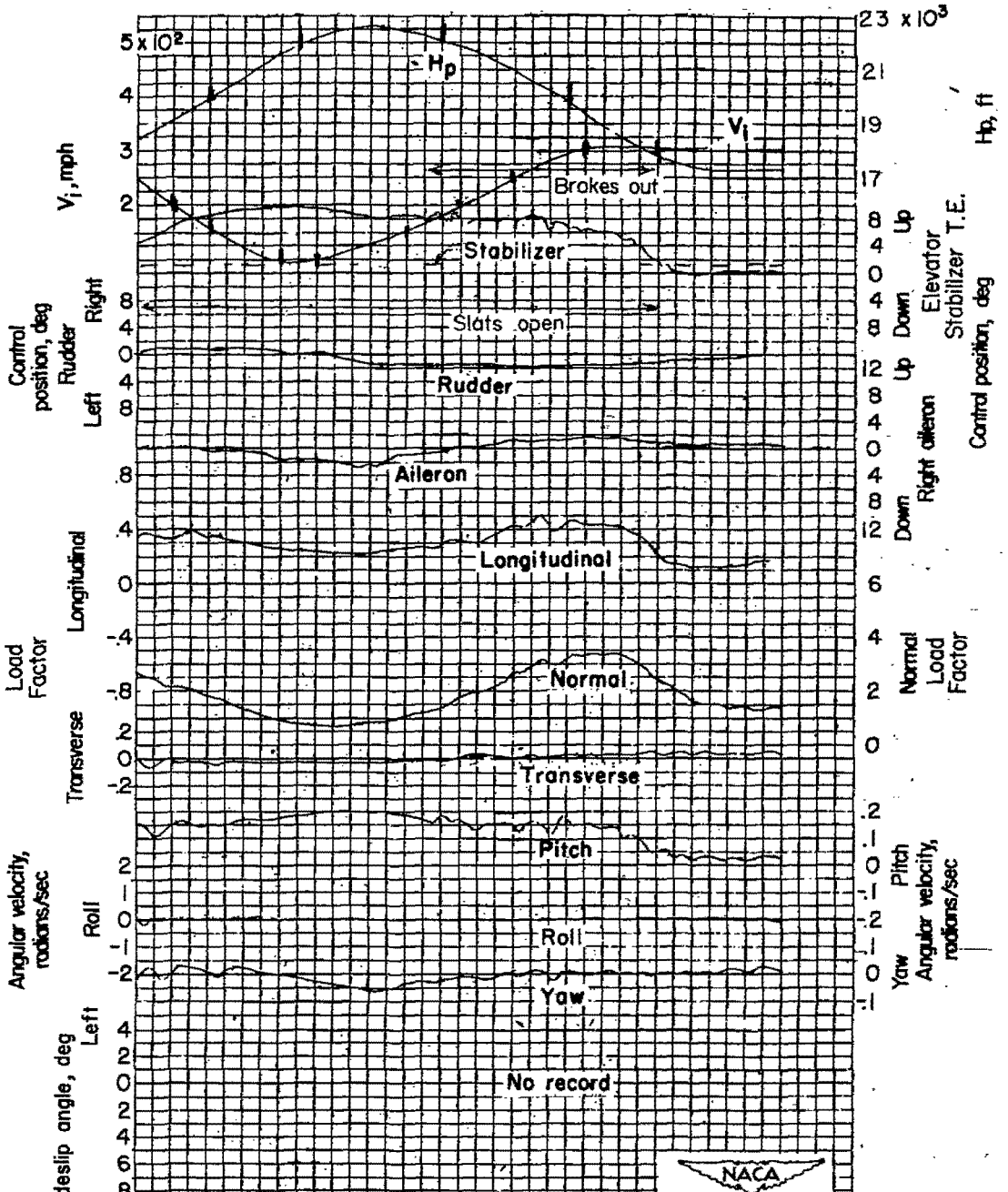


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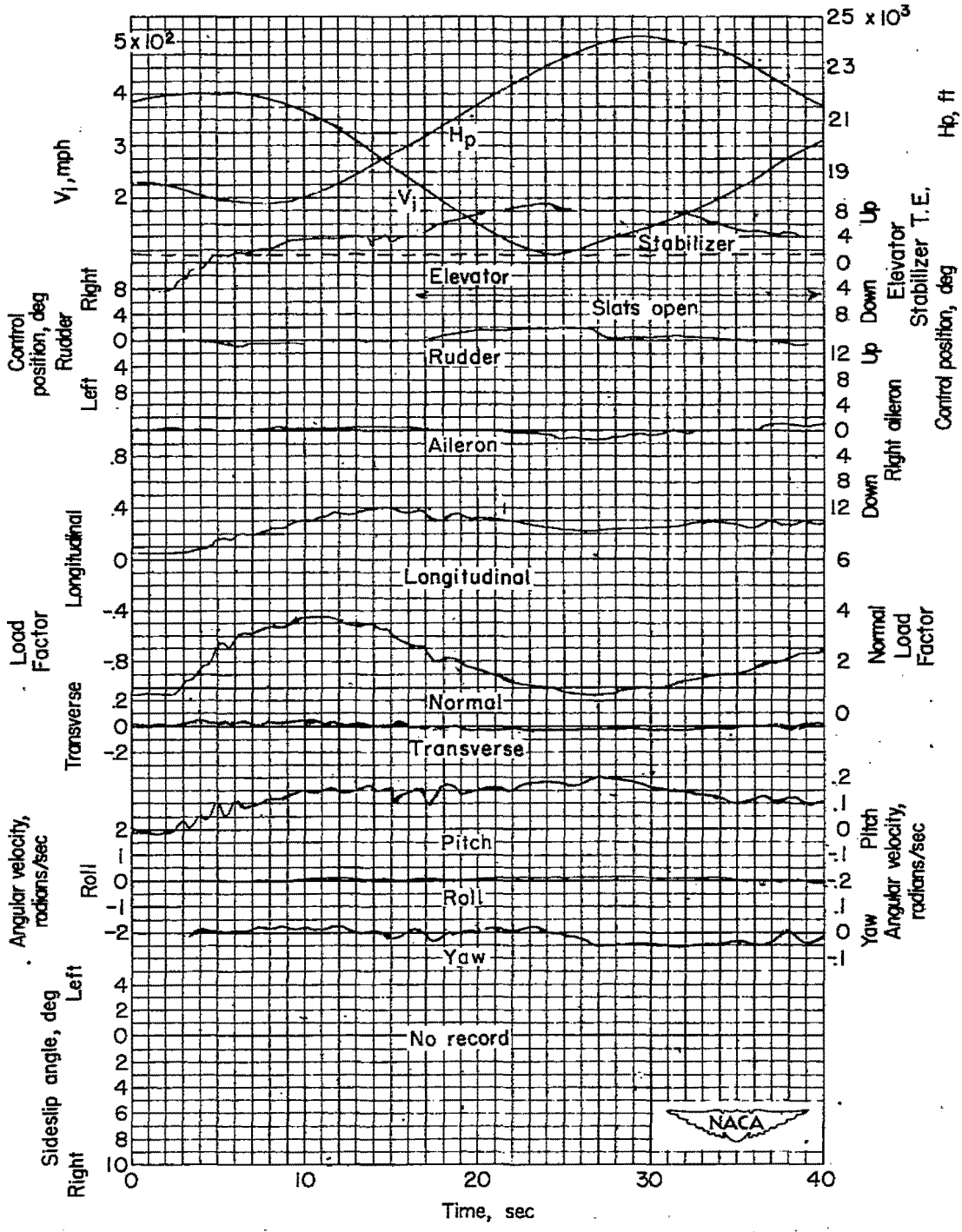


Figure 29.- Loop. Airplane weight, 12,300 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

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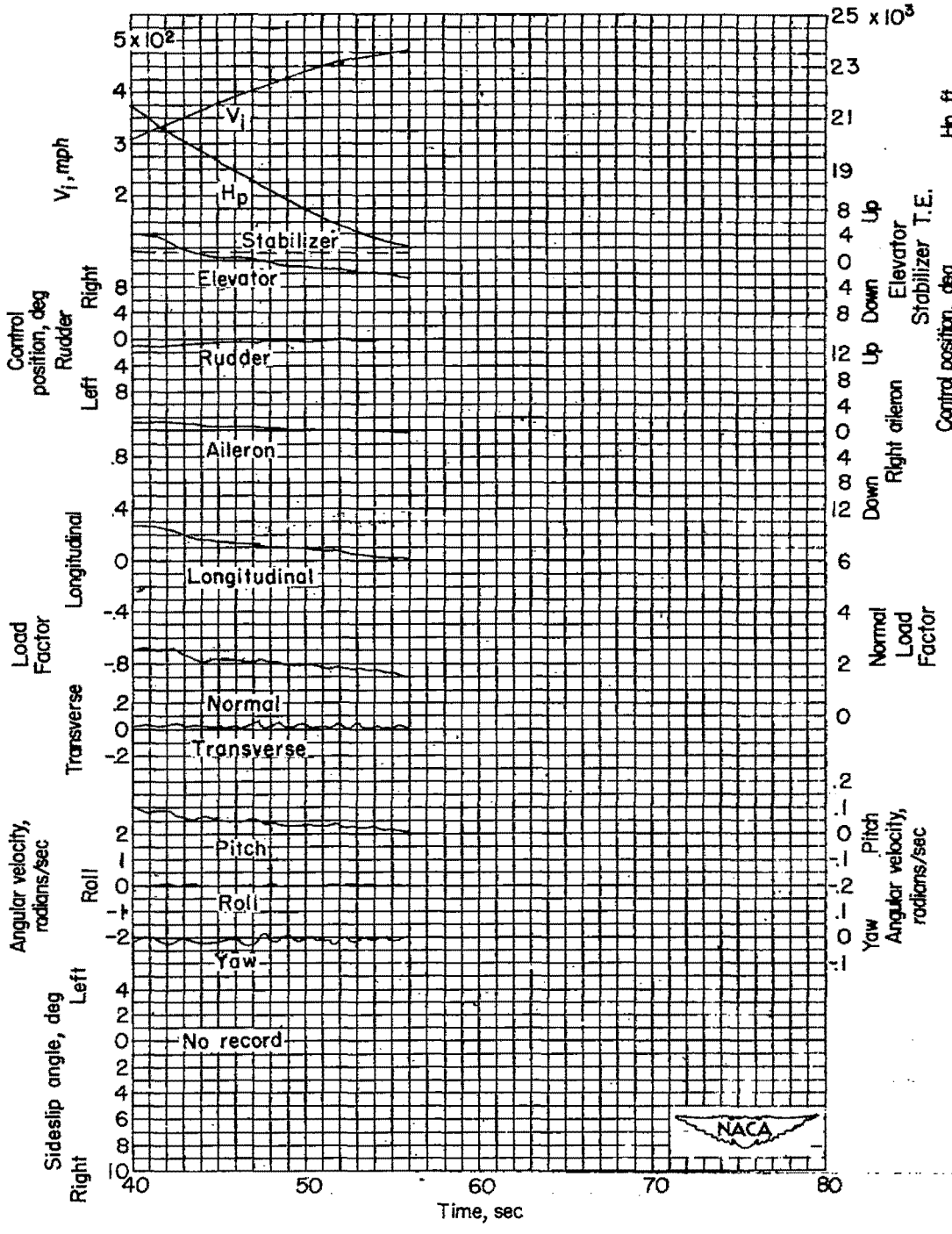


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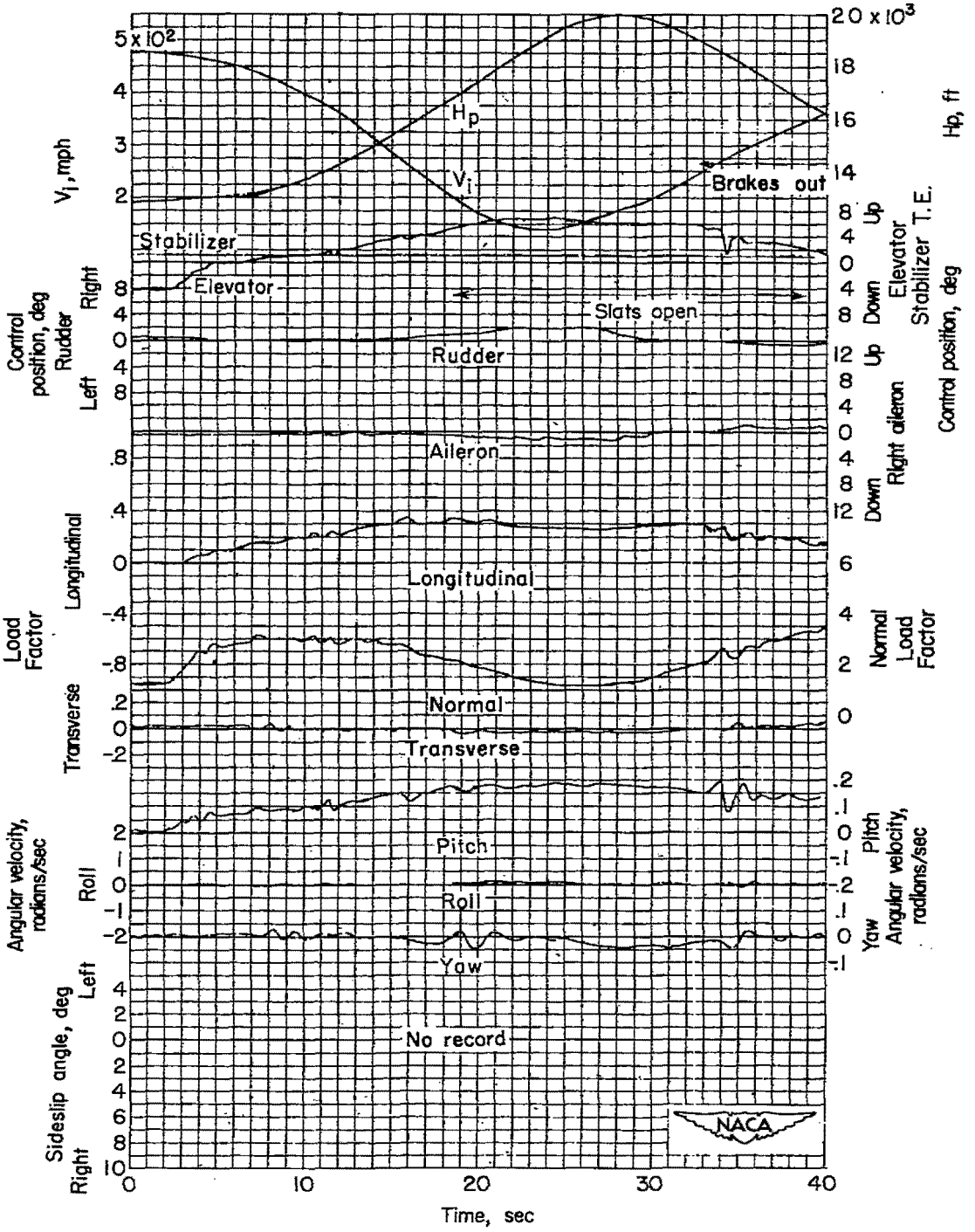


Figure 30.- Loop. Airplane weight, 12,150 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

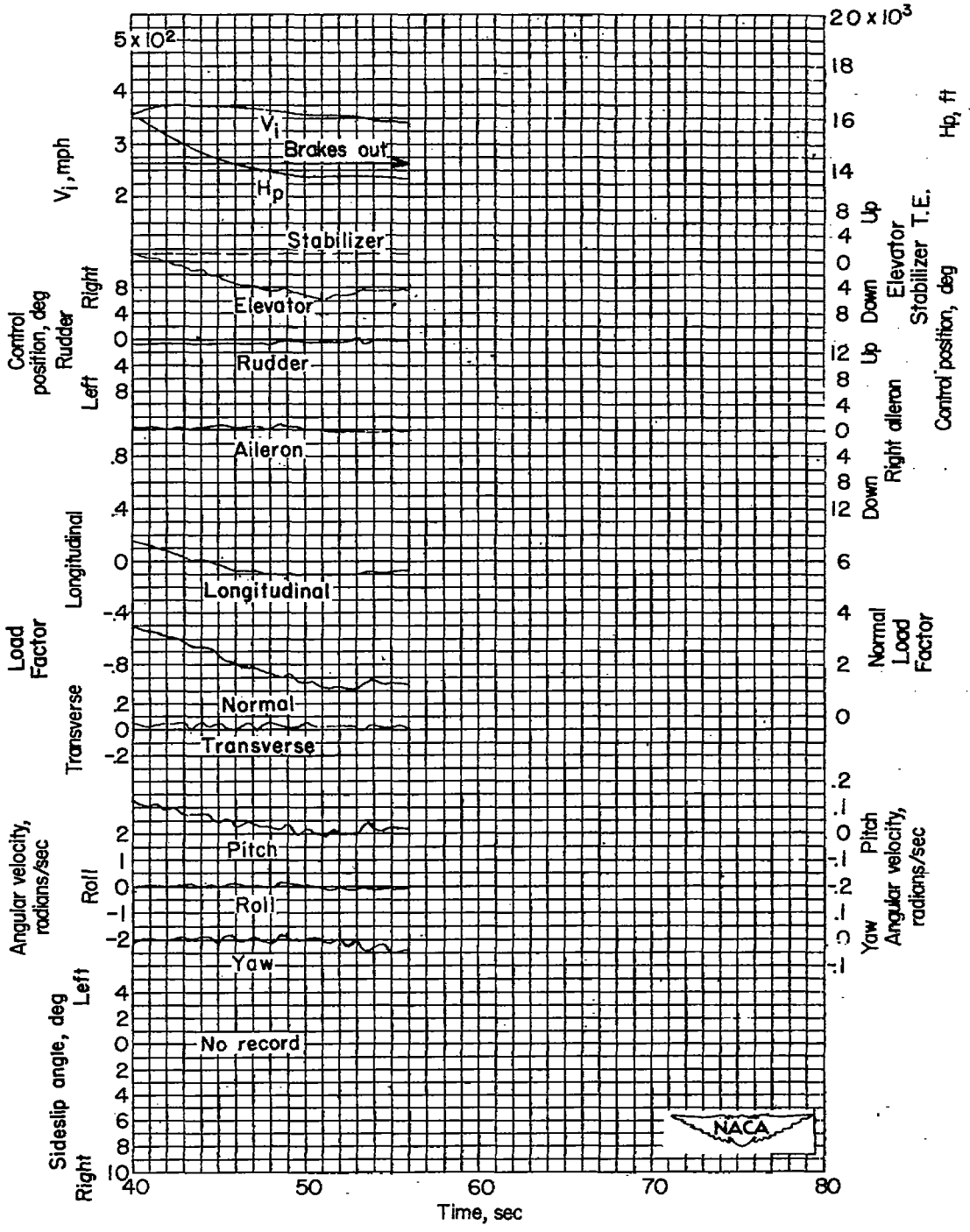


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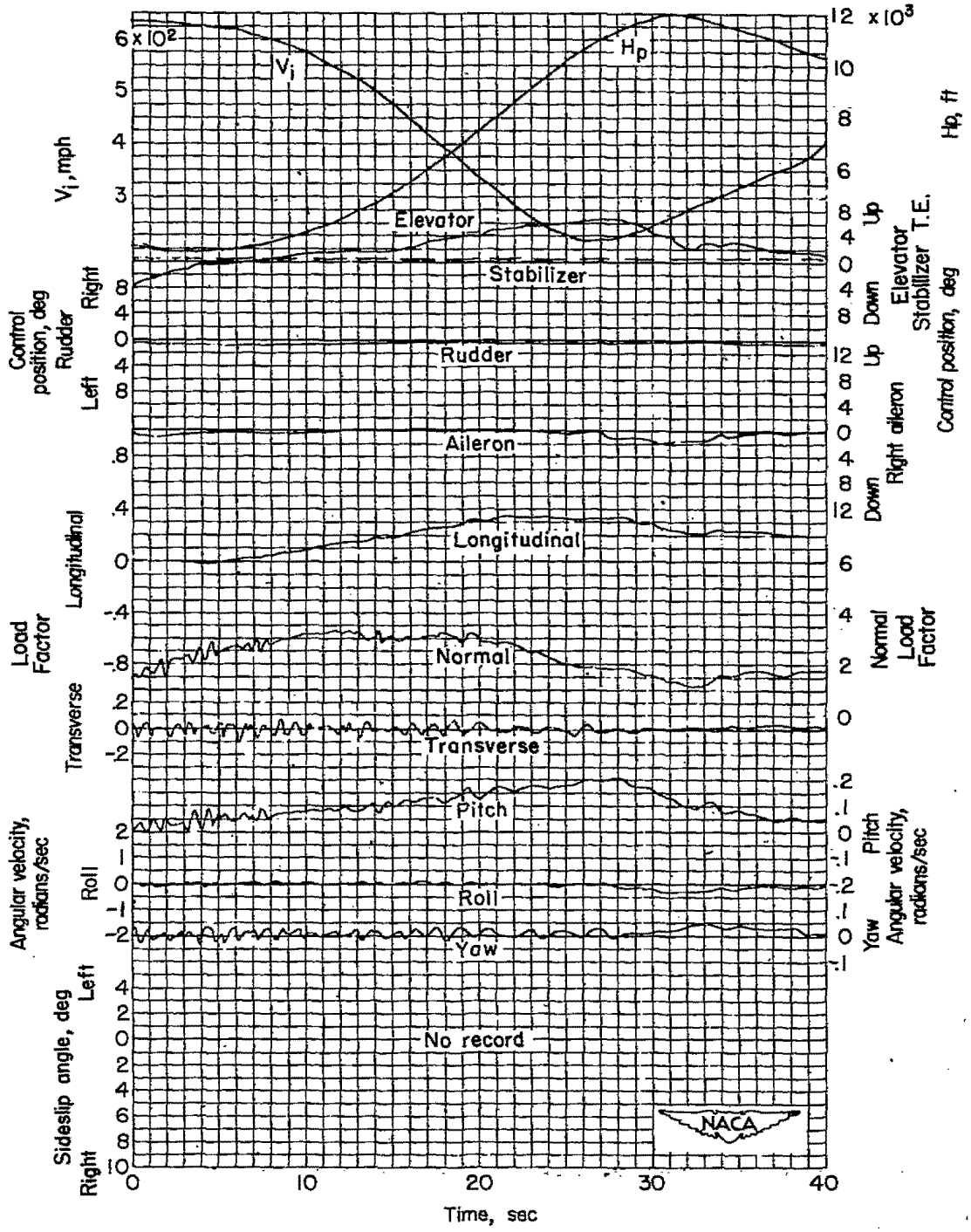


Figure 31.- Half loop with roll entry into a diving turn. Airplane weight, 13,300 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

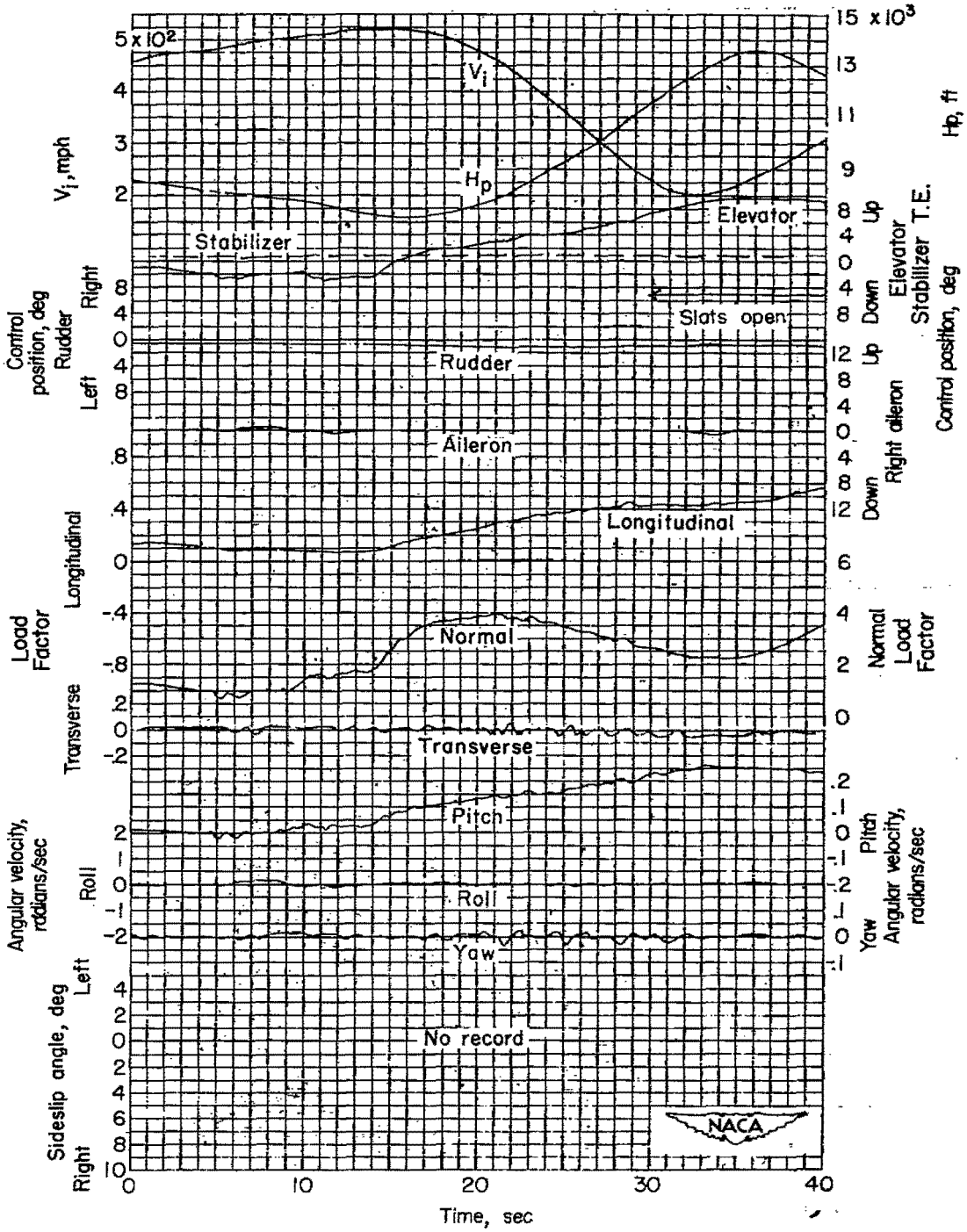


Figure 32.- Loop. Airplane weight, 13,300 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

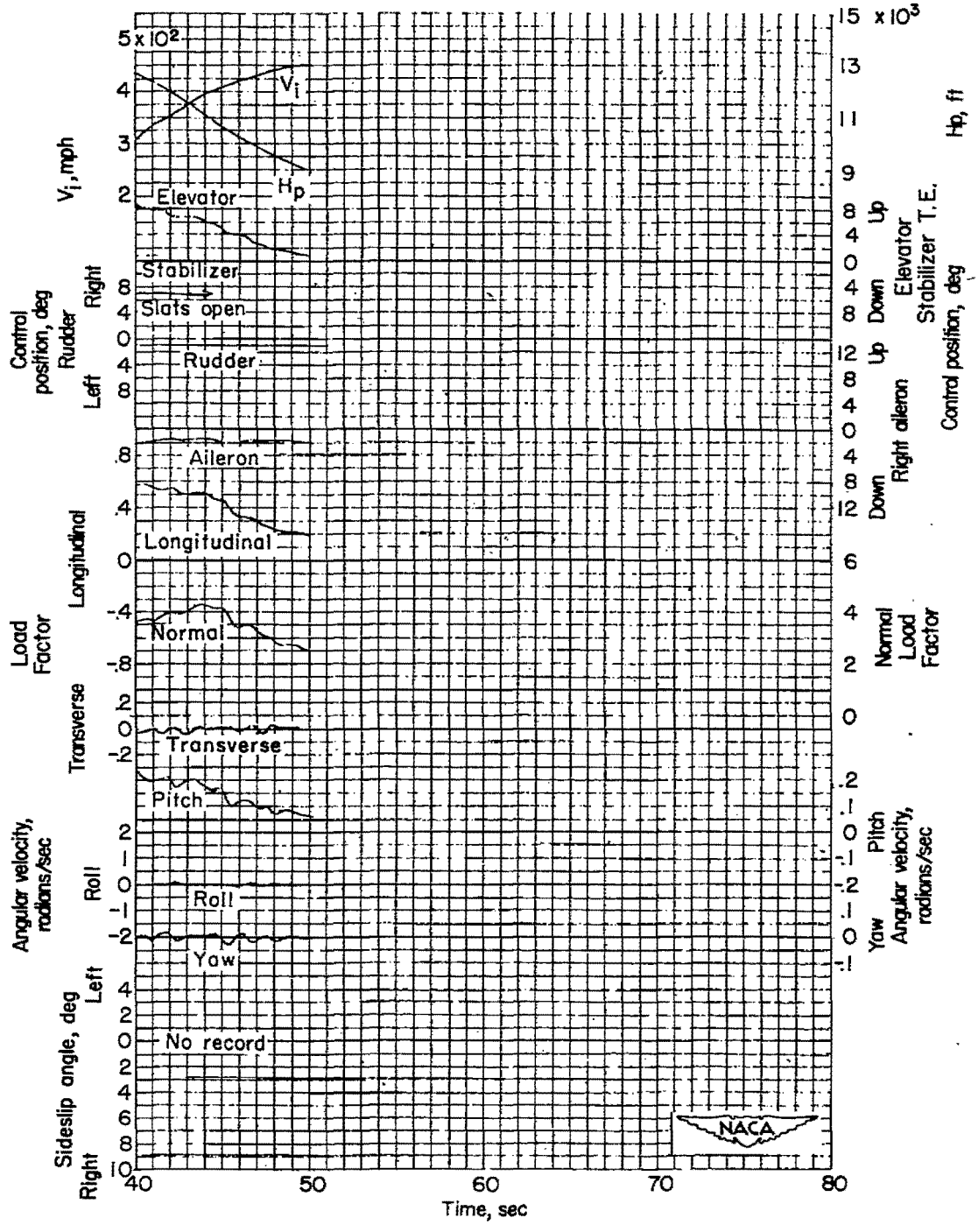


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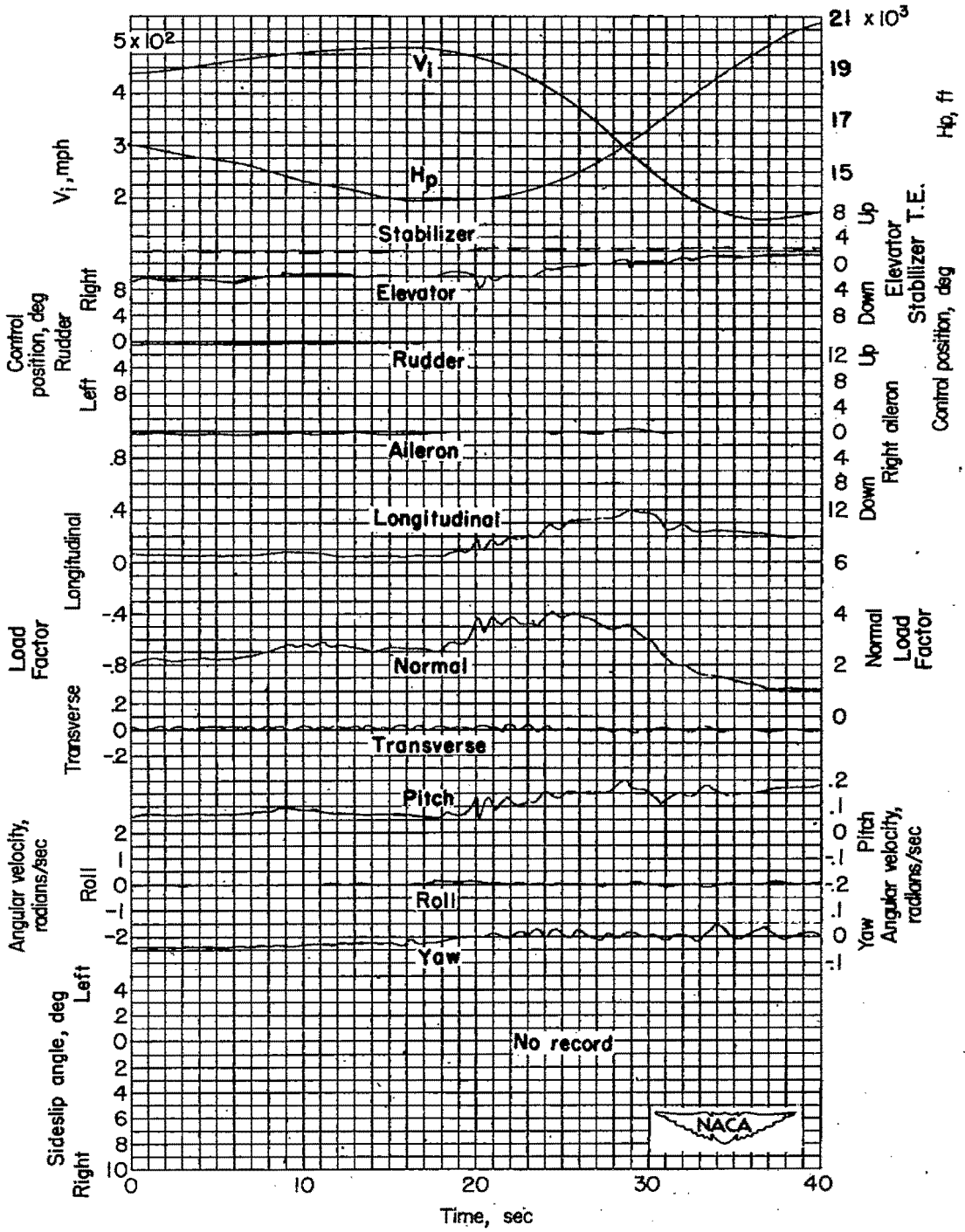


Figure 33.- Loop. Airplane weight, 12,550 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

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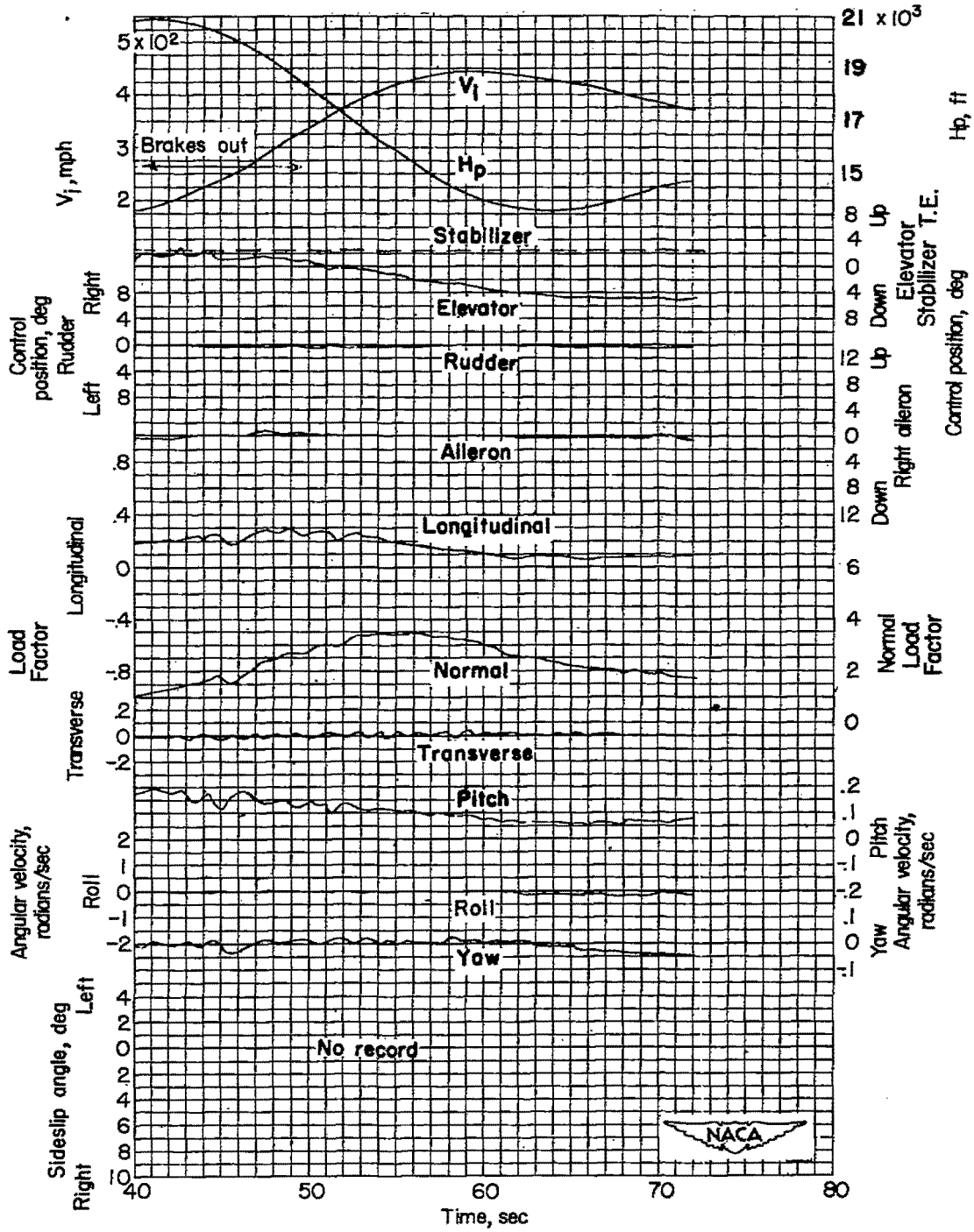


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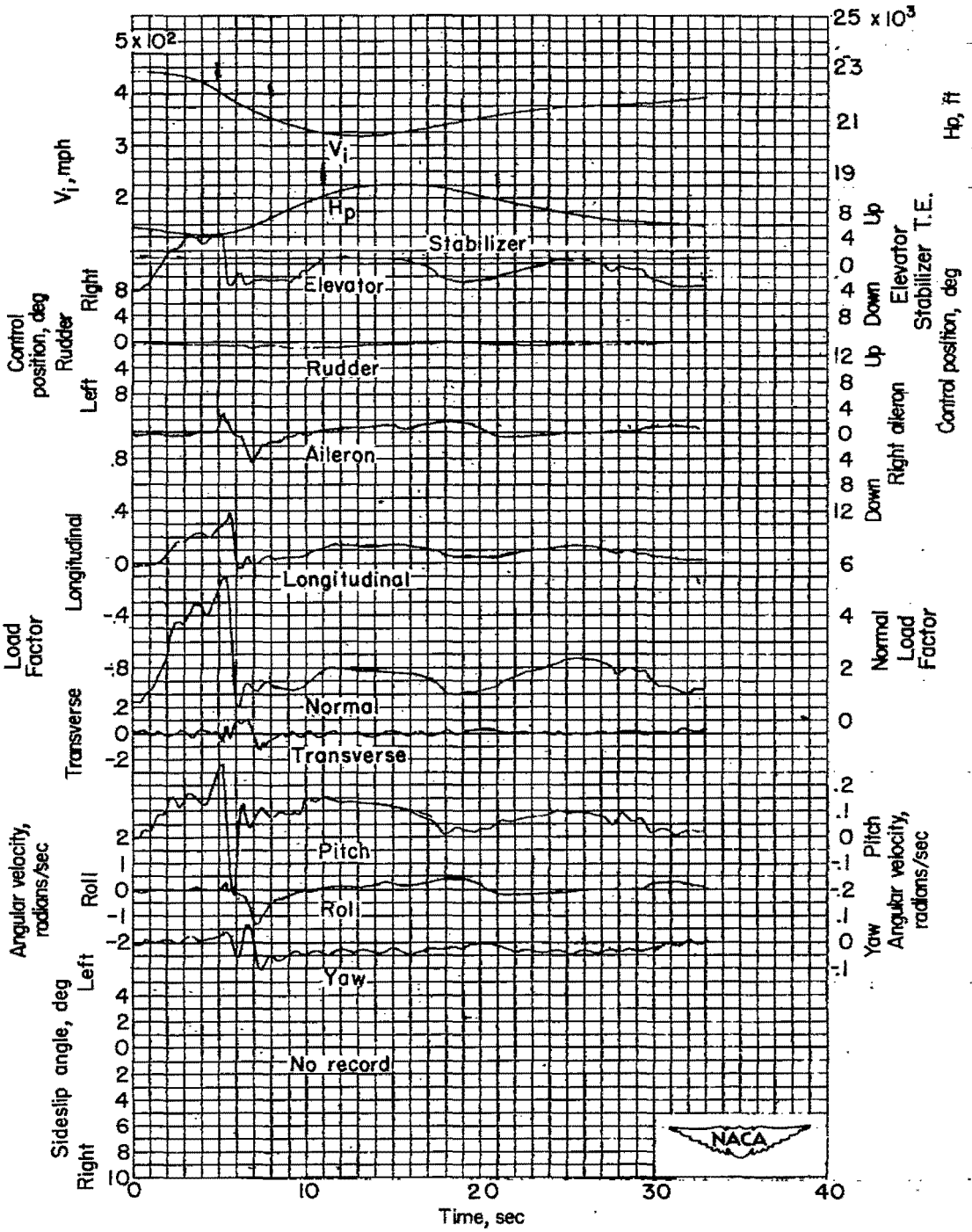


Figure 34.- Inclined half-loop with a quarter roll recovery. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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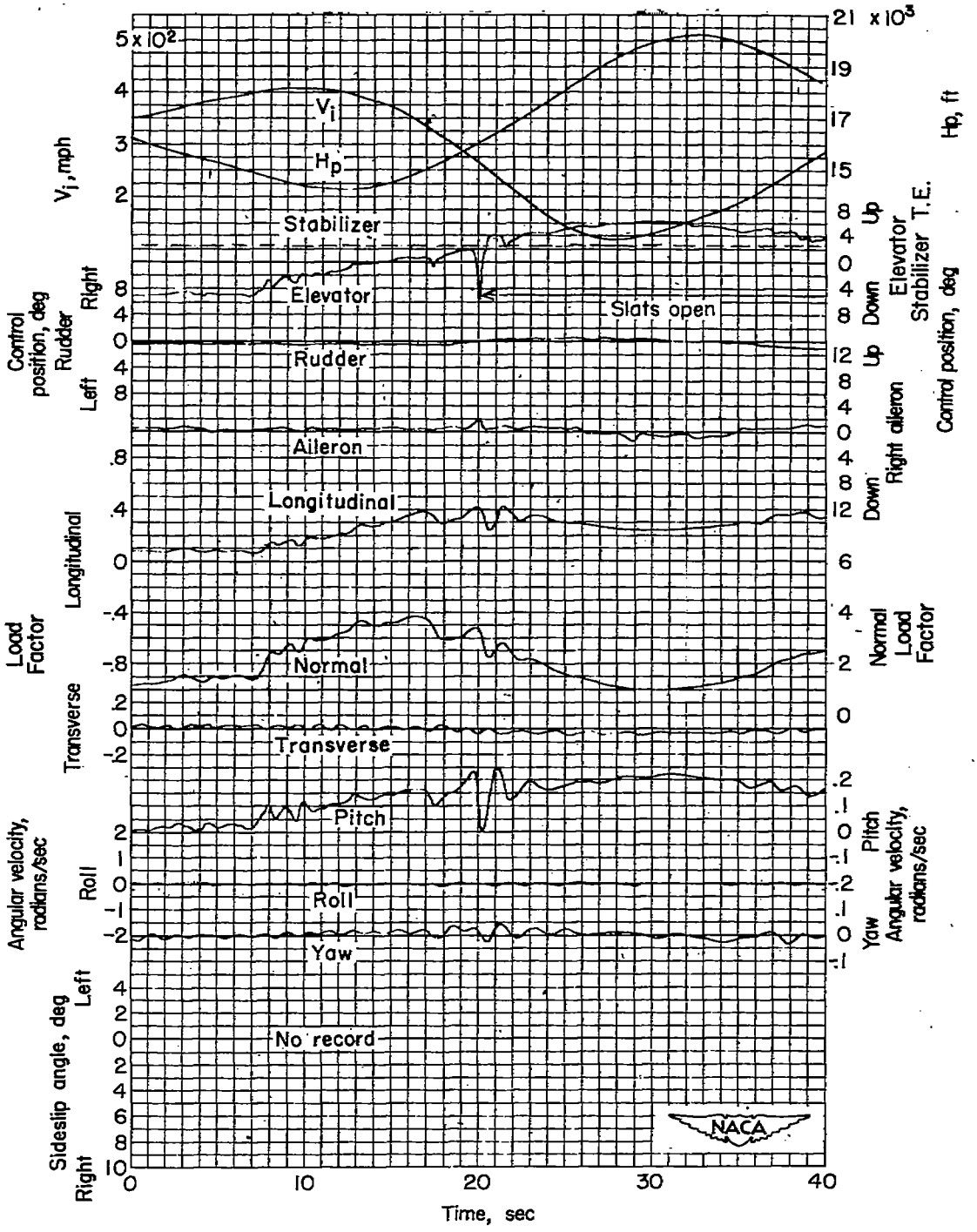


Figure 35.- A loop followed by an Immelman turn. Airplane weight, 13,000 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

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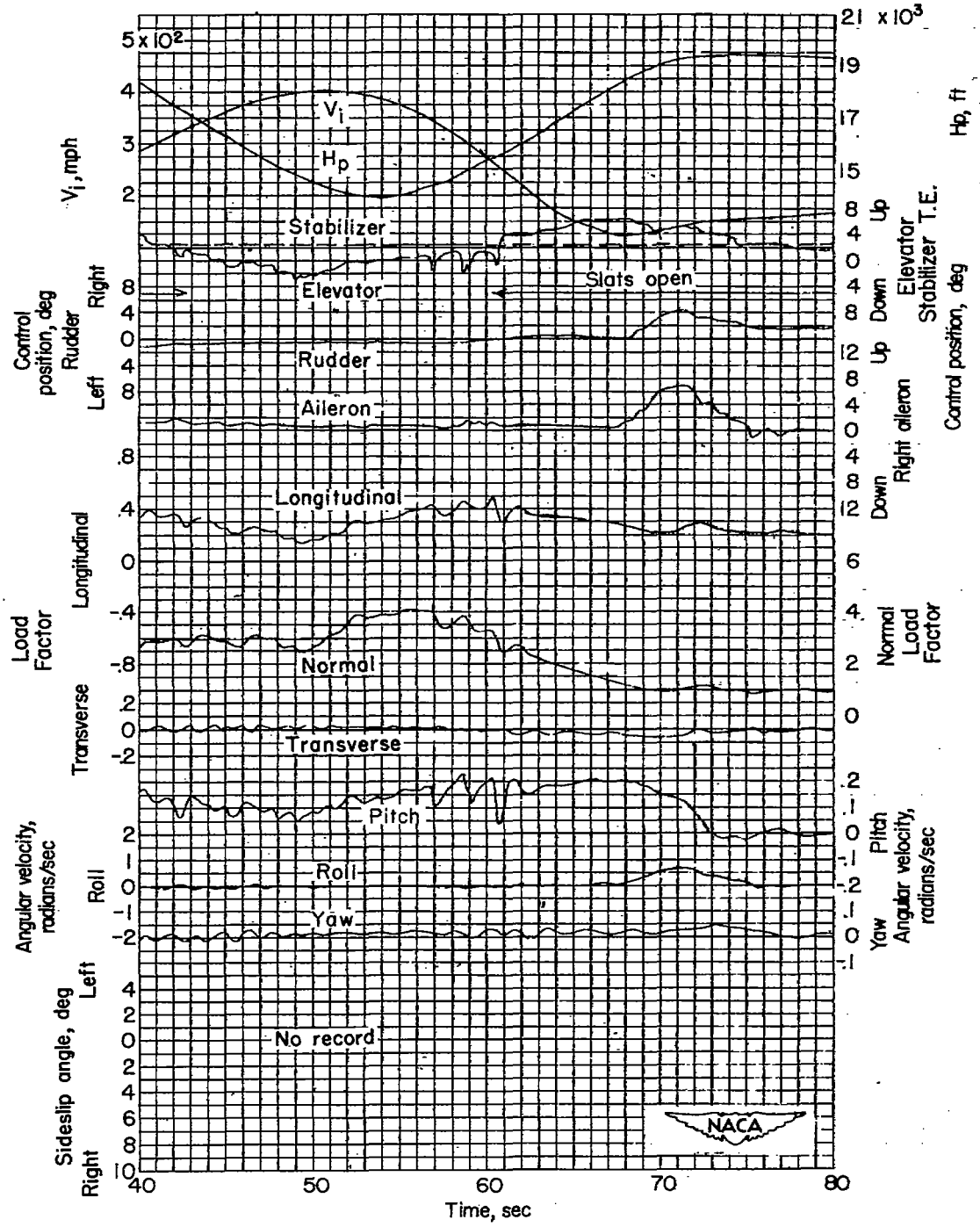


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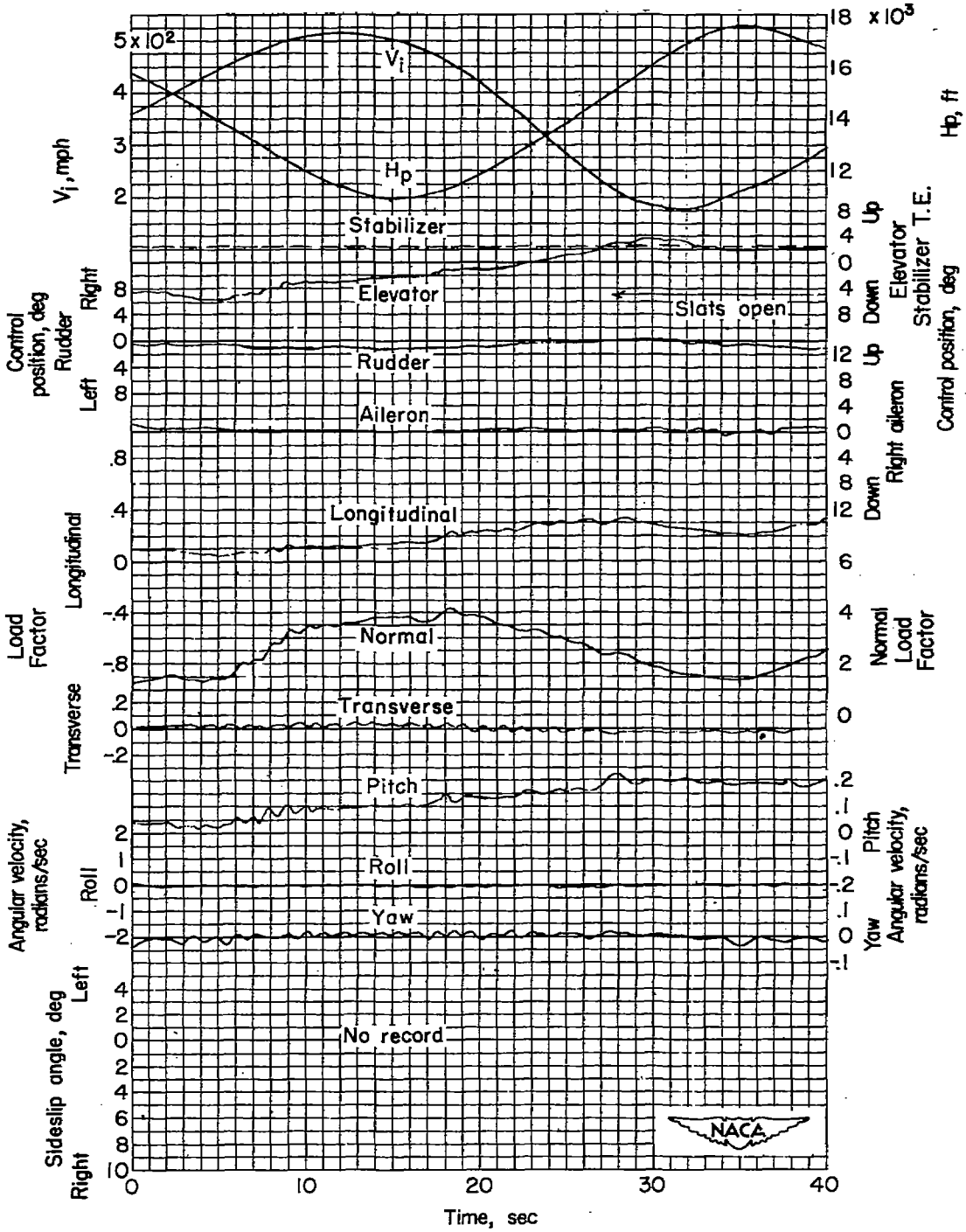


Figure 36.- Two loops followed by an Immelman turn. Airplane weight, 13,150 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

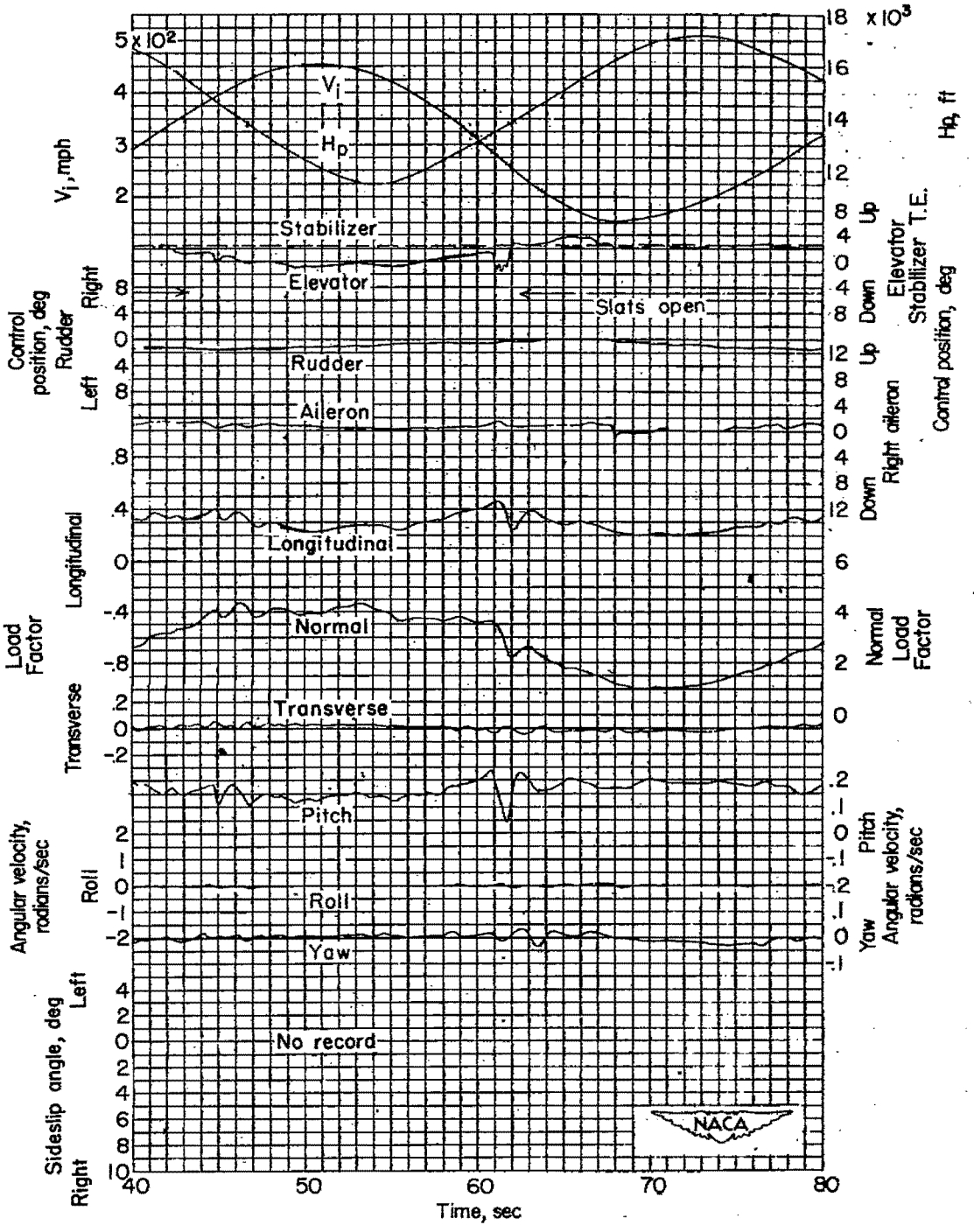


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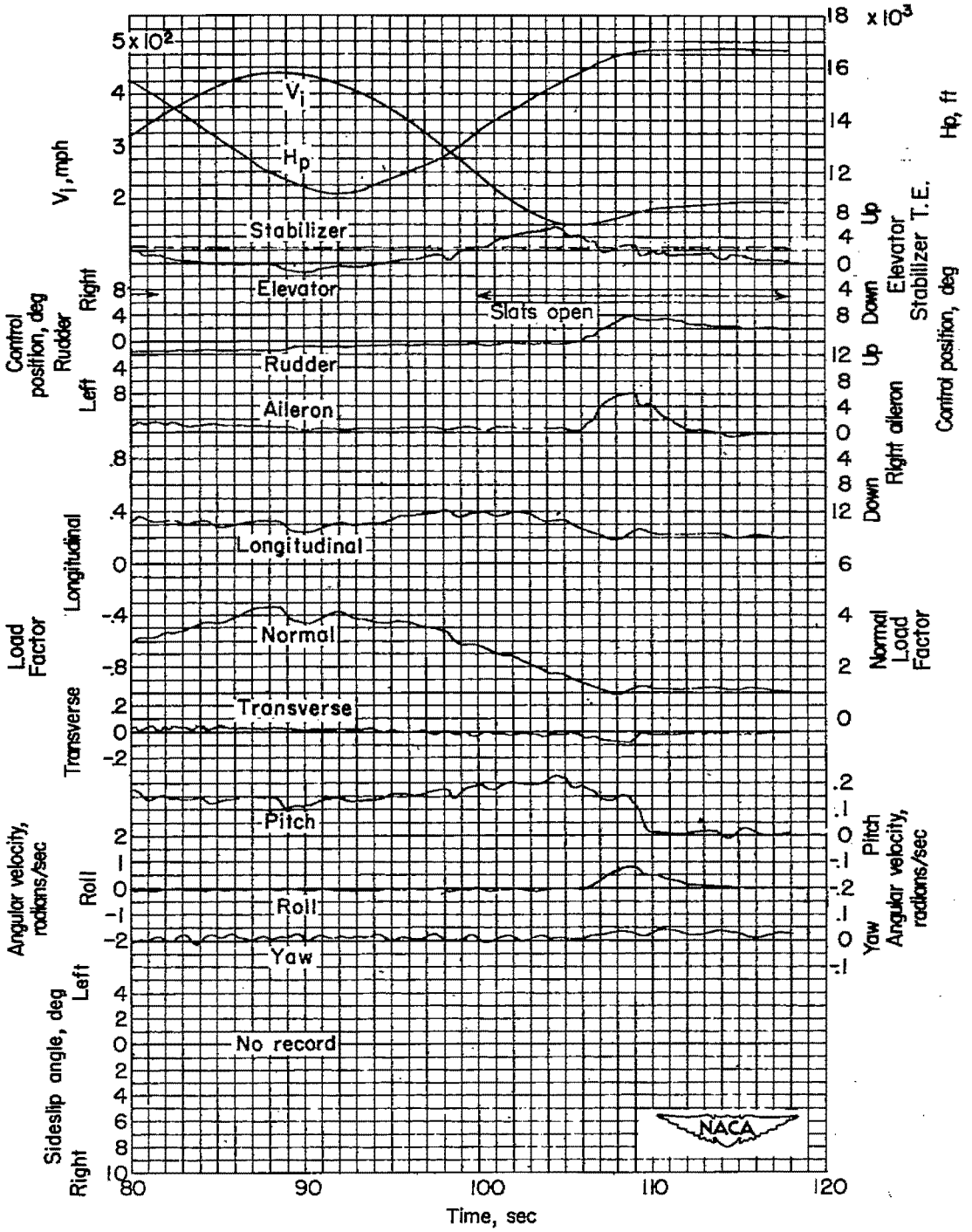


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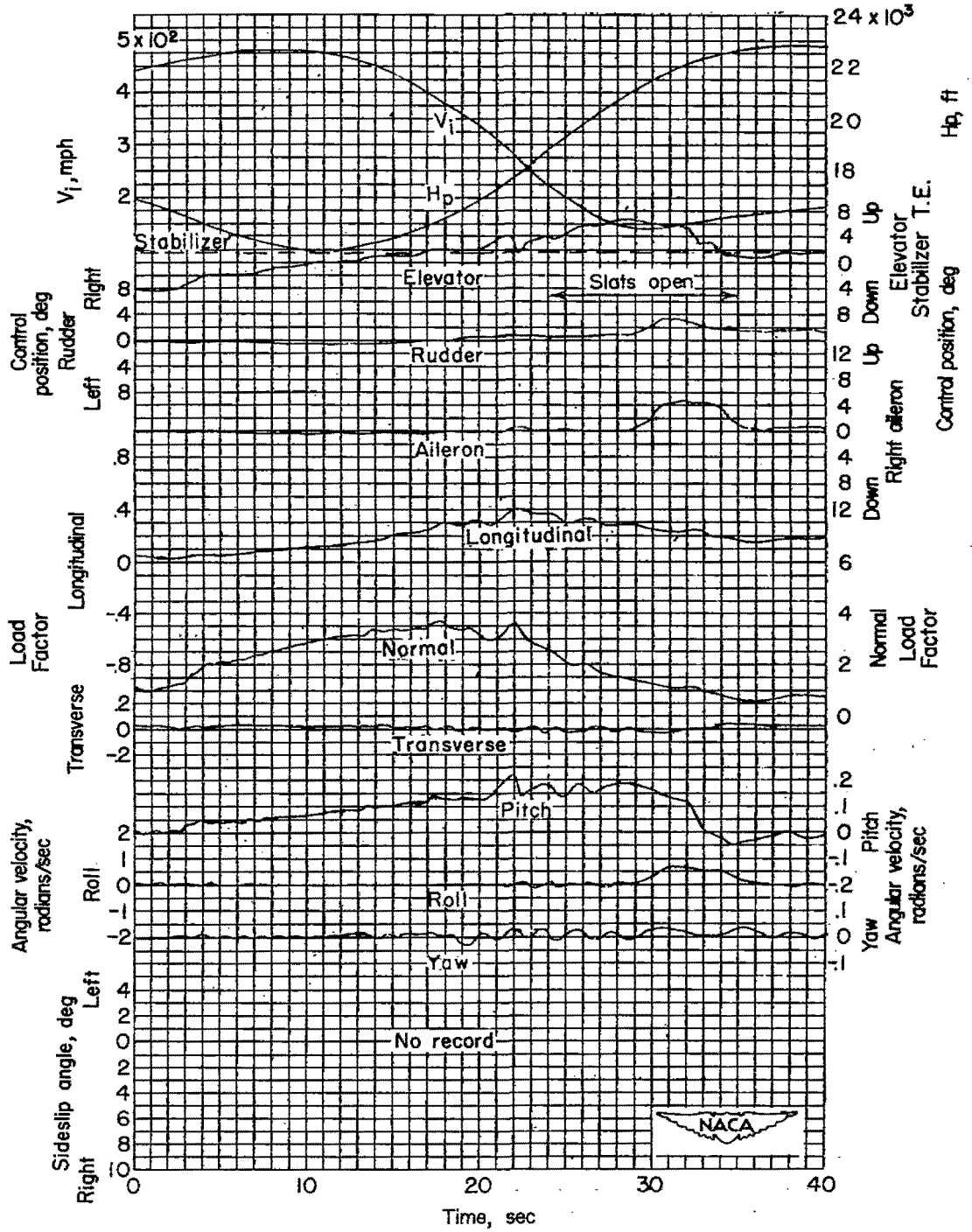


Figure 37.- Immelman turn. Airplane weight, 13,400 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

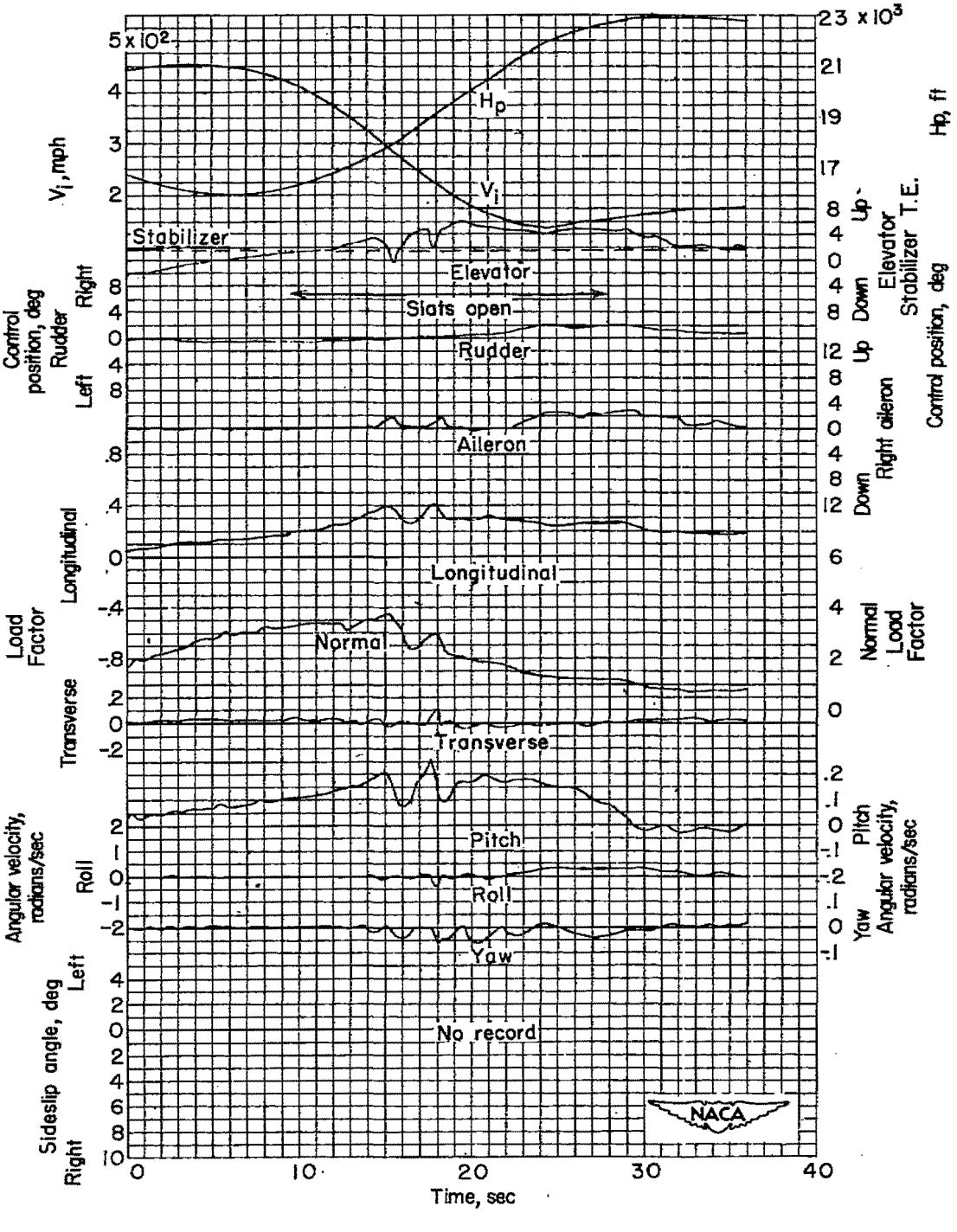


Figure 38.- Immelman turn. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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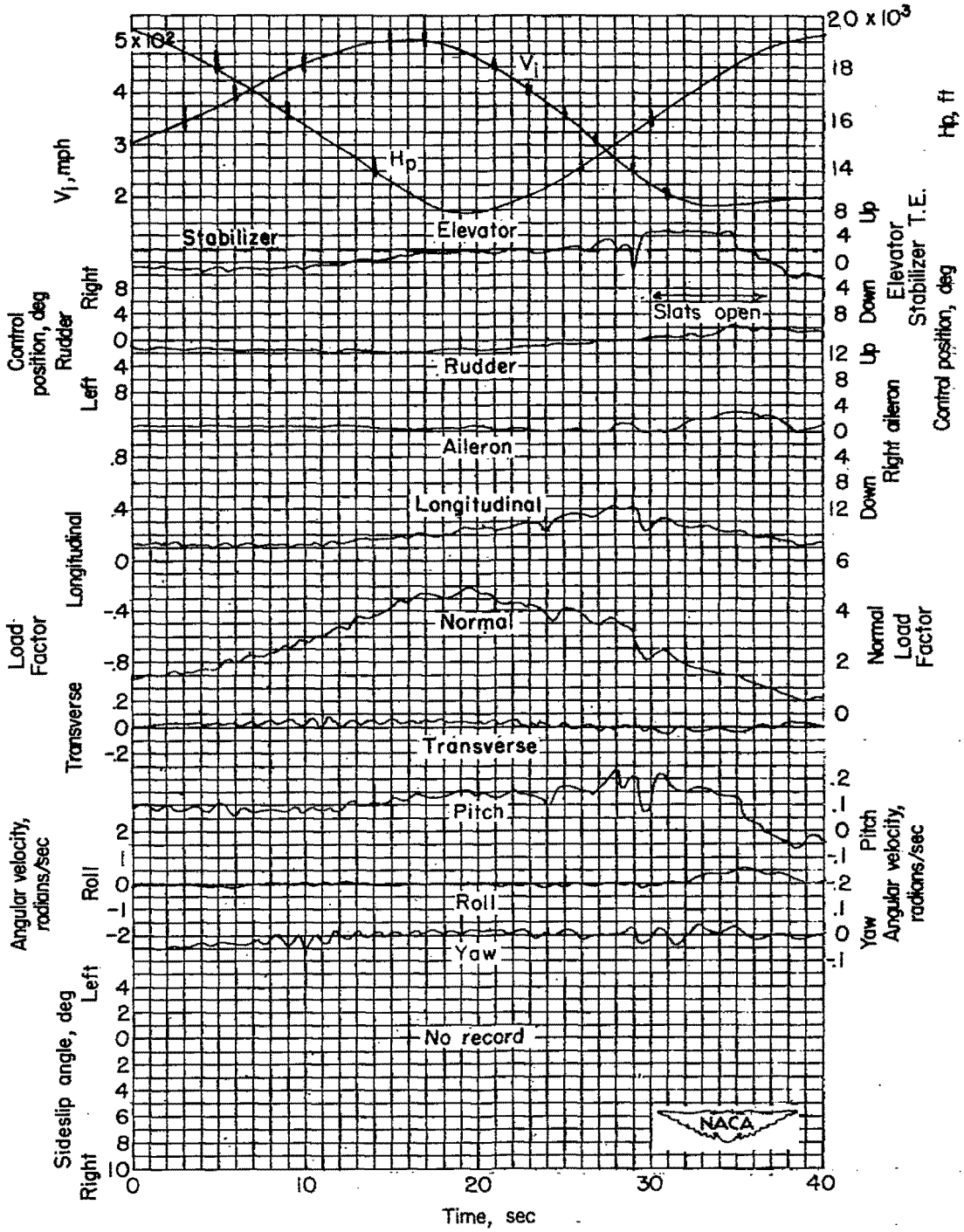


Figure 39.- Immelman turn. Airplane weight, 13,550 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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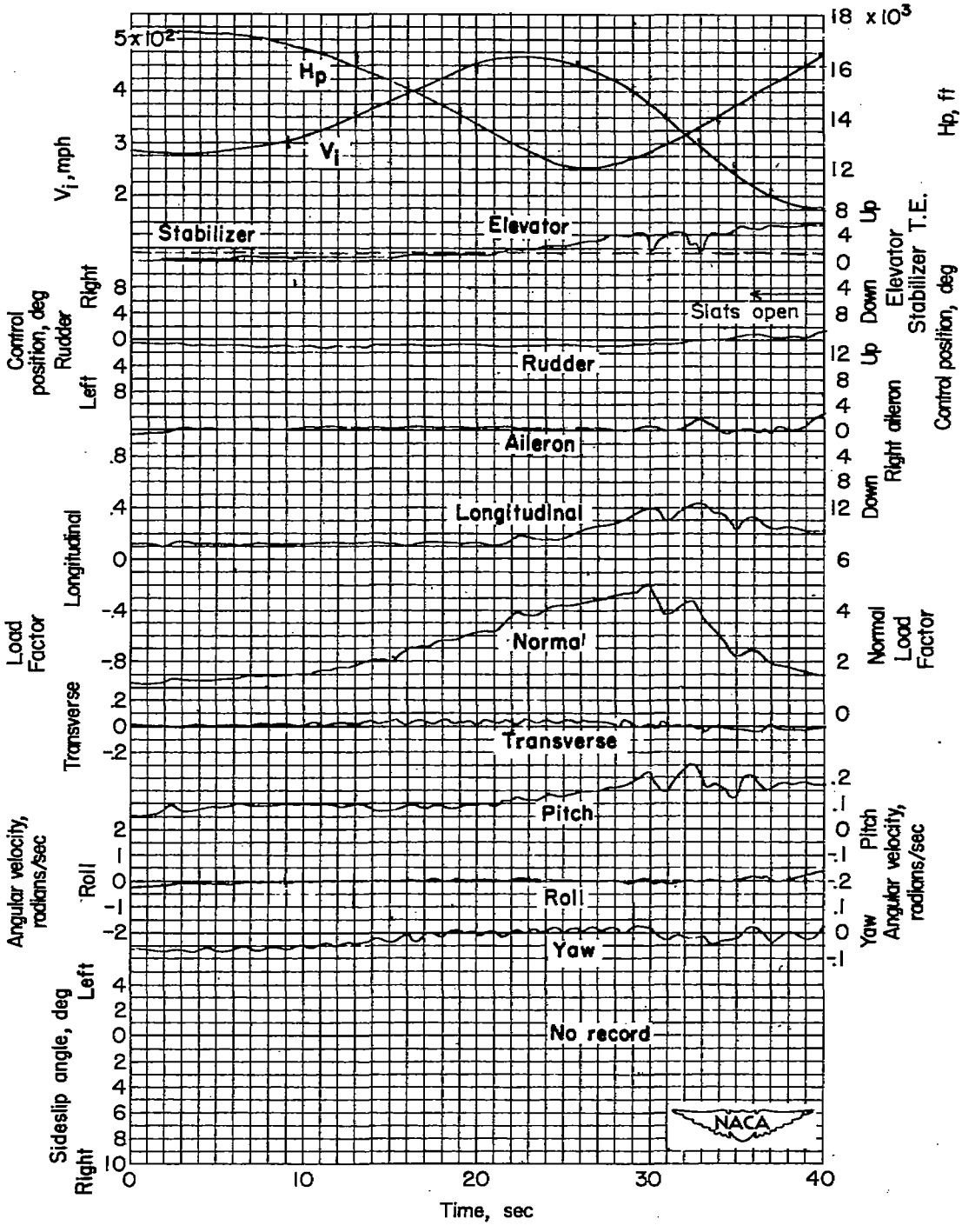


Figure 40.- Diving left turn and pull-up into an Immelman turn. Airplane weight, 13,000 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

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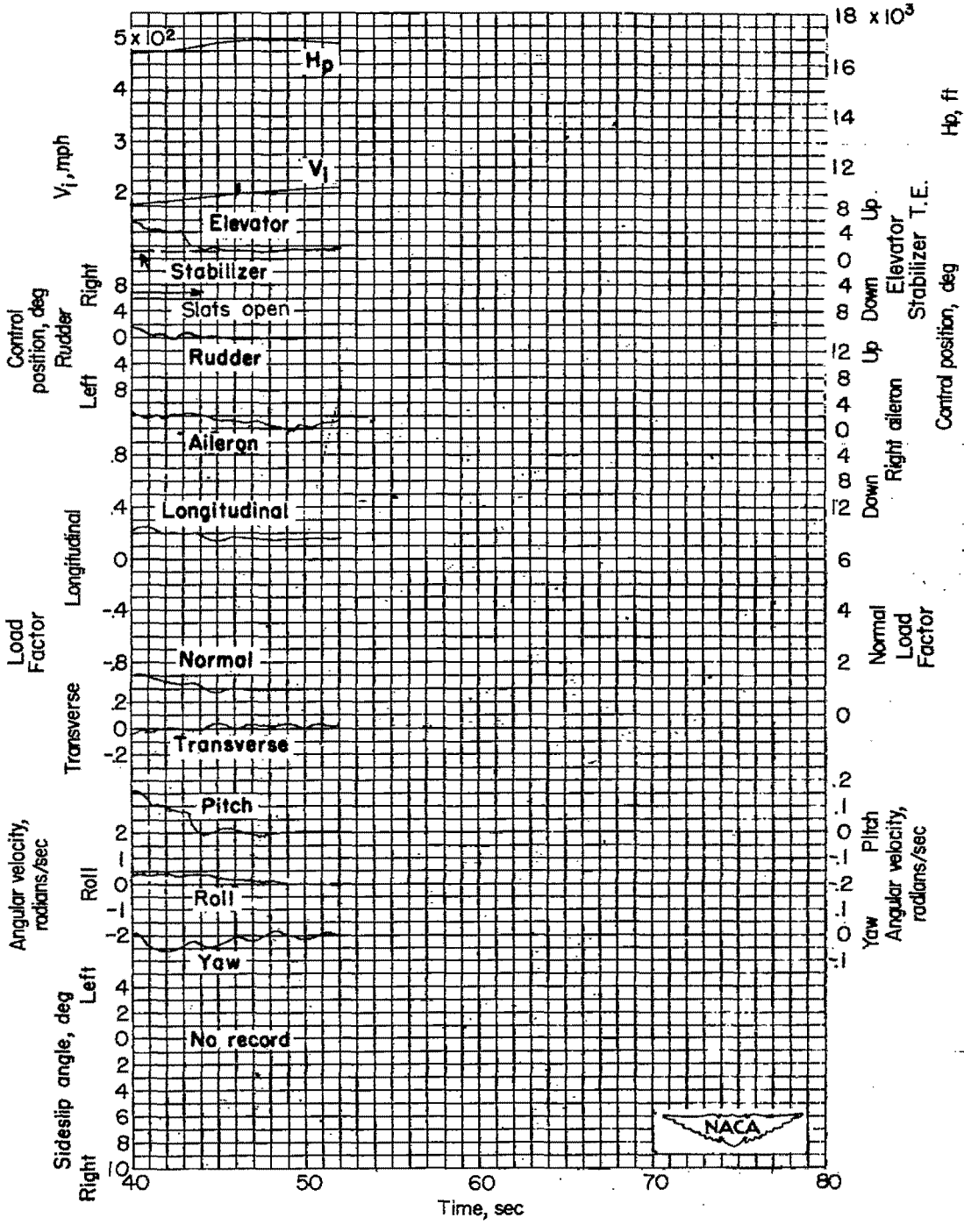


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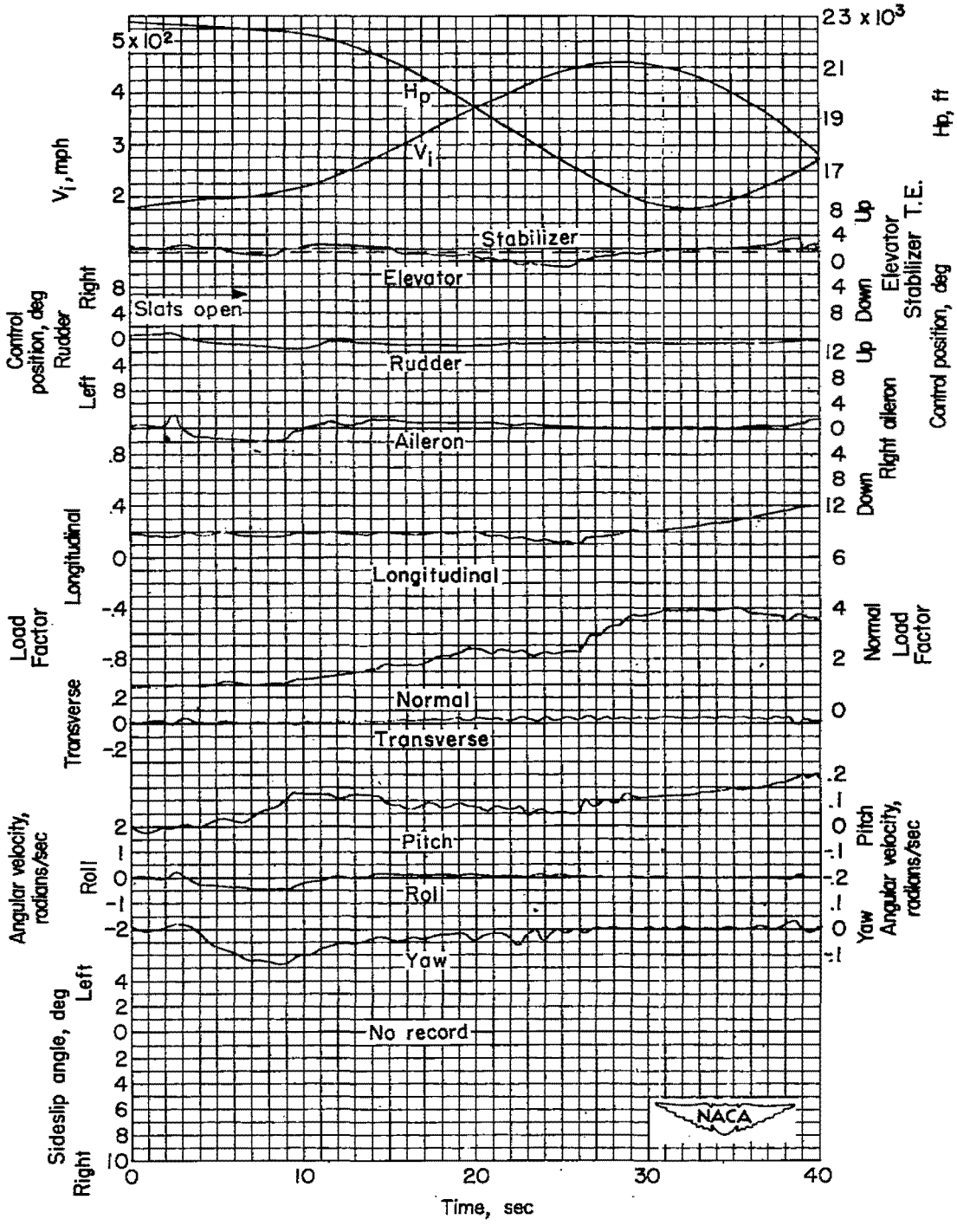


Figure 41.- Roll entry into a dive and pull-up into an Immelman turn. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

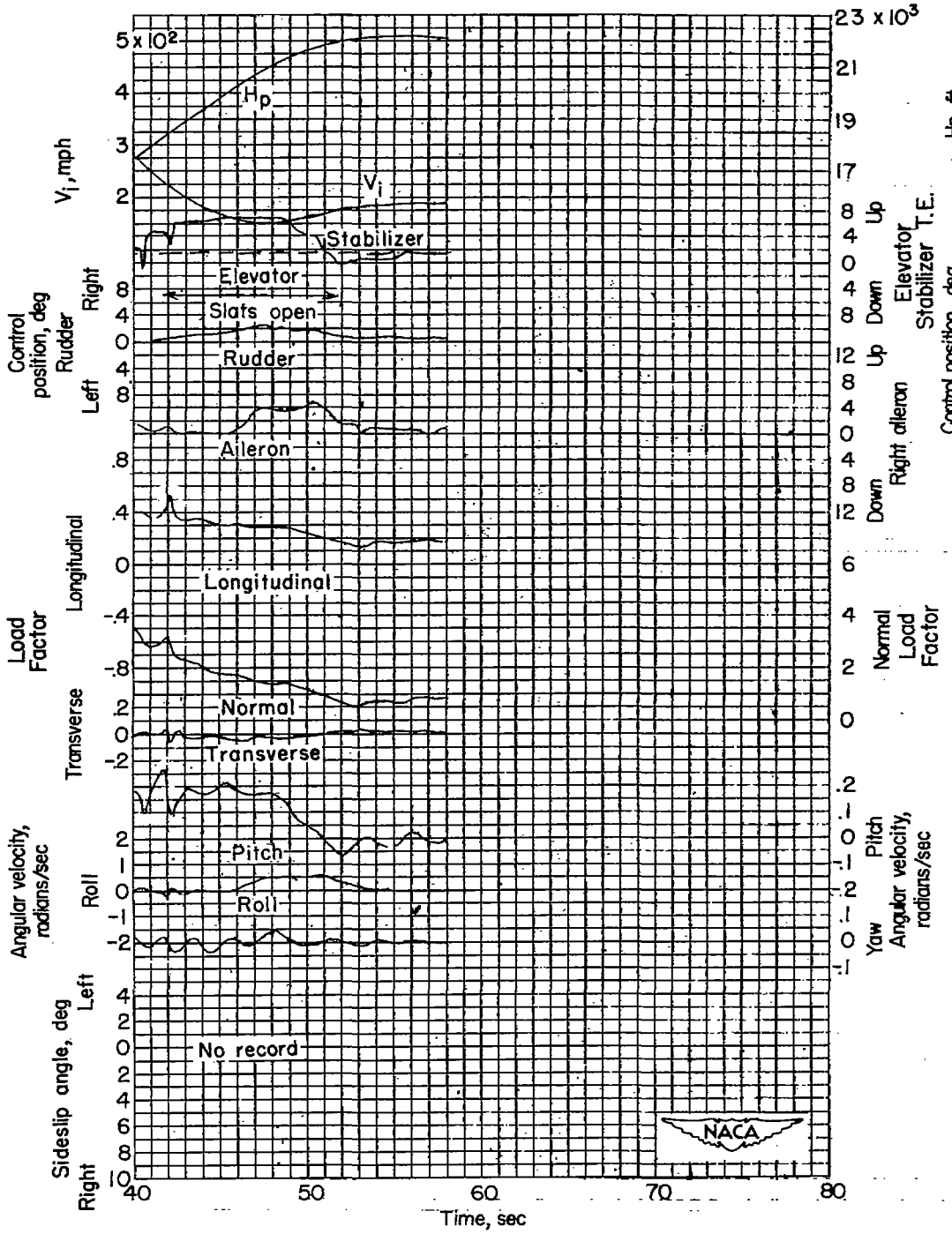


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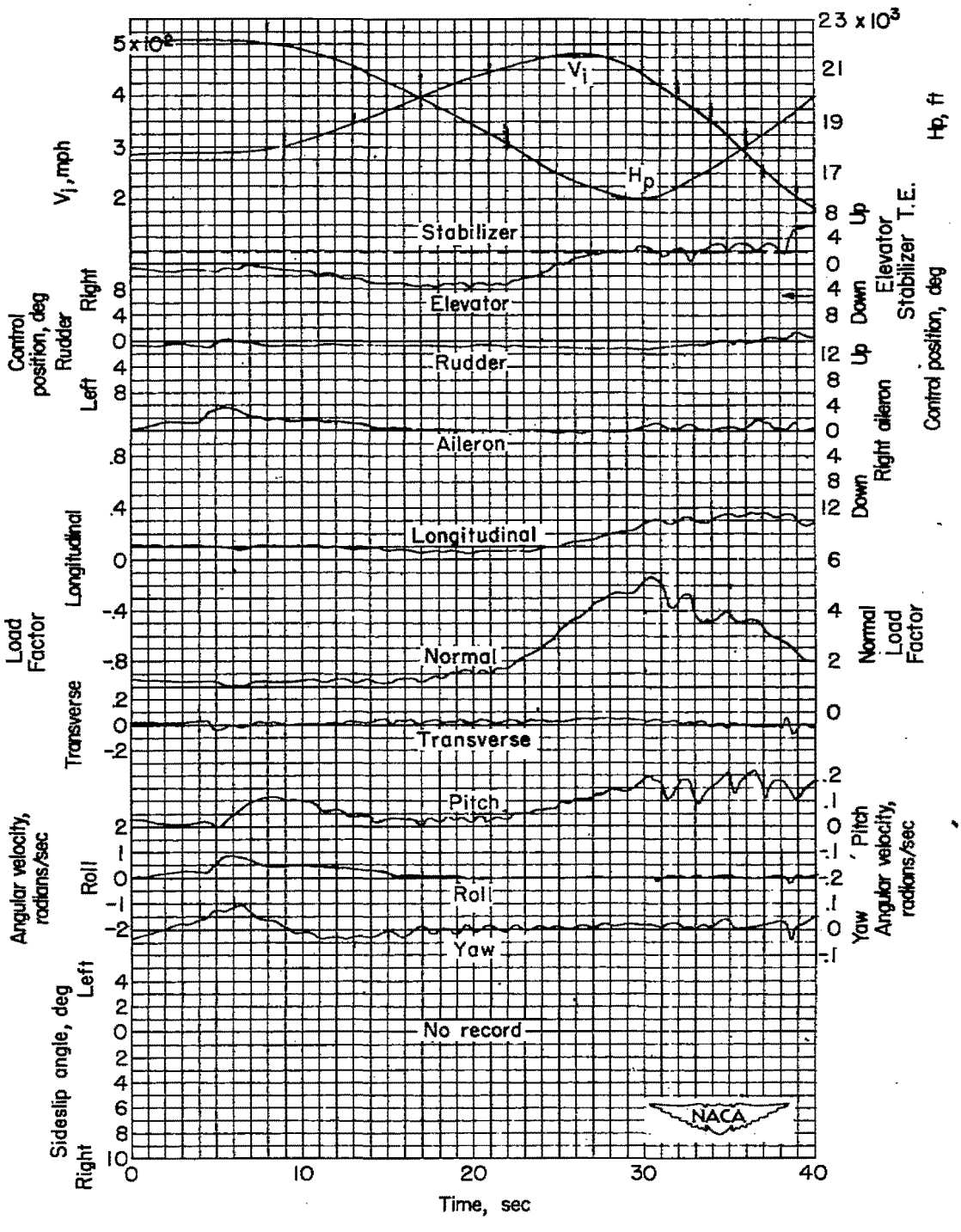


Figure 42.- Roll entry into a dive and pull-up into an Immelman turn. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

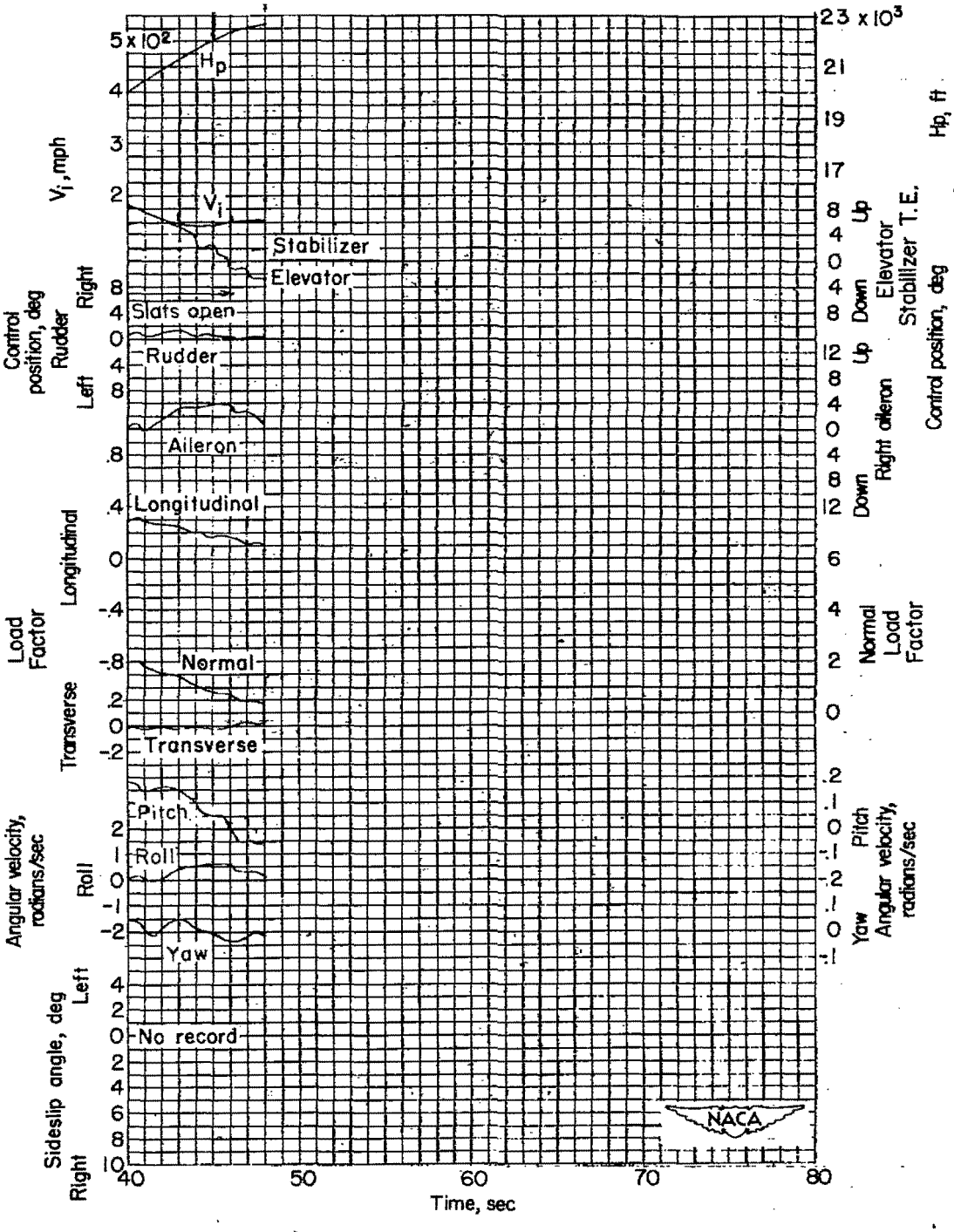


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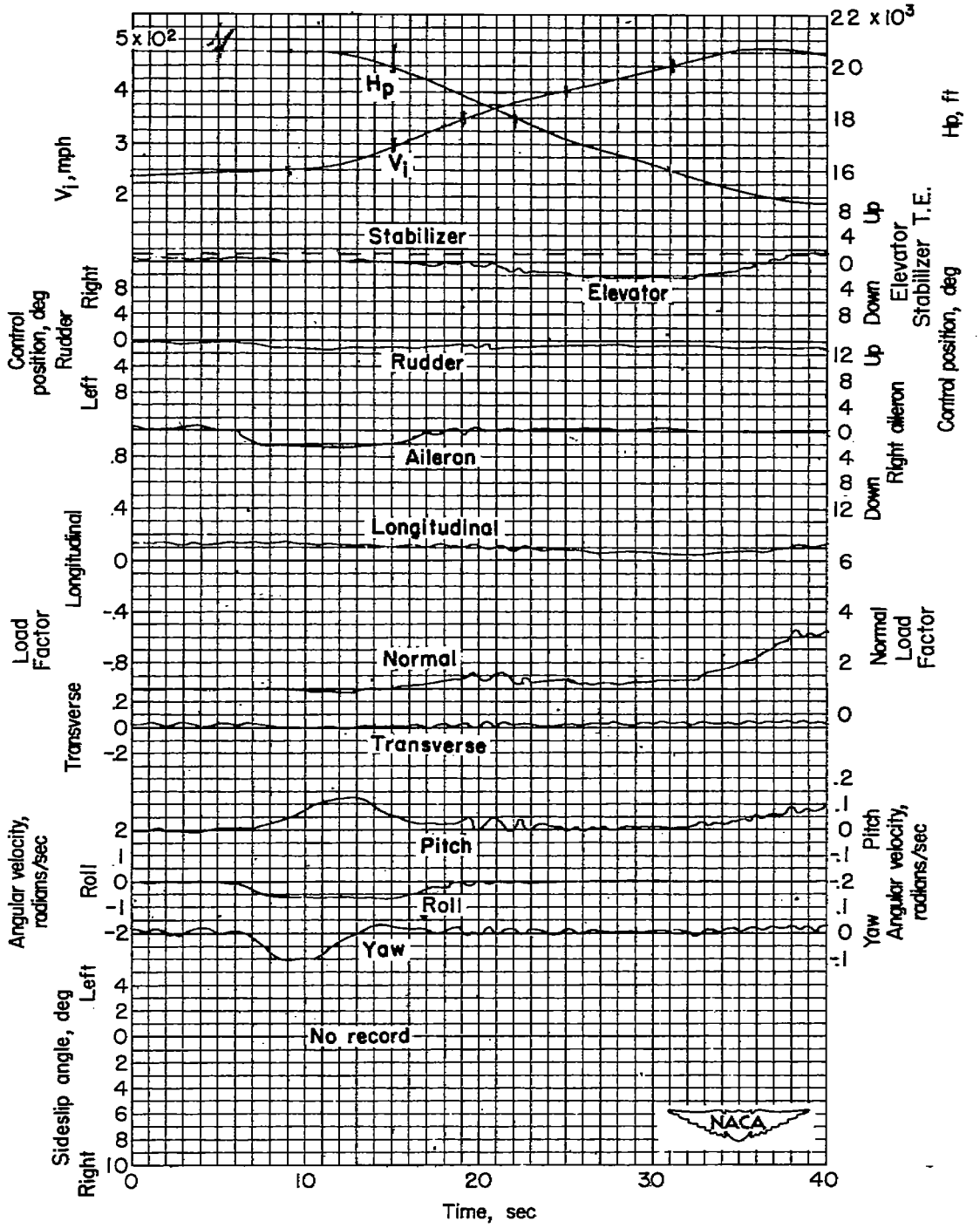


Figure 43.- Roll entry into a dive and pull-up into an Immelman turn. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

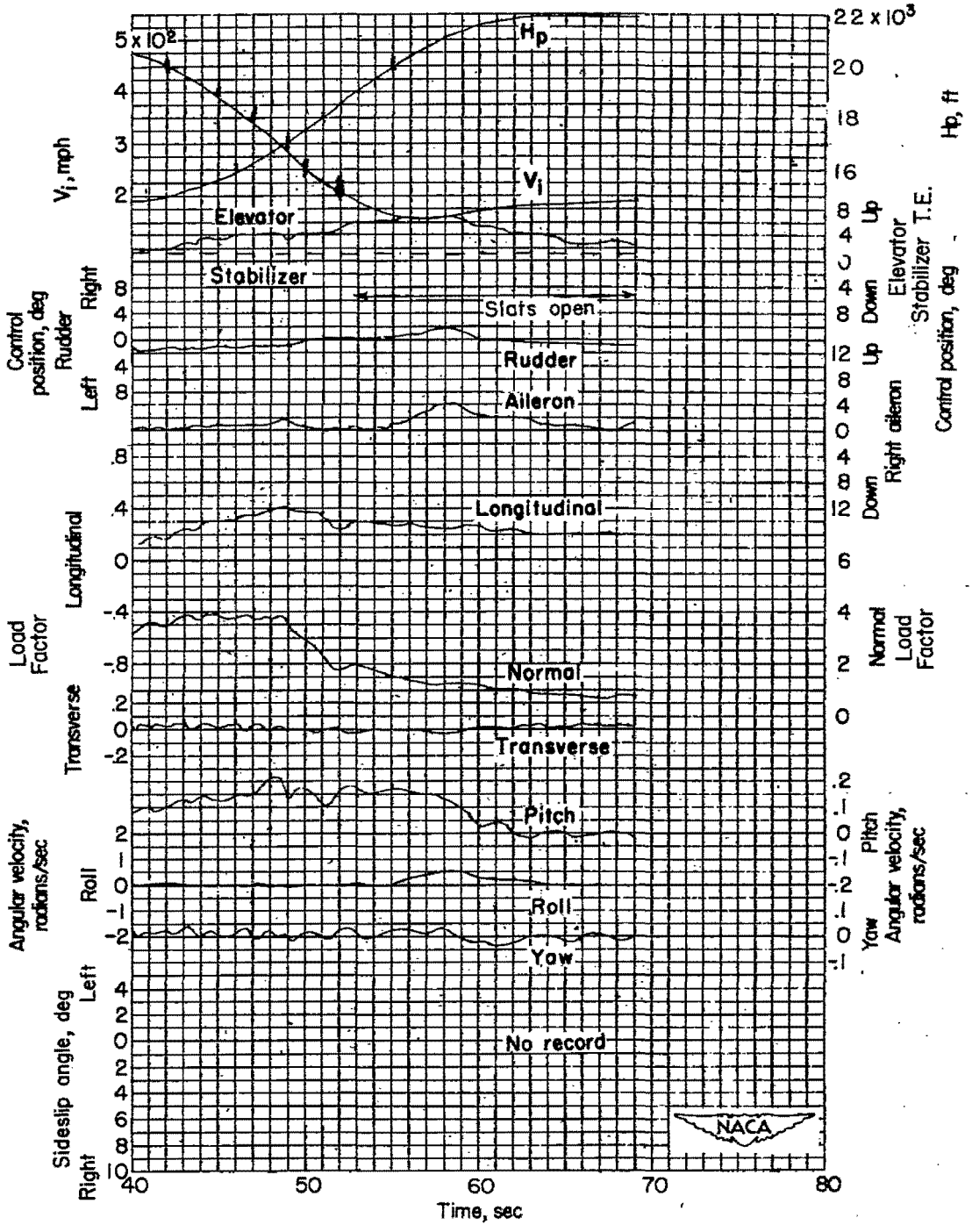


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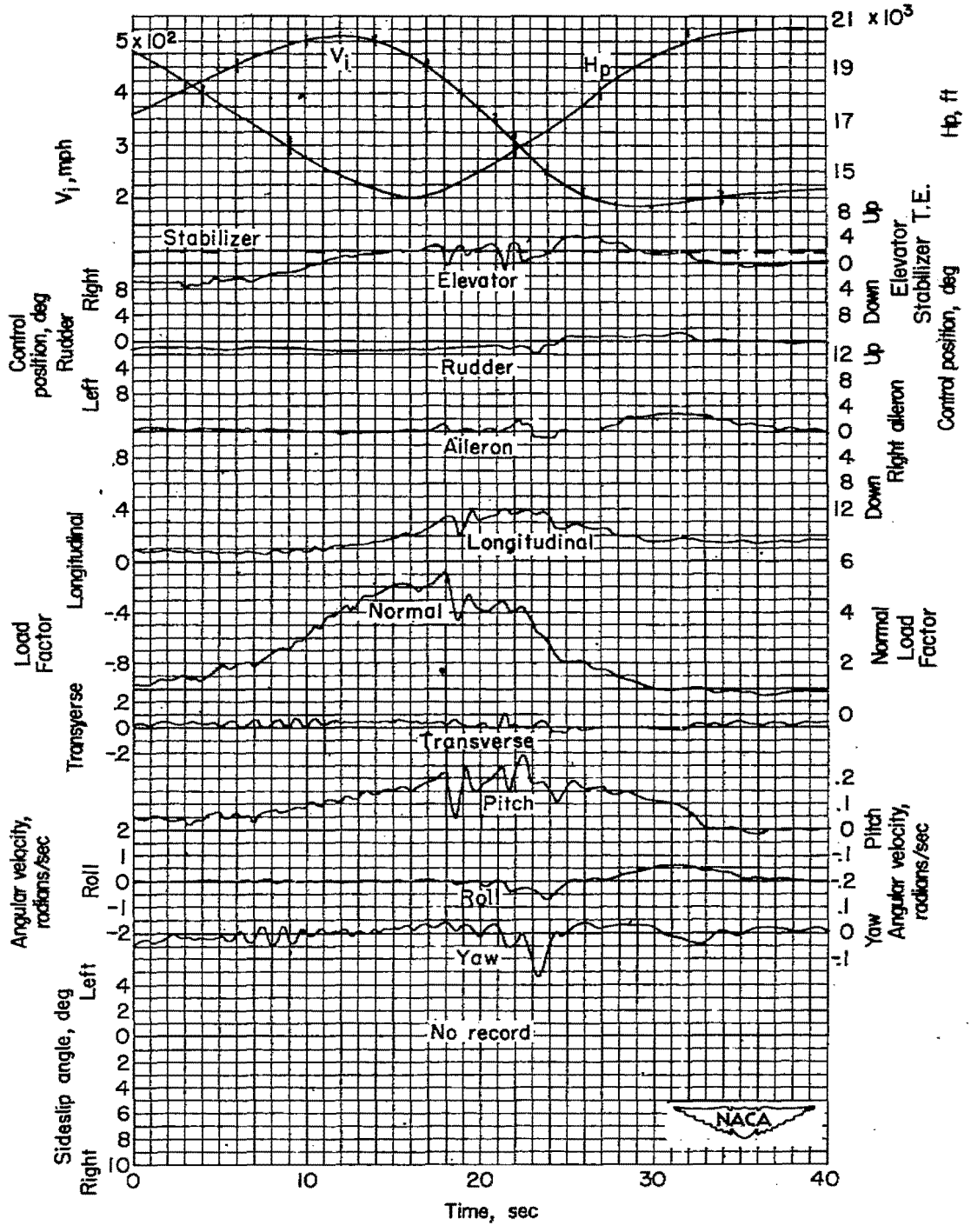


Figure 44.- Dive, pull-up, and quarter roll entry into an Immelman turn. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

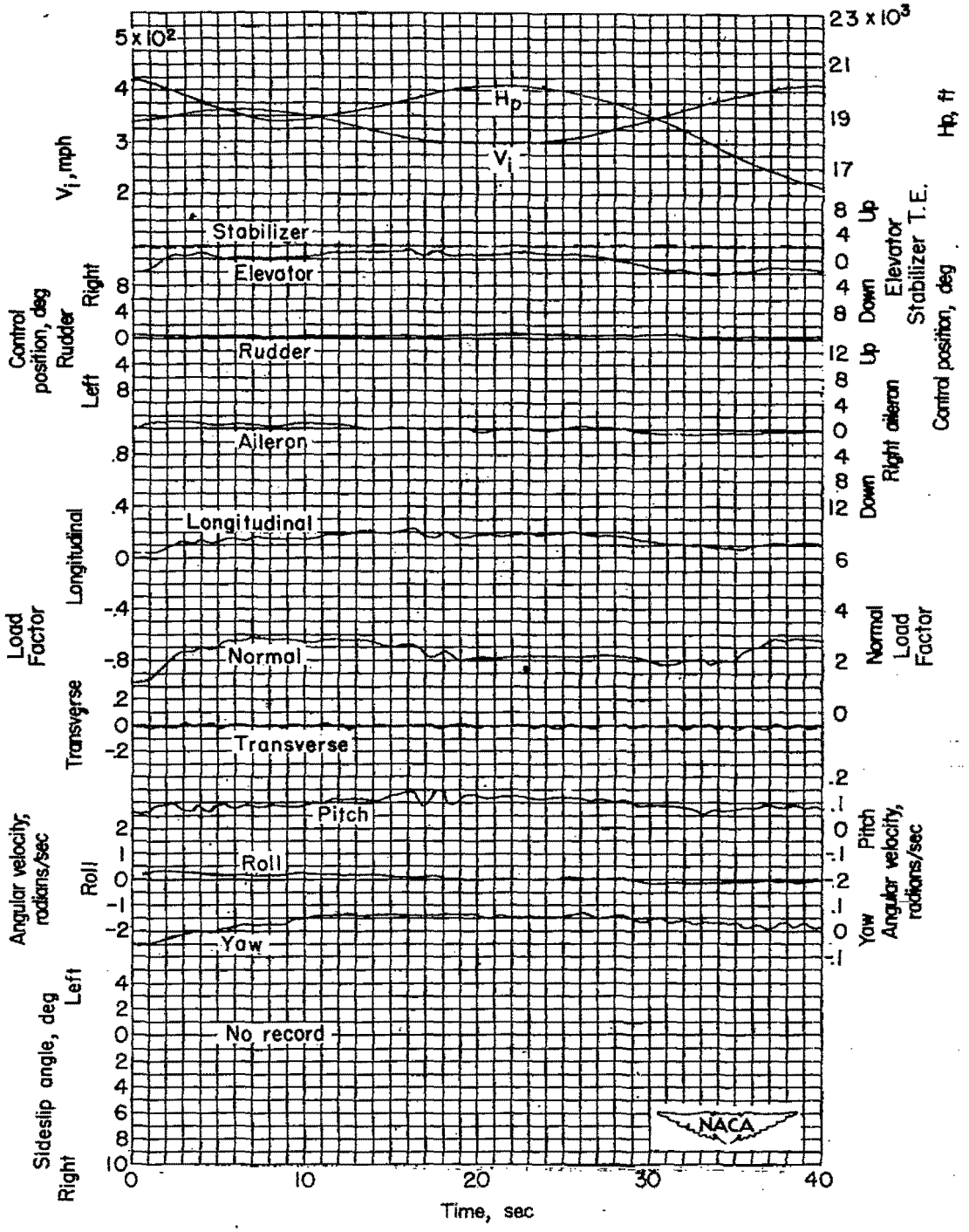


Figure 45.- Wing-over. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

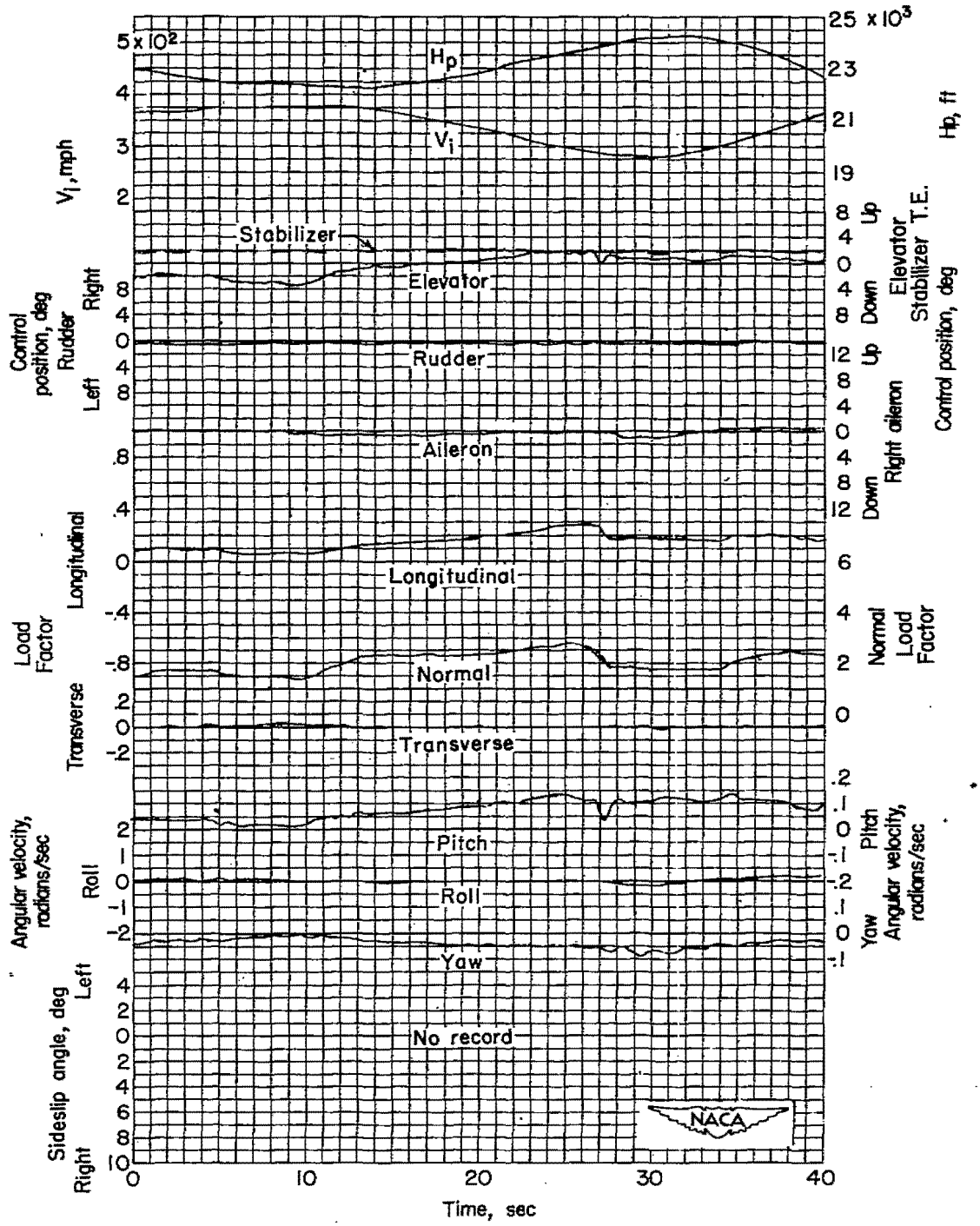


Figure 46.- Wing-over. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

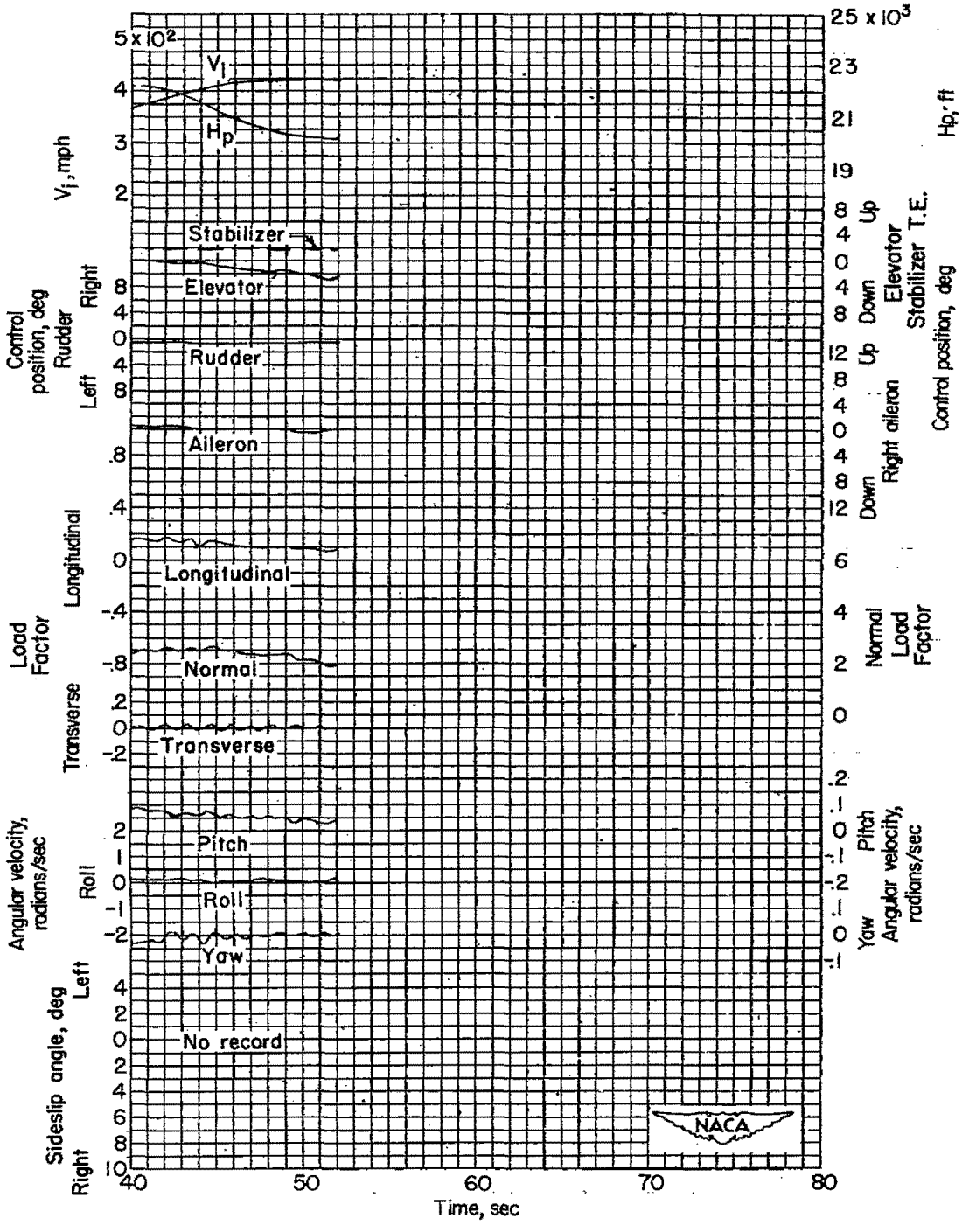


Figure 46.- Concluded.

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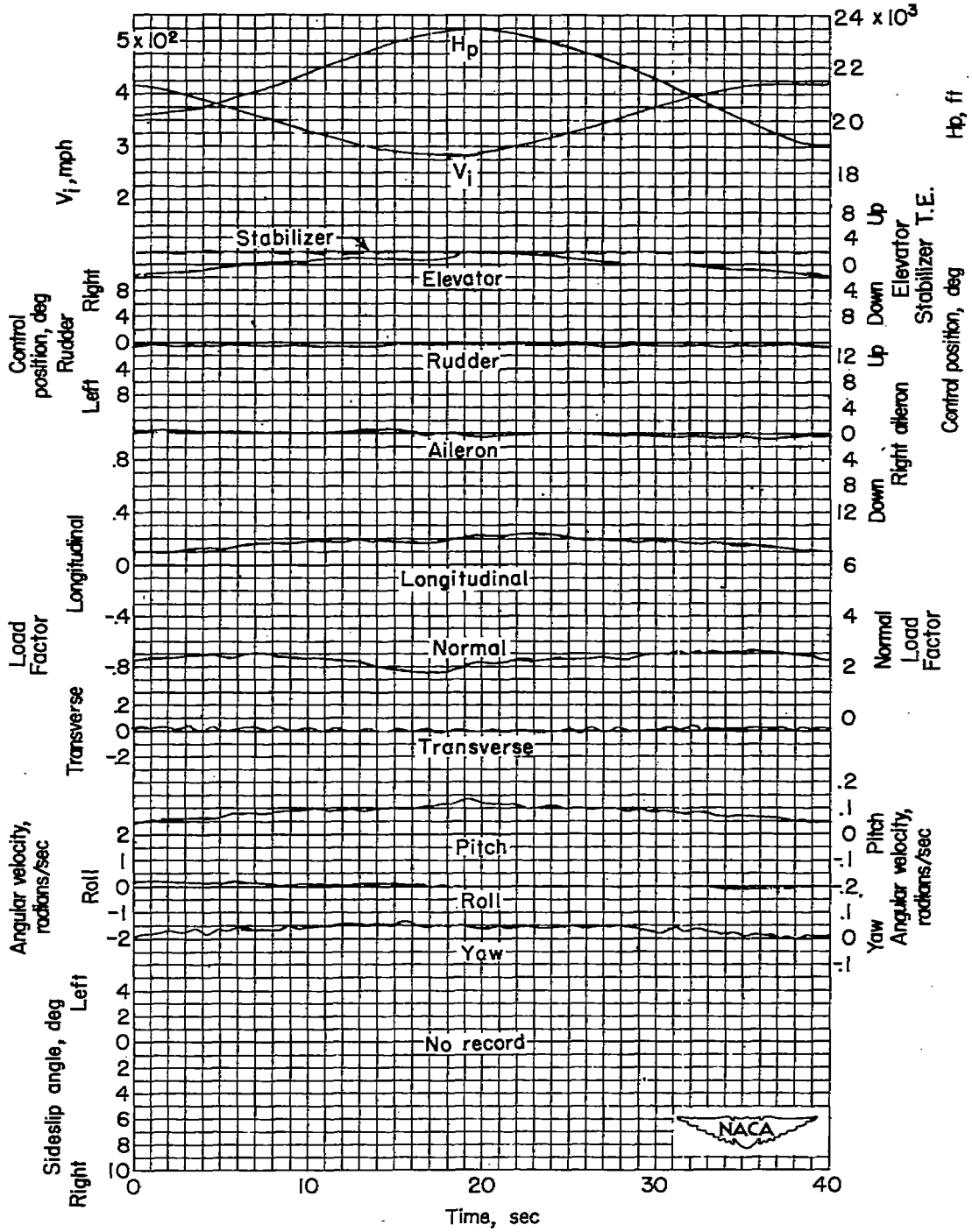


Figure 47.- Wing-over. Airplane weight, 13,750 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

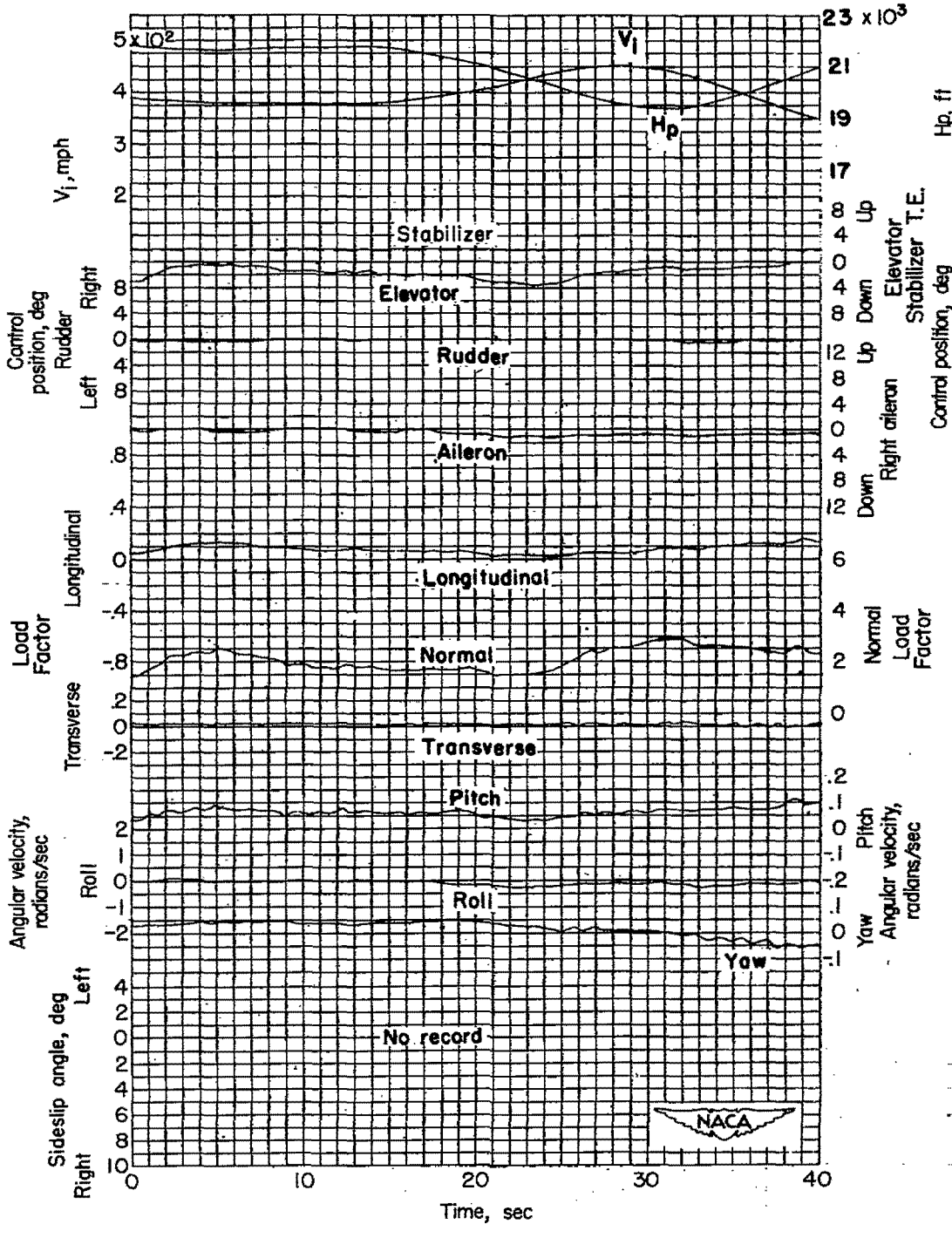


Figure 48.- Right turn followed by a wing-over. Airplane weight, 12,700 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

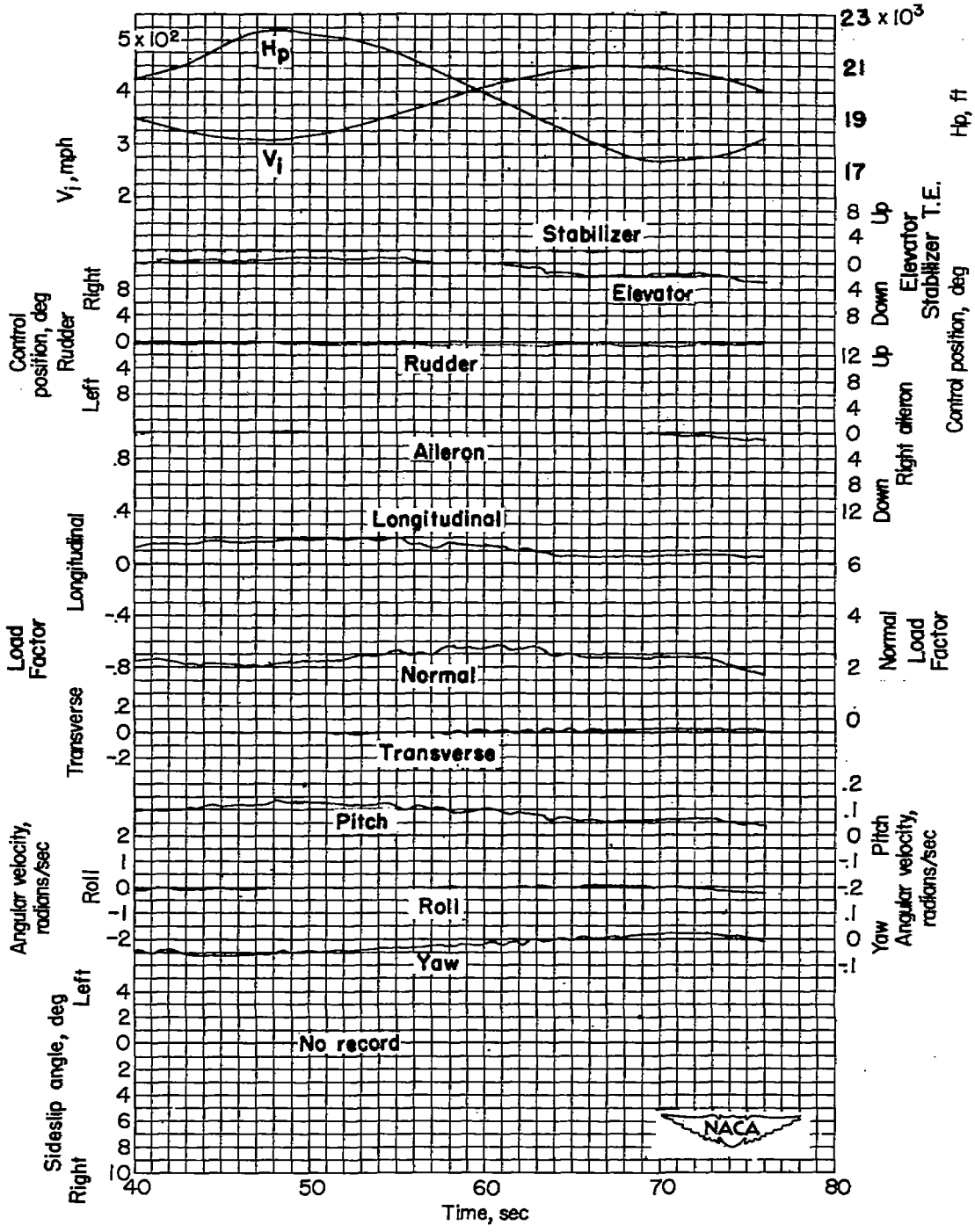


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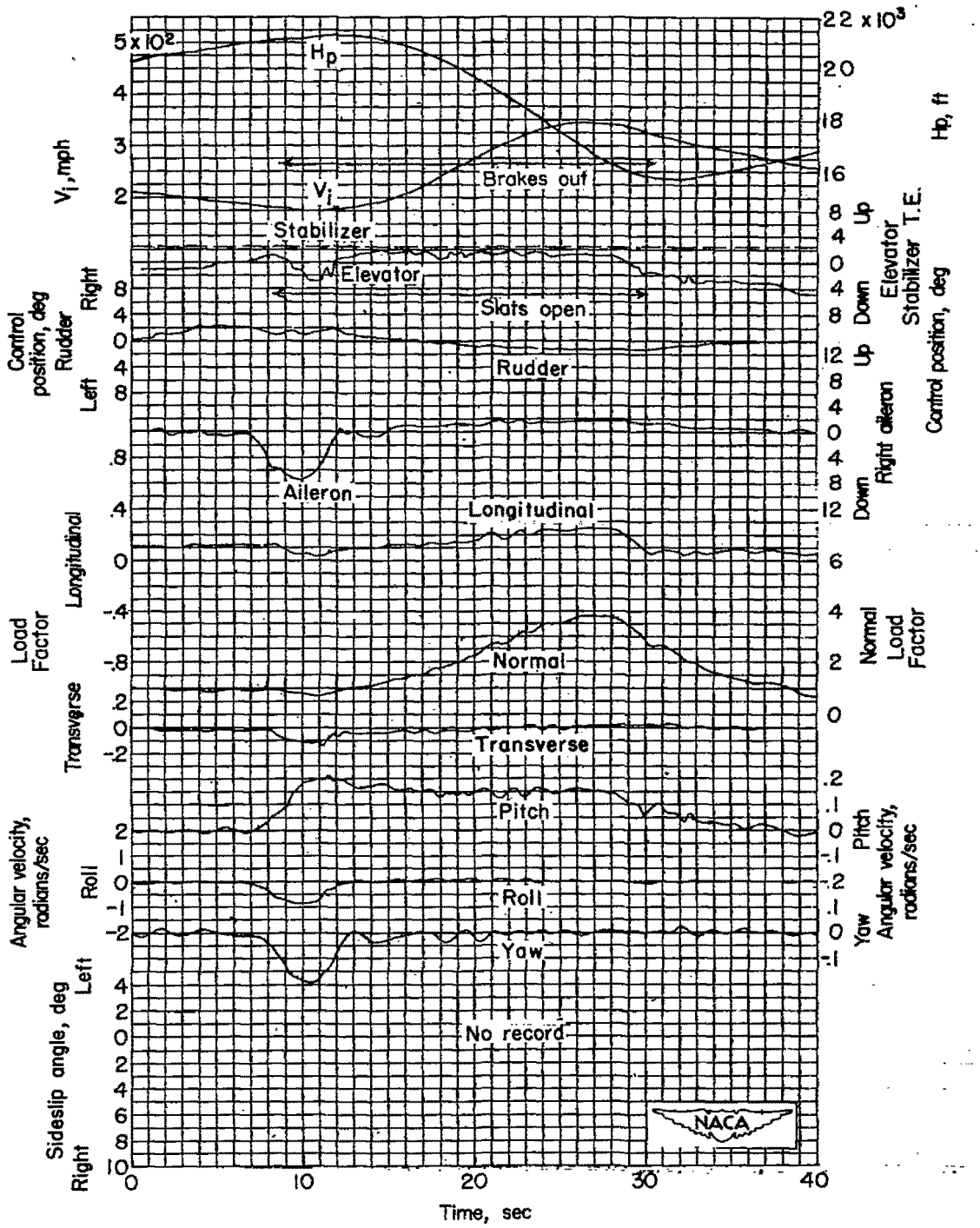


Figure 49.- Split-S. Airplane weight, 13,400 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

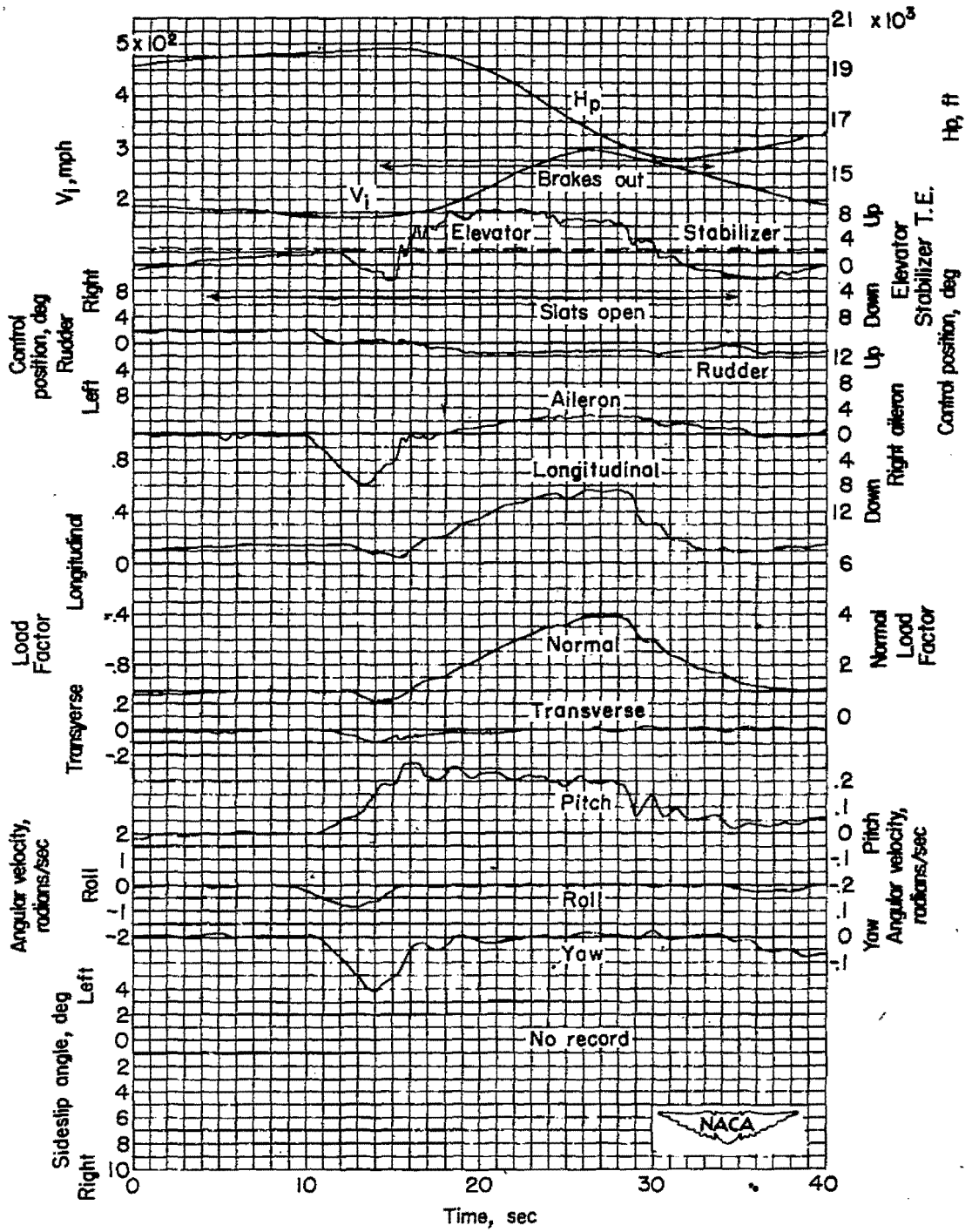


Figure 50.- Split-S. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

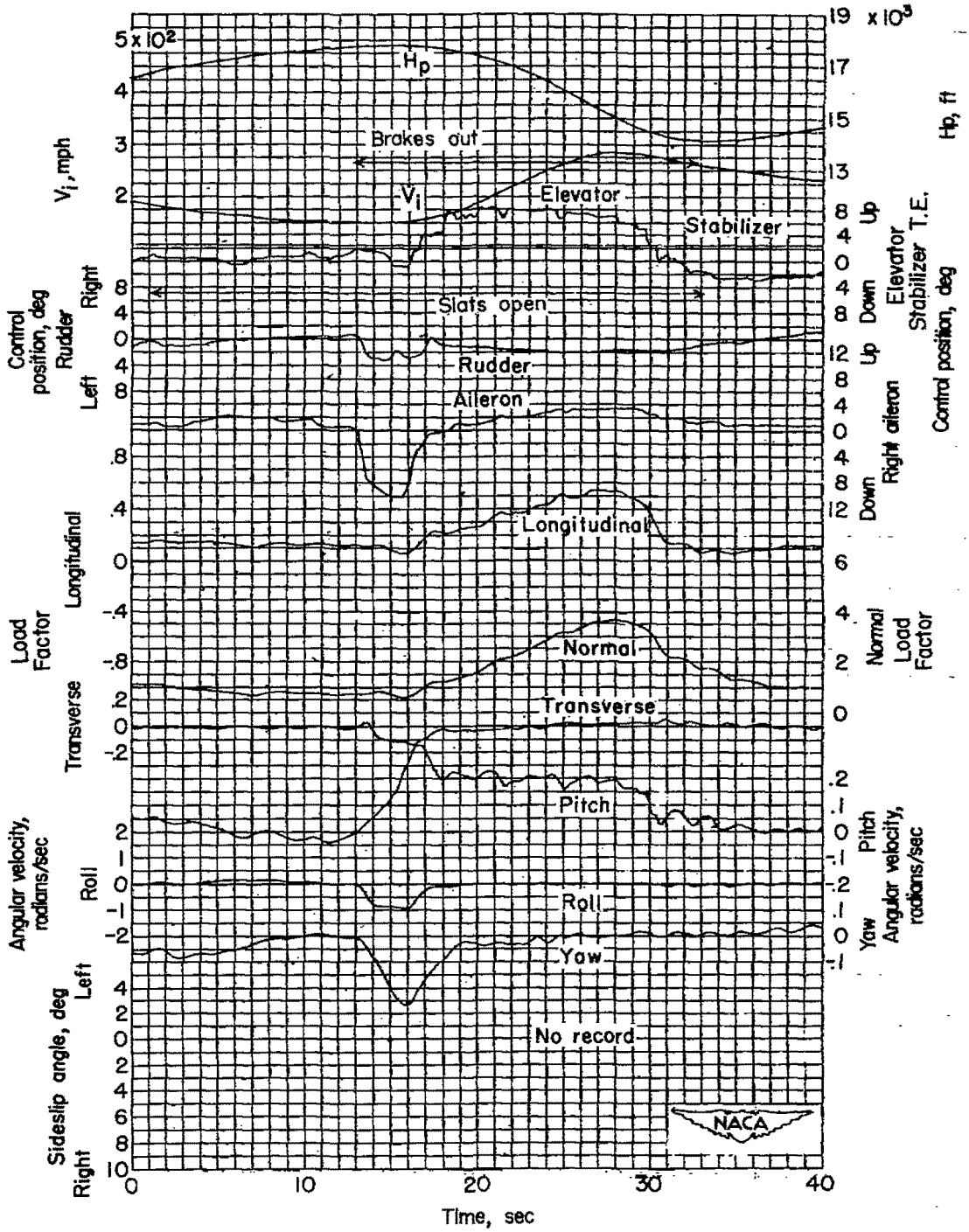


Figure 51.- Split-S. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

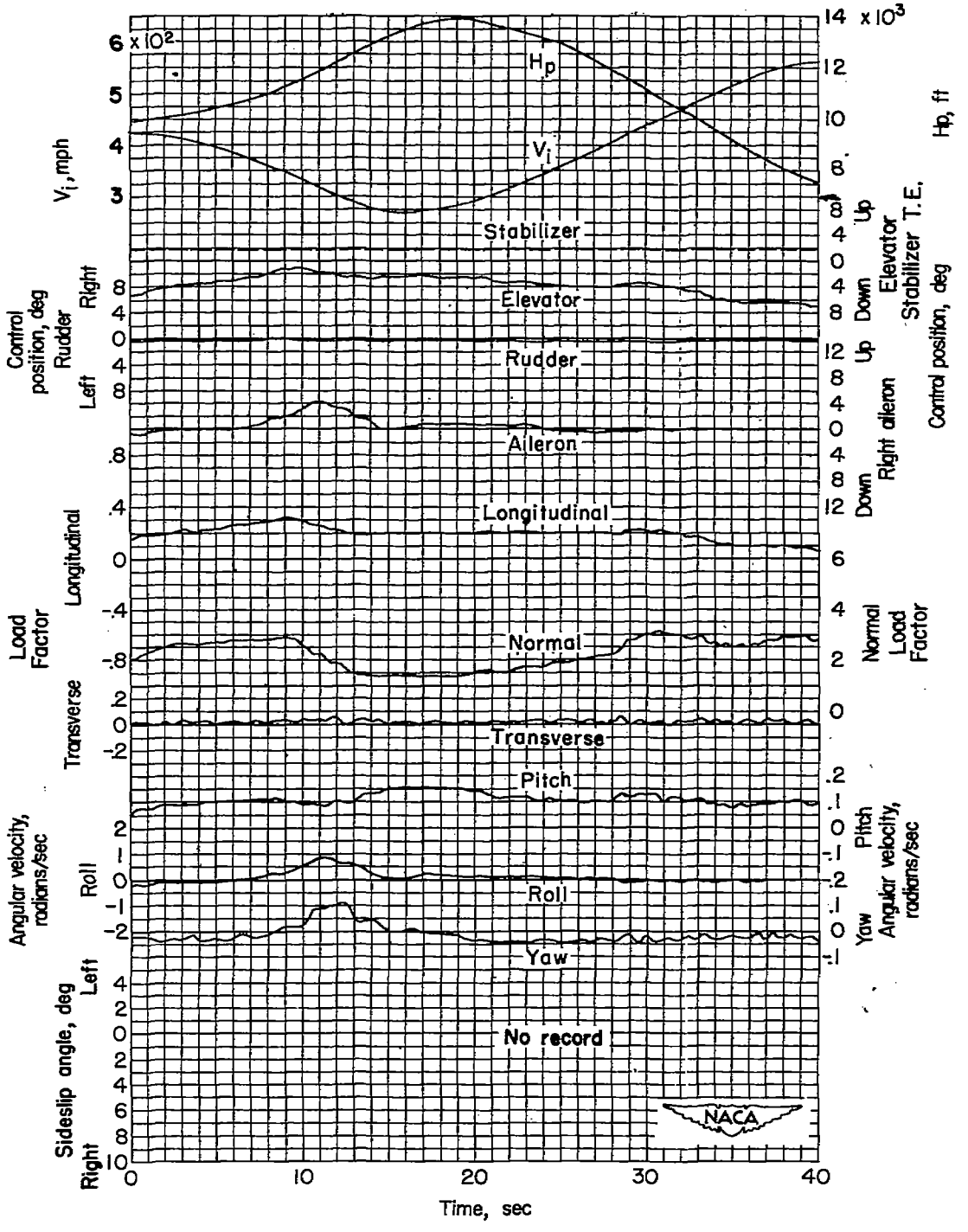


Figure 52.- Climbing entry into a split-S. Airplane weight, 13,650 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

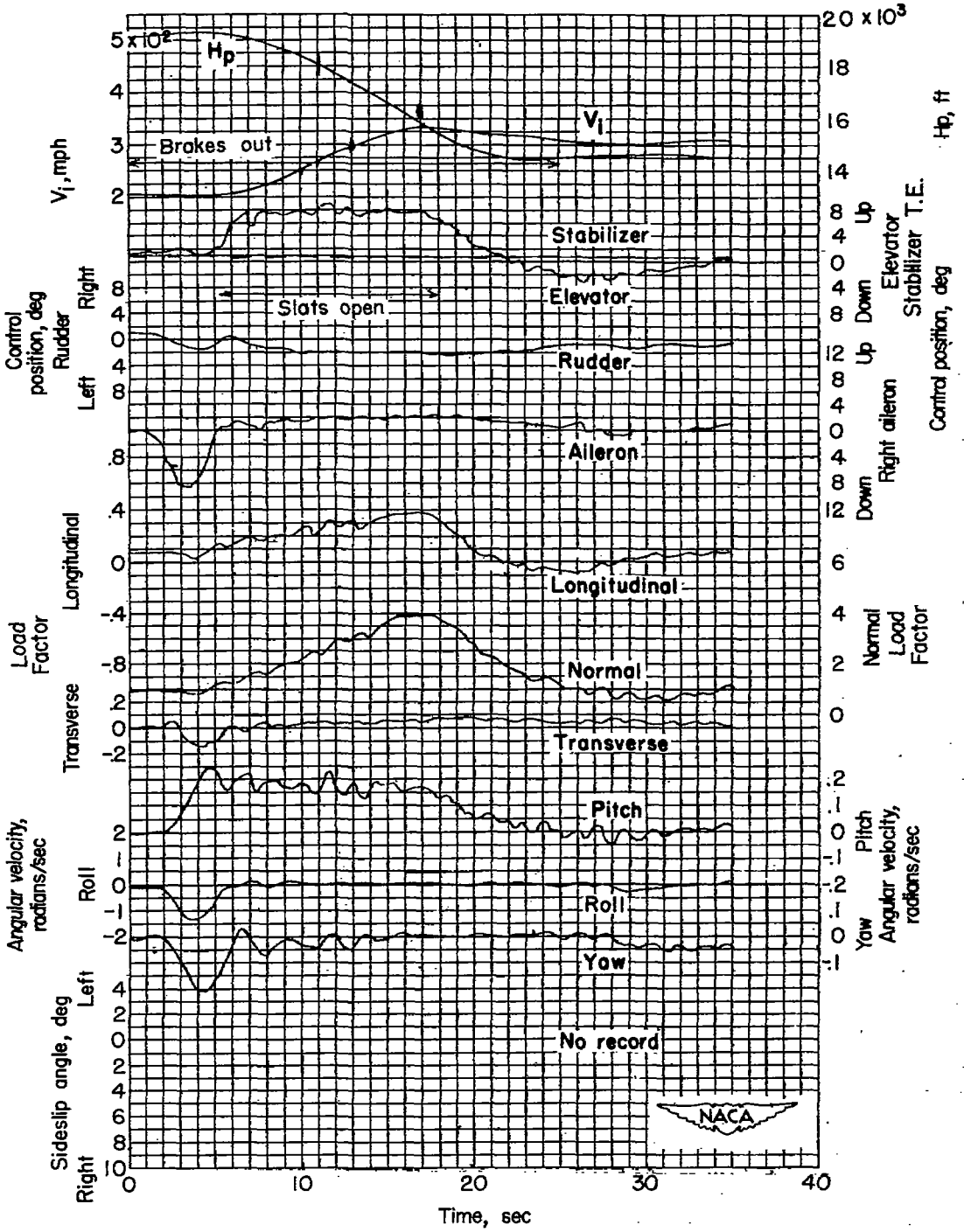


Figure 53.- Split-S. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

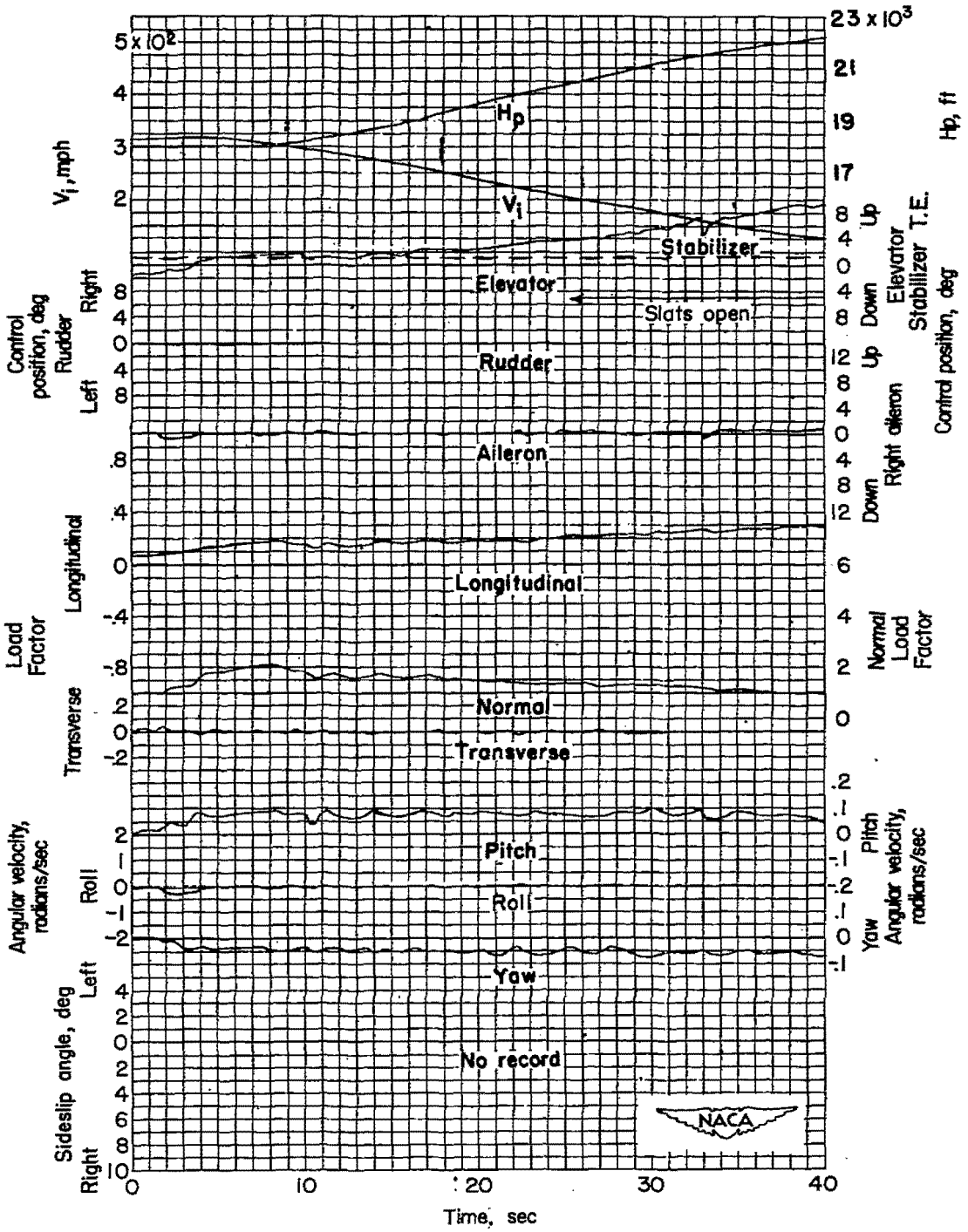


Figure 54.- Climbing left turns followed by a split-S and pull-out. Airplane weight, 13,000 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

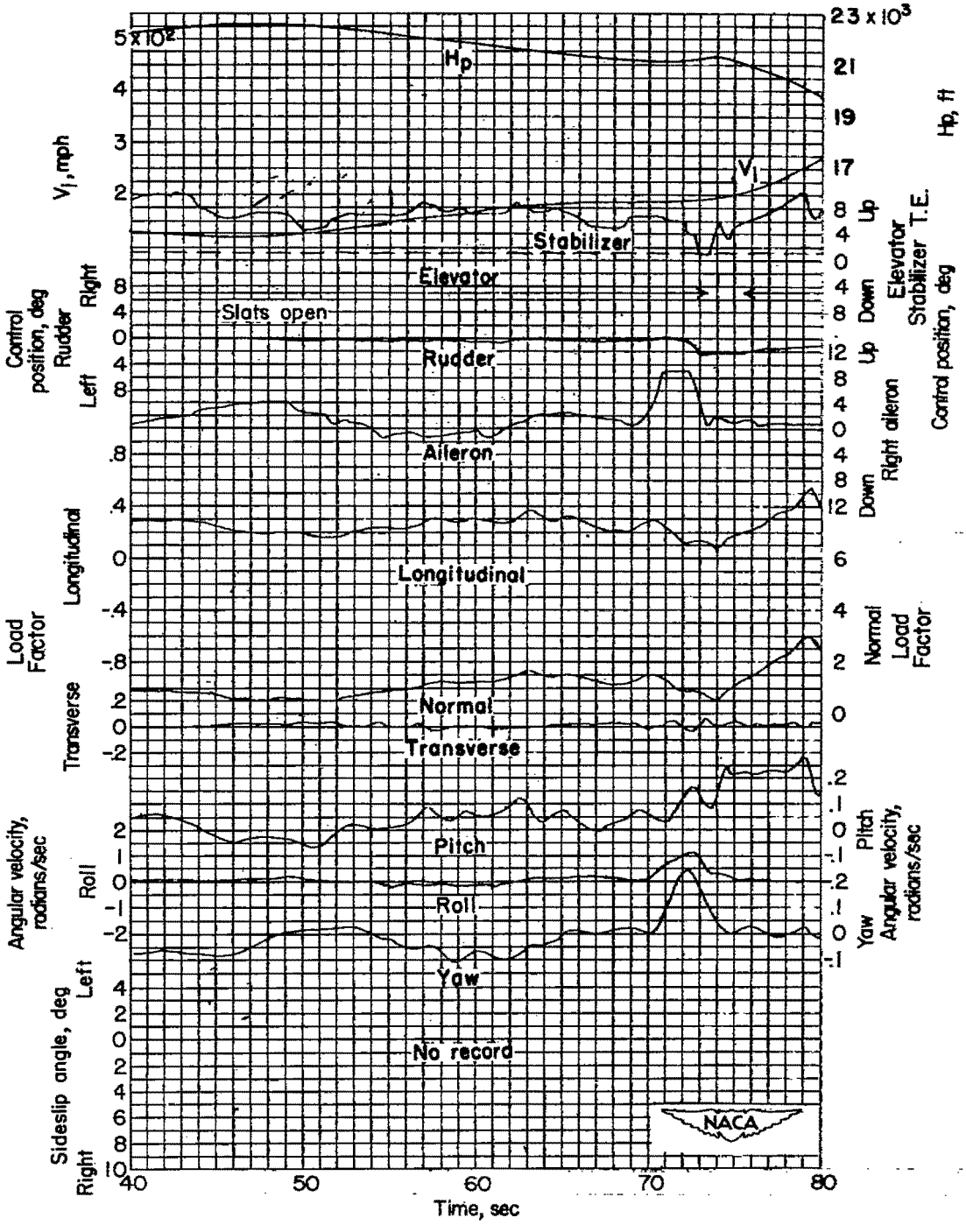


Figure 54.- Continued.

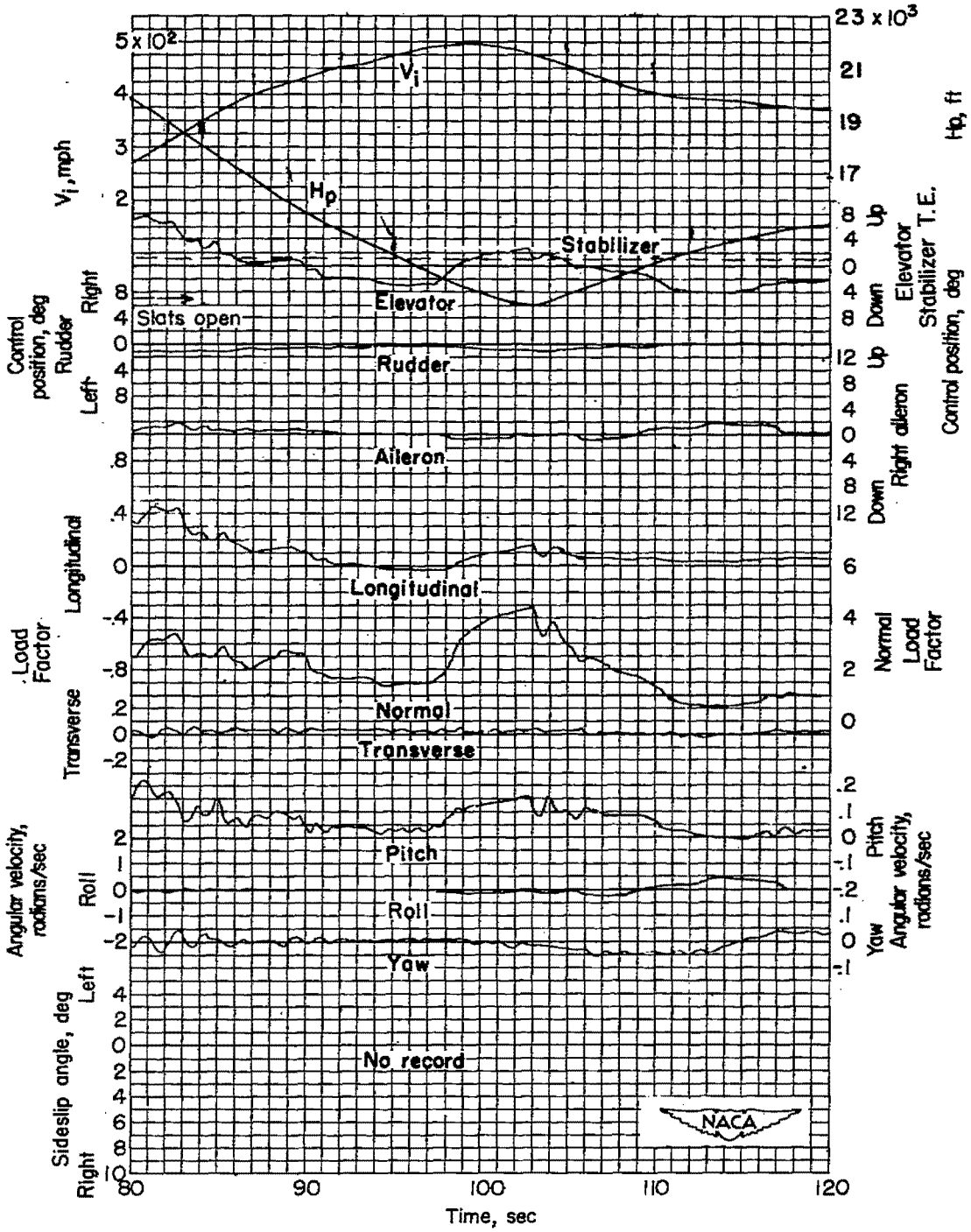


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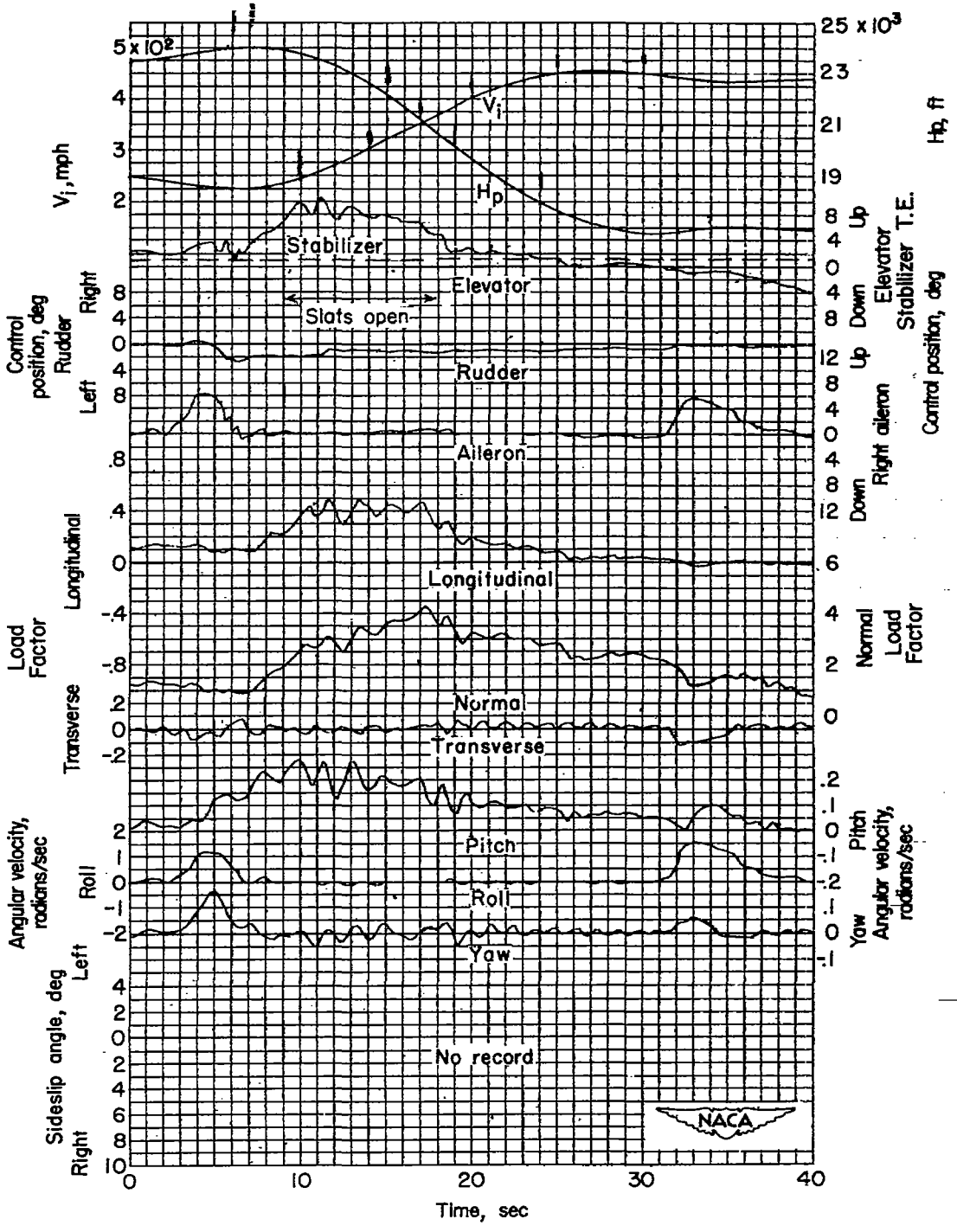


Figure 55.- Split-S followed by a right barrel roll. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

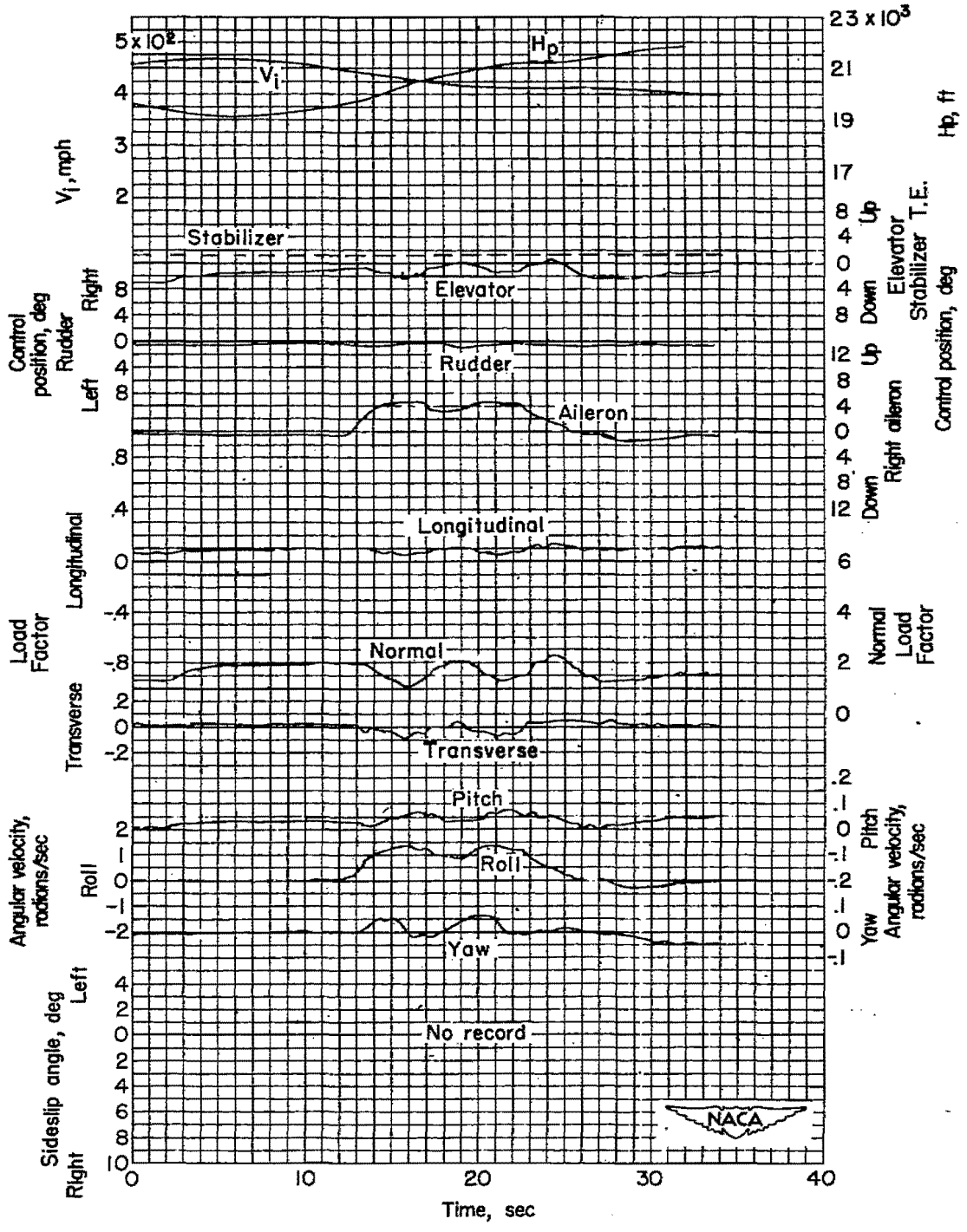


Figure 56.- Right climbing barrel rolls. Airplane weight, 13,650 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

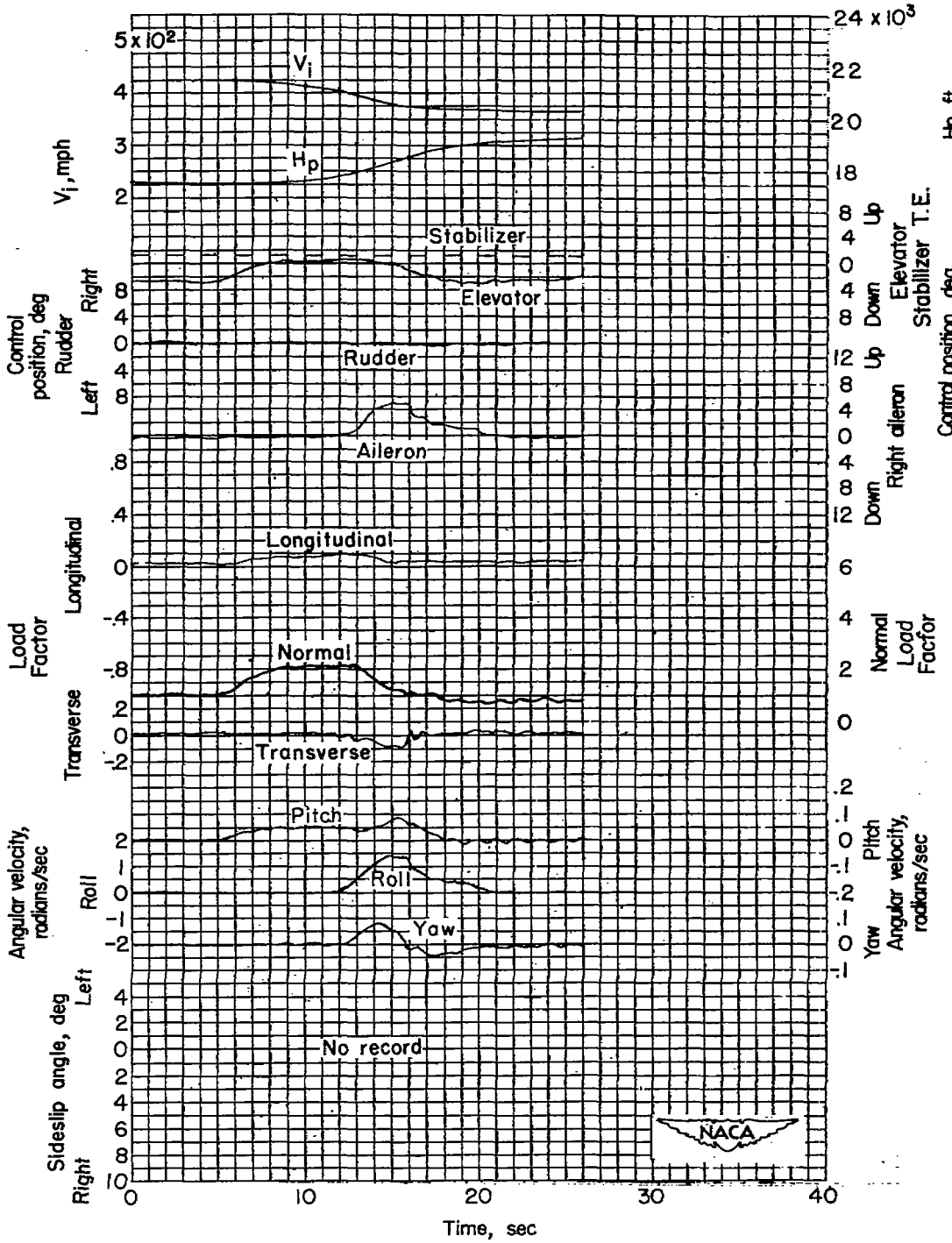


Figure 57.- Pull-up and right barrel roll. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

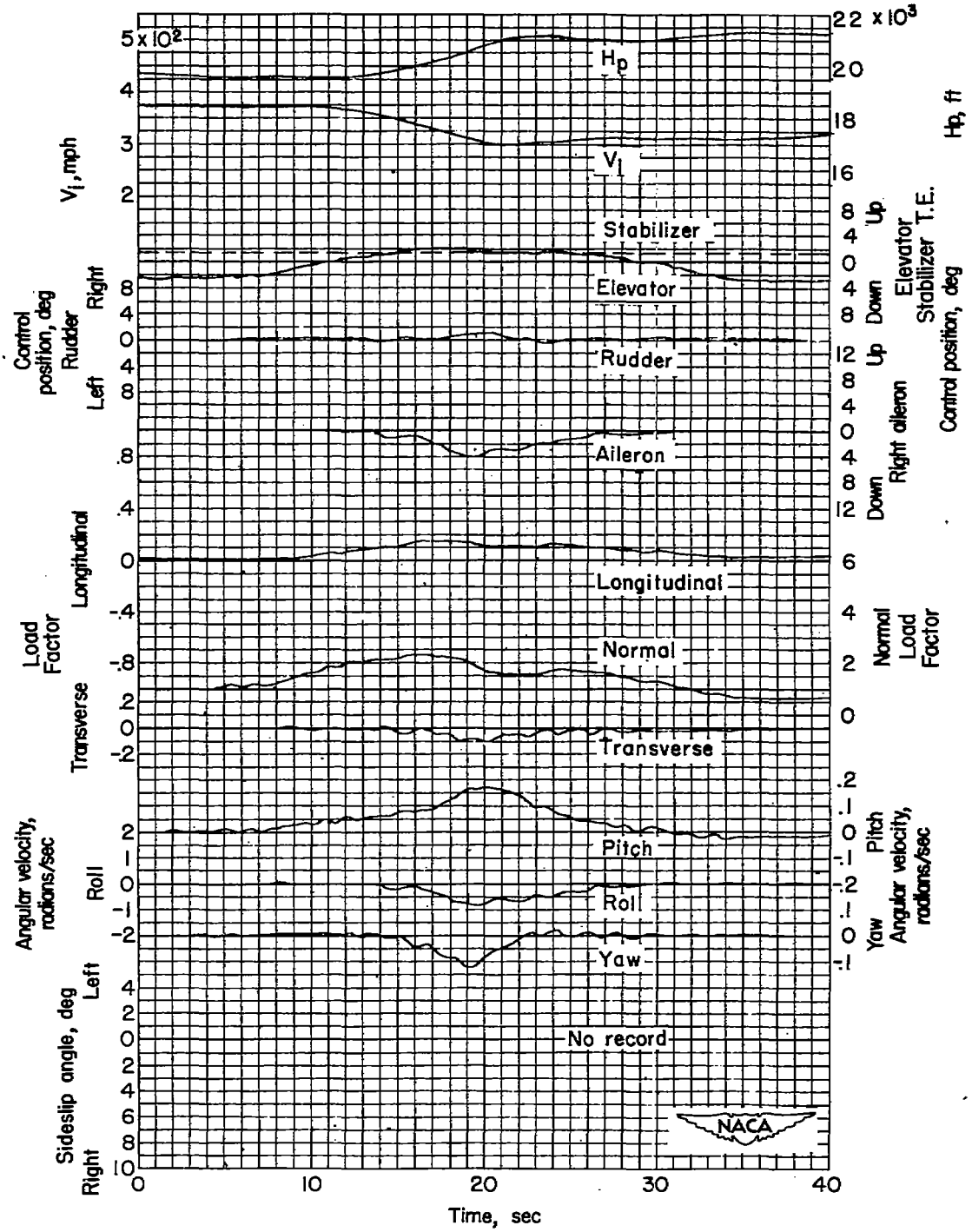


Figure 58.- Left barrel roll. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

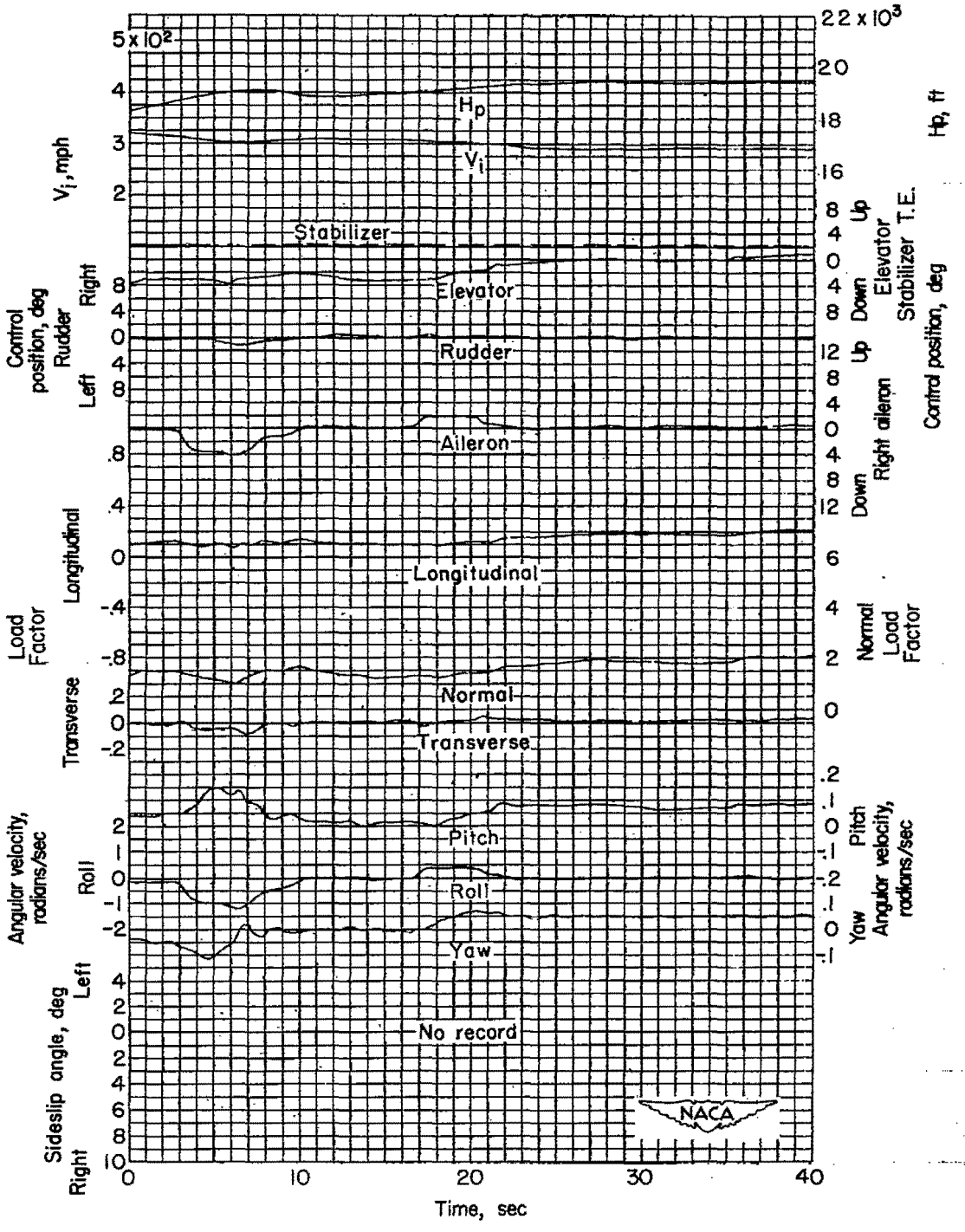


Figure 59.- Left barrel roll followed by a right turn. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

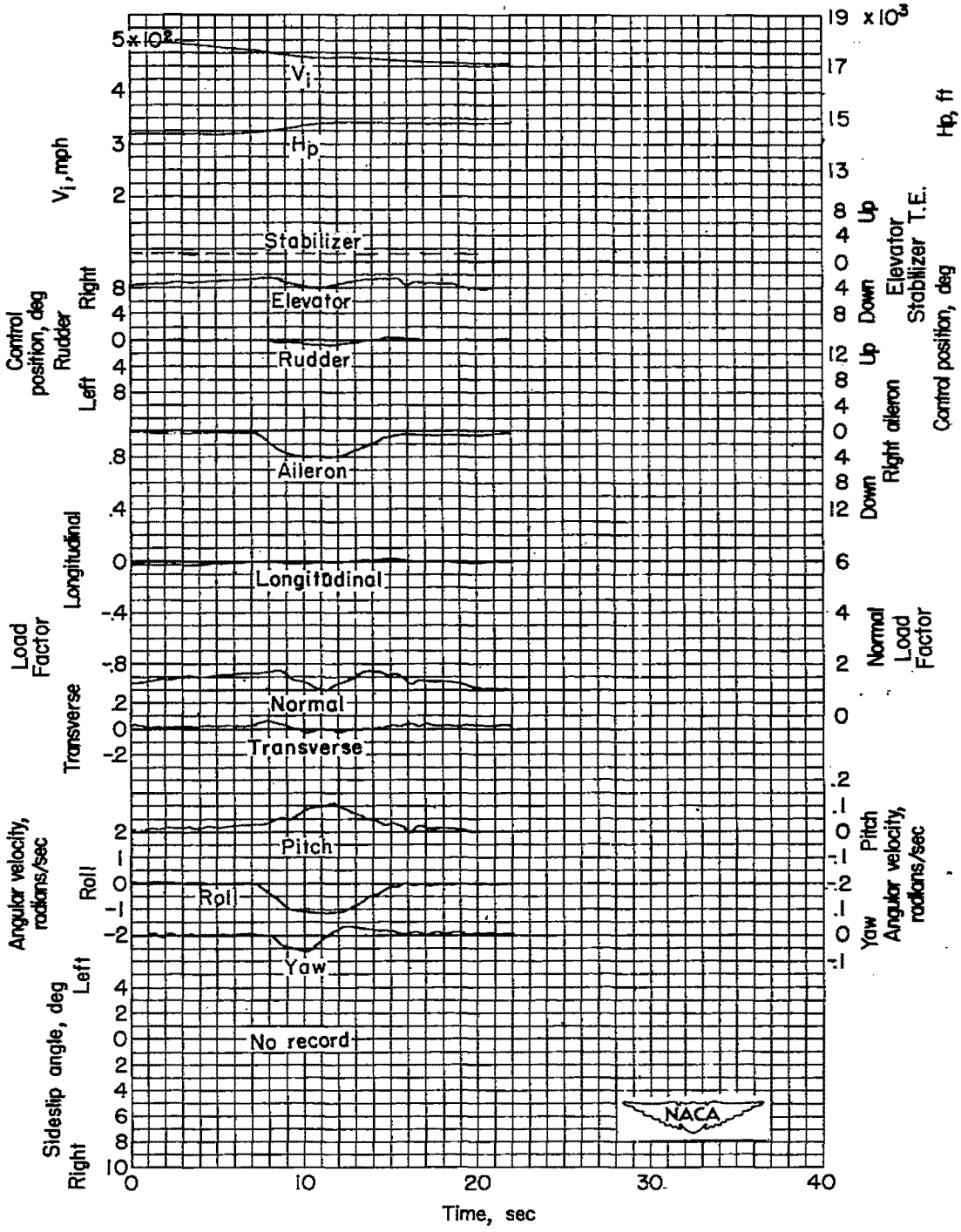


Figure 60.- Left barrel roll. Airplane weight, 12,250 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

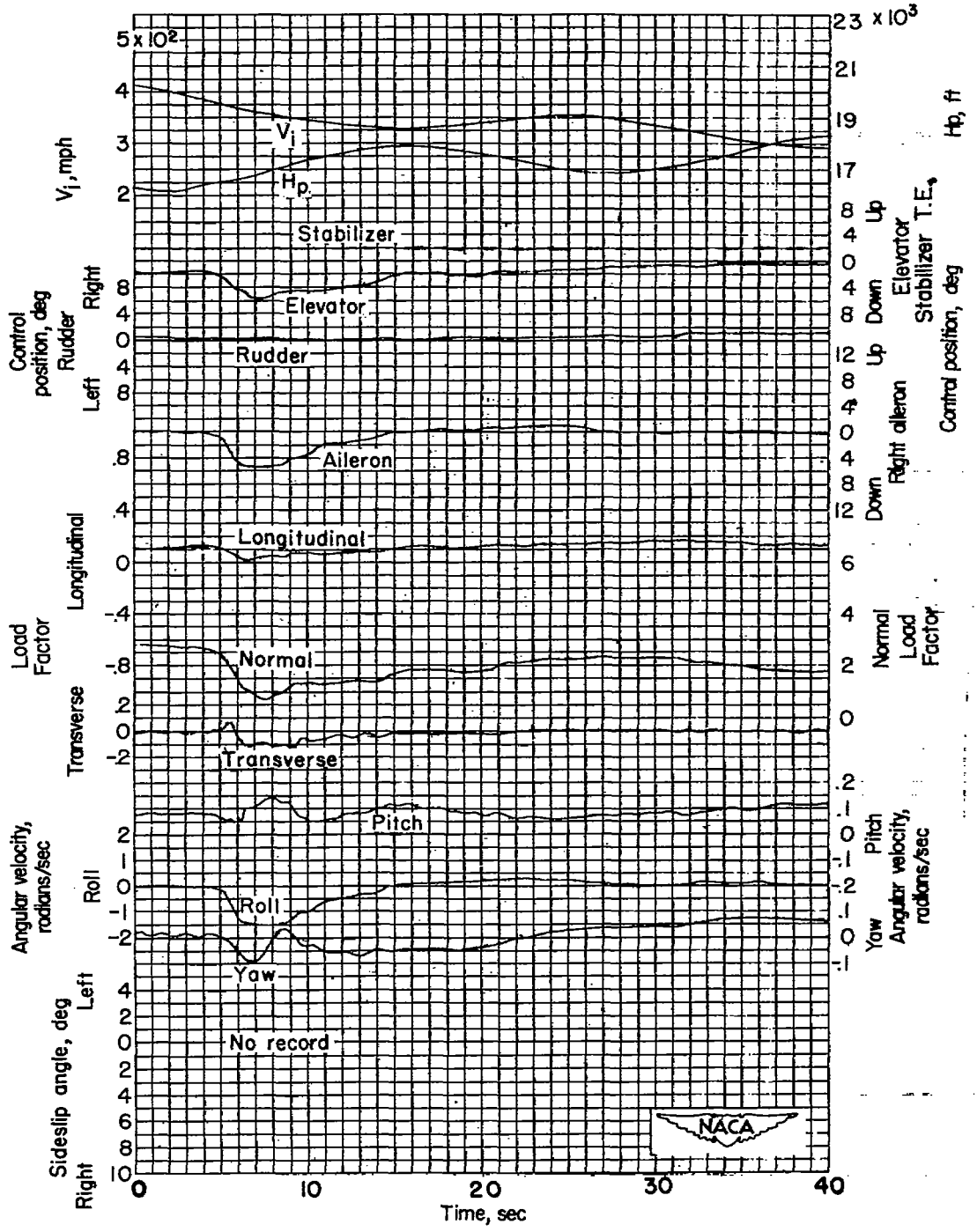


Figure 61.- Left barrel roll followed by right and left climbing and diving turns. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

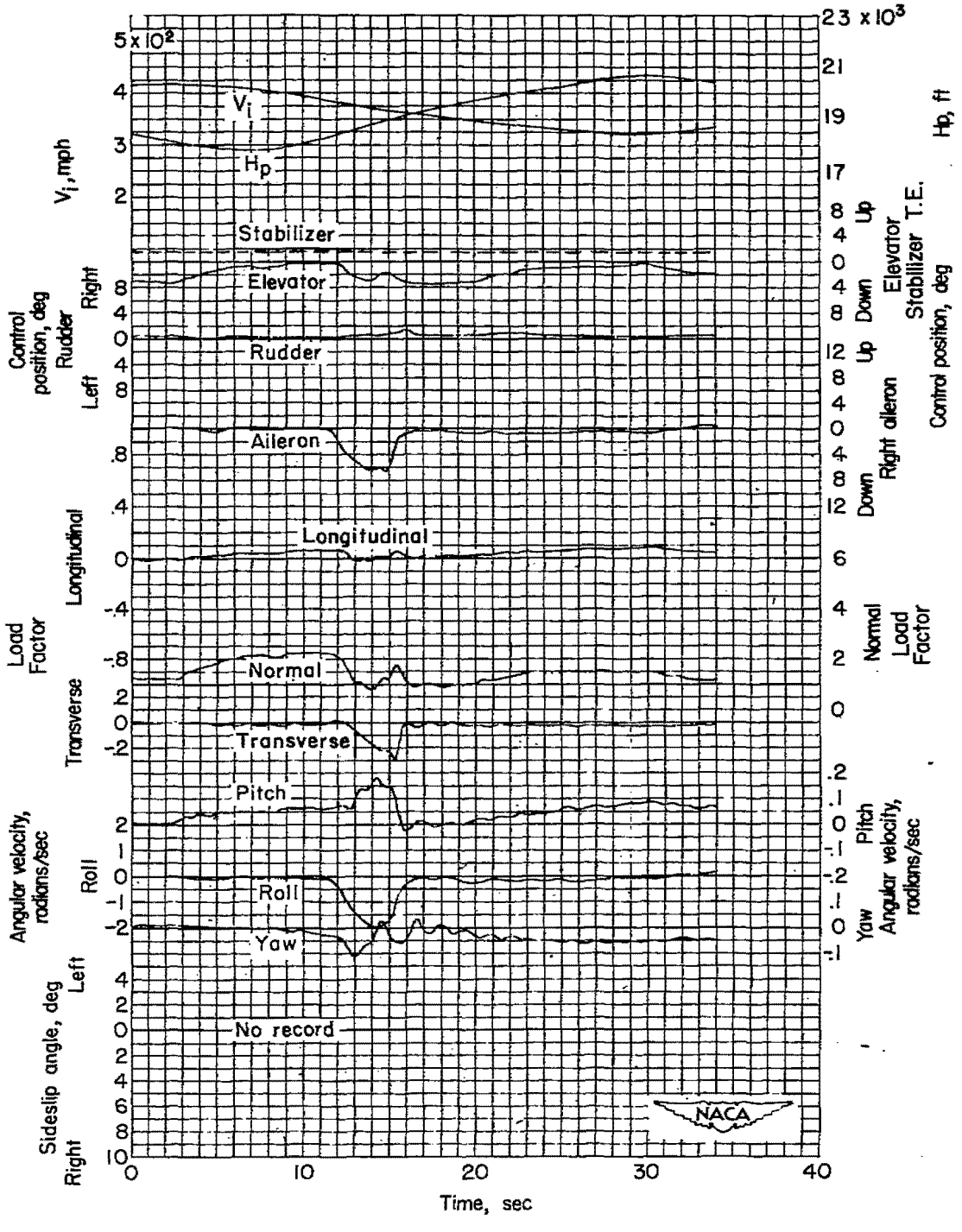


Figure 62.- Left barrel roll followed by a left climbing turn. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

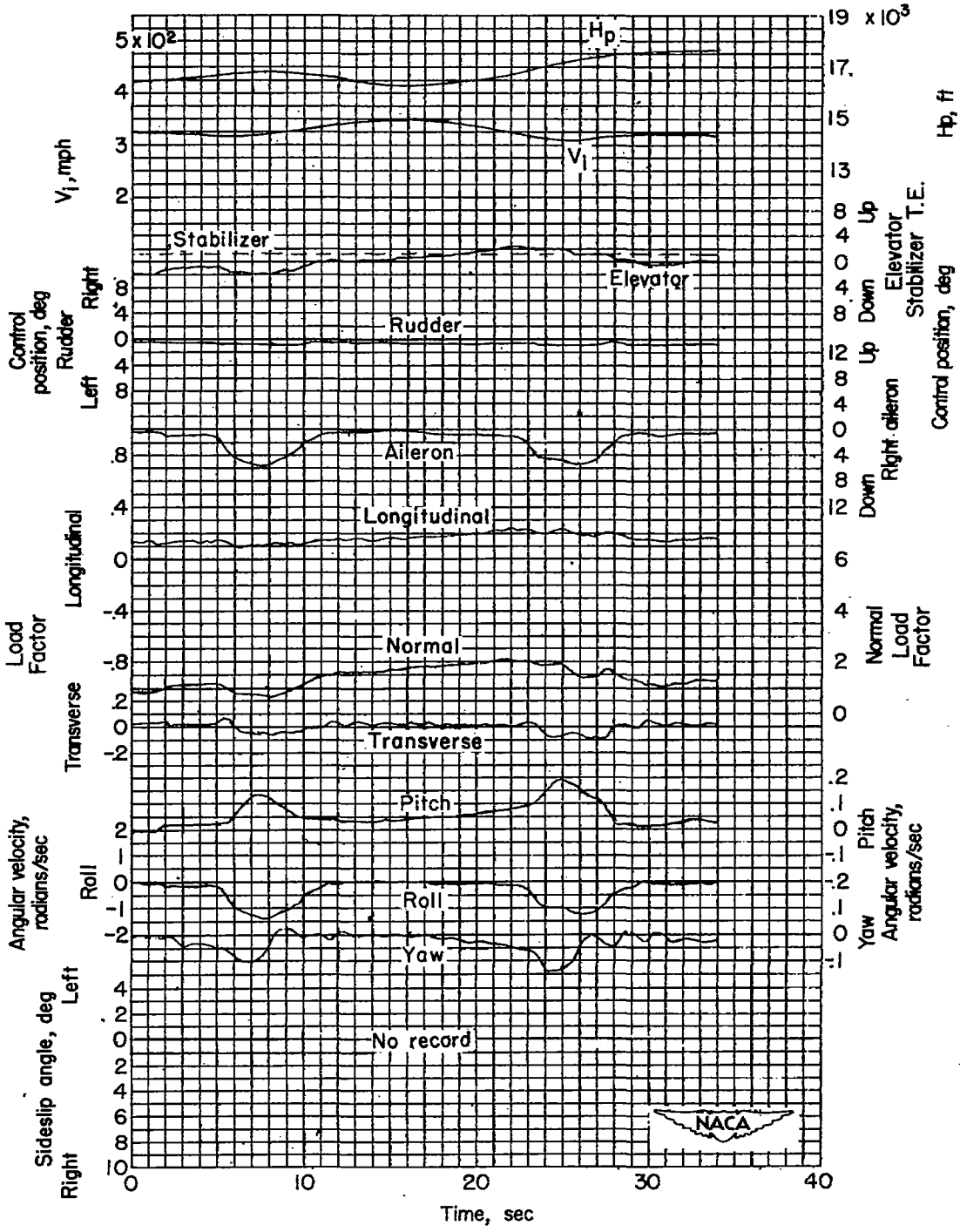


Figure 63.- Left barrel rolls. Airplane weight, 13,900 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

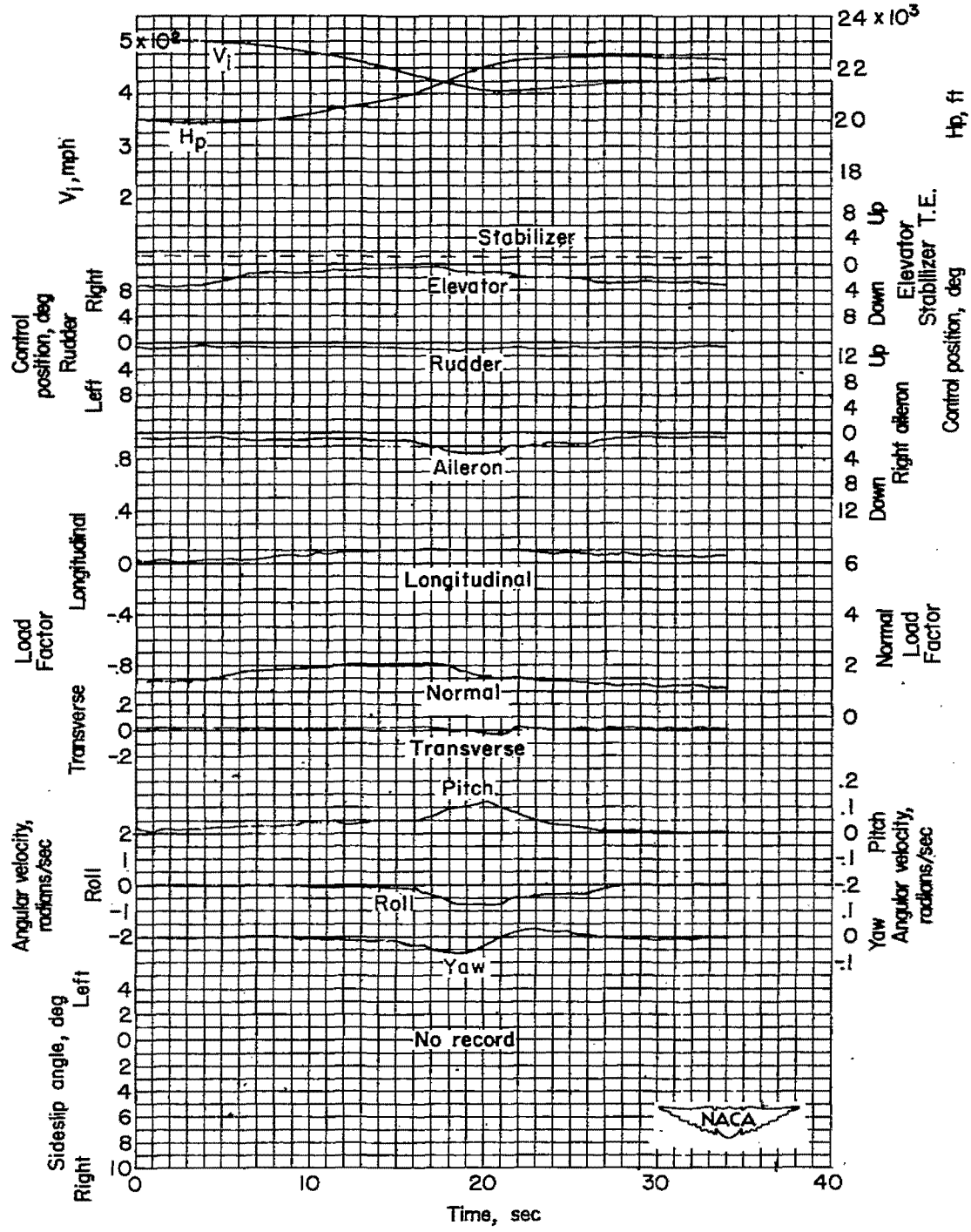


Figure 64.- Pull-up into a left barrel roll. Airplane weight, 13,550 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

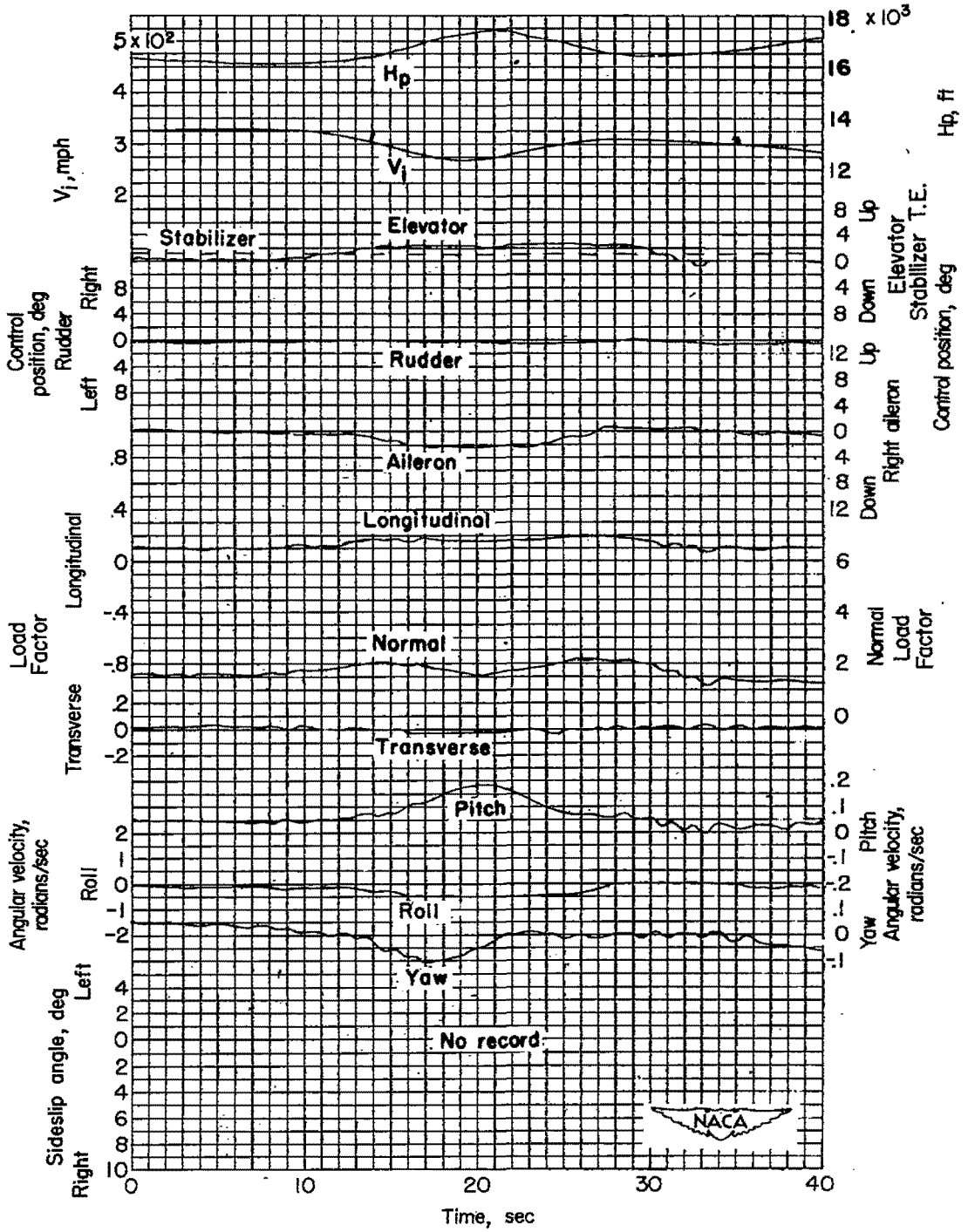


Figure 65.- Left barrel roll. Airplane weight, 13,050 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

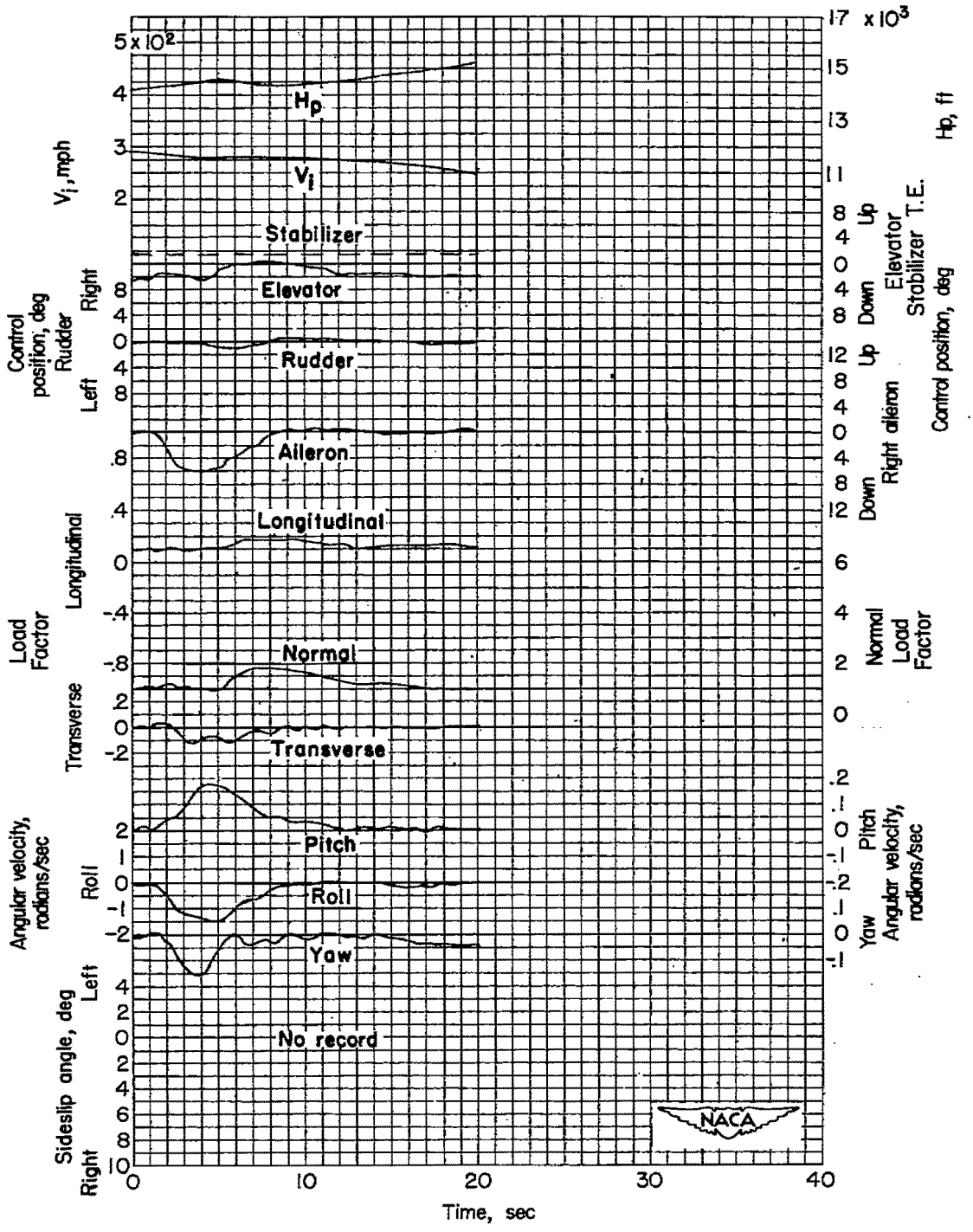


Figure 66.- Left barrel roll. Airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

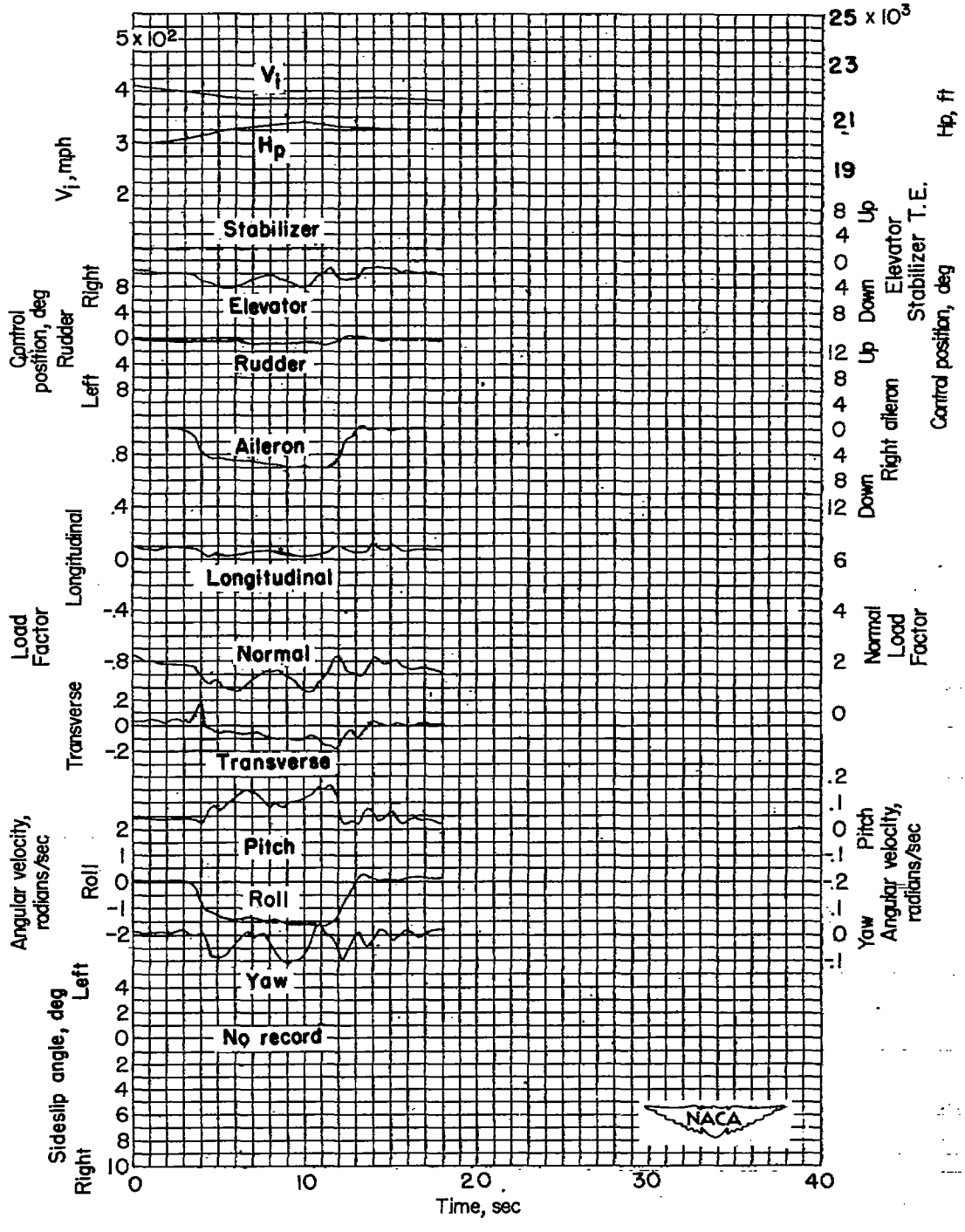


Figure 67.- Left barrel rolls. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

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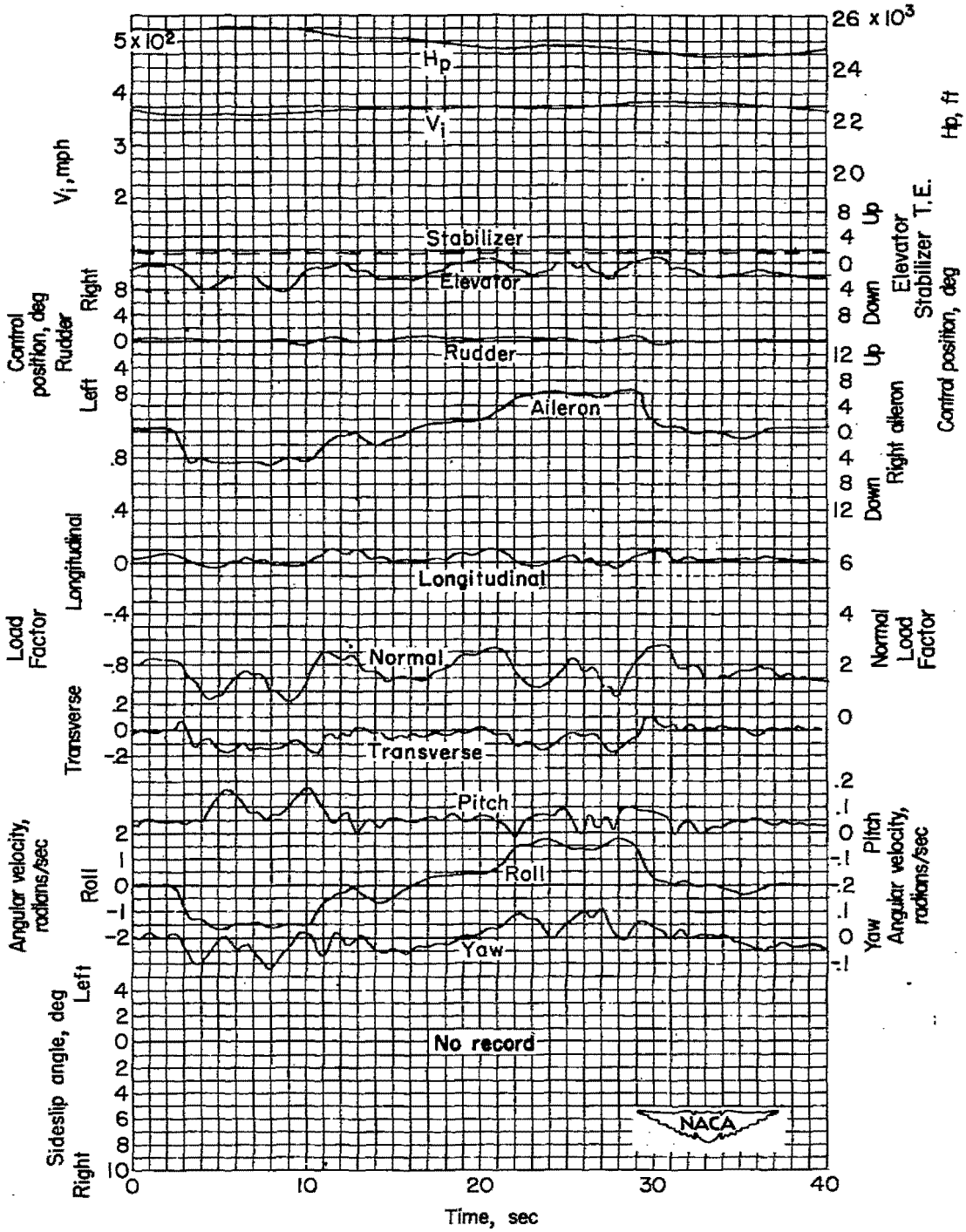


Figure 68.- Left and right barrel rolls. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

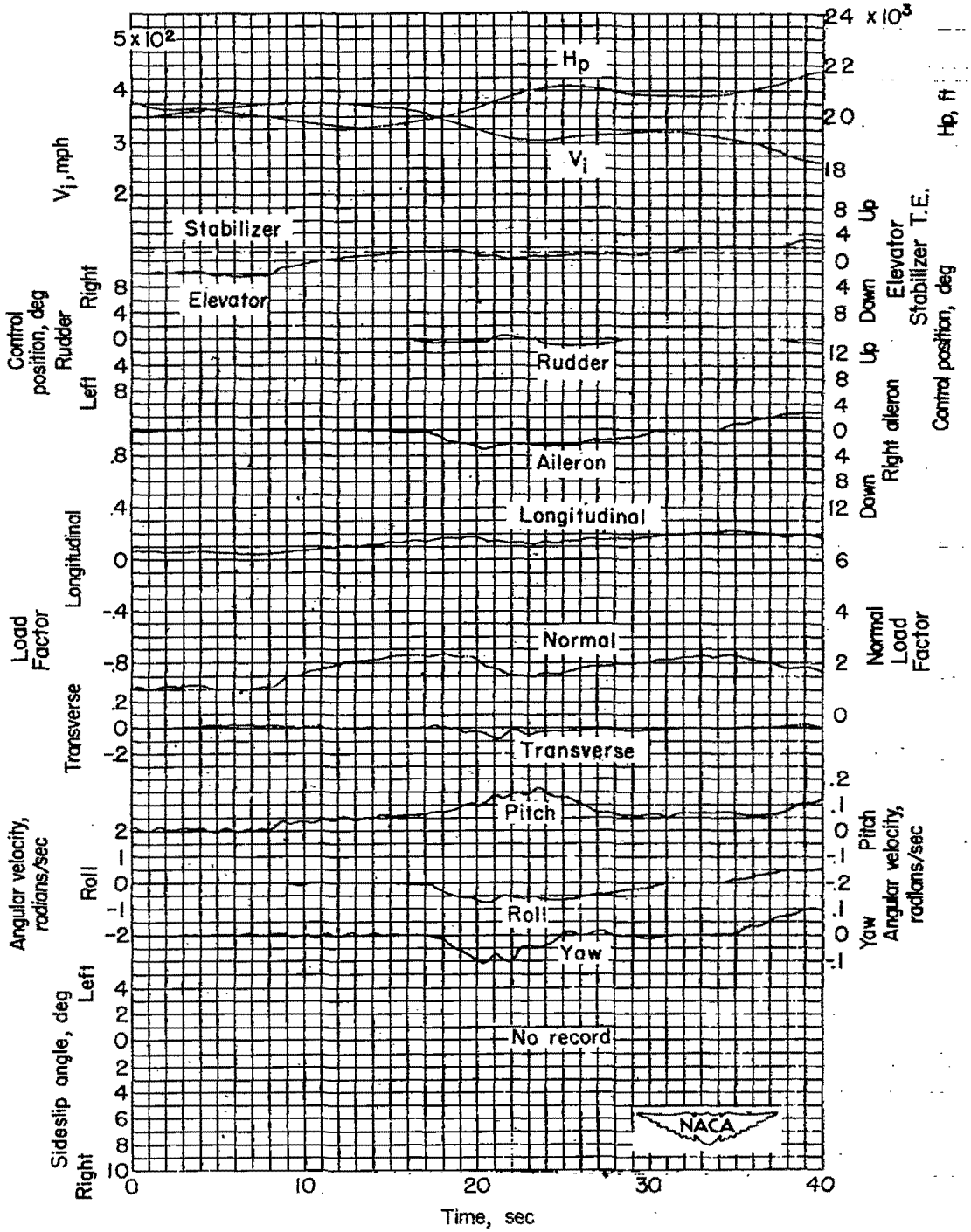


Figure 69.- Left and right barrel rolls. Airplane weight, 13,750 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

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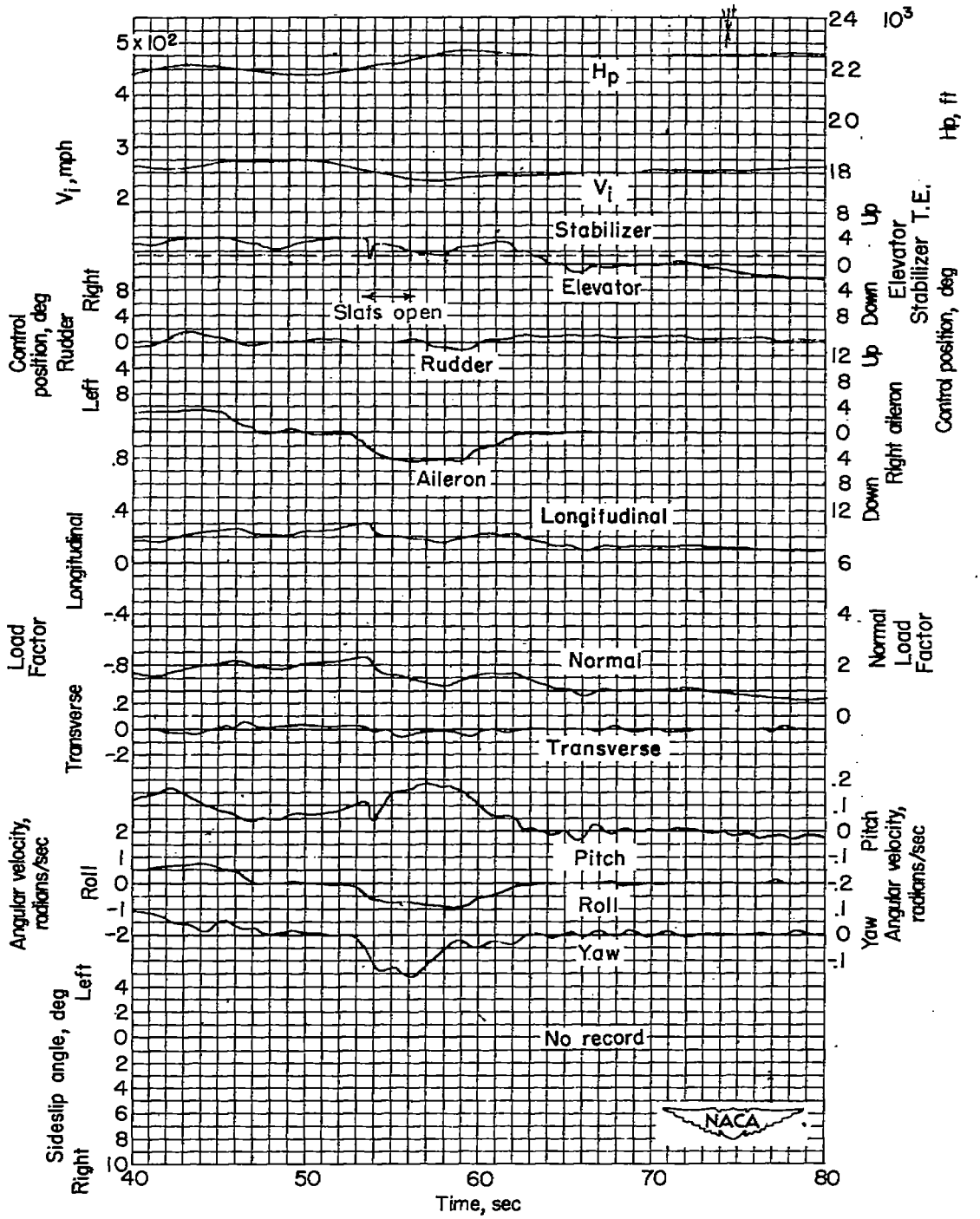


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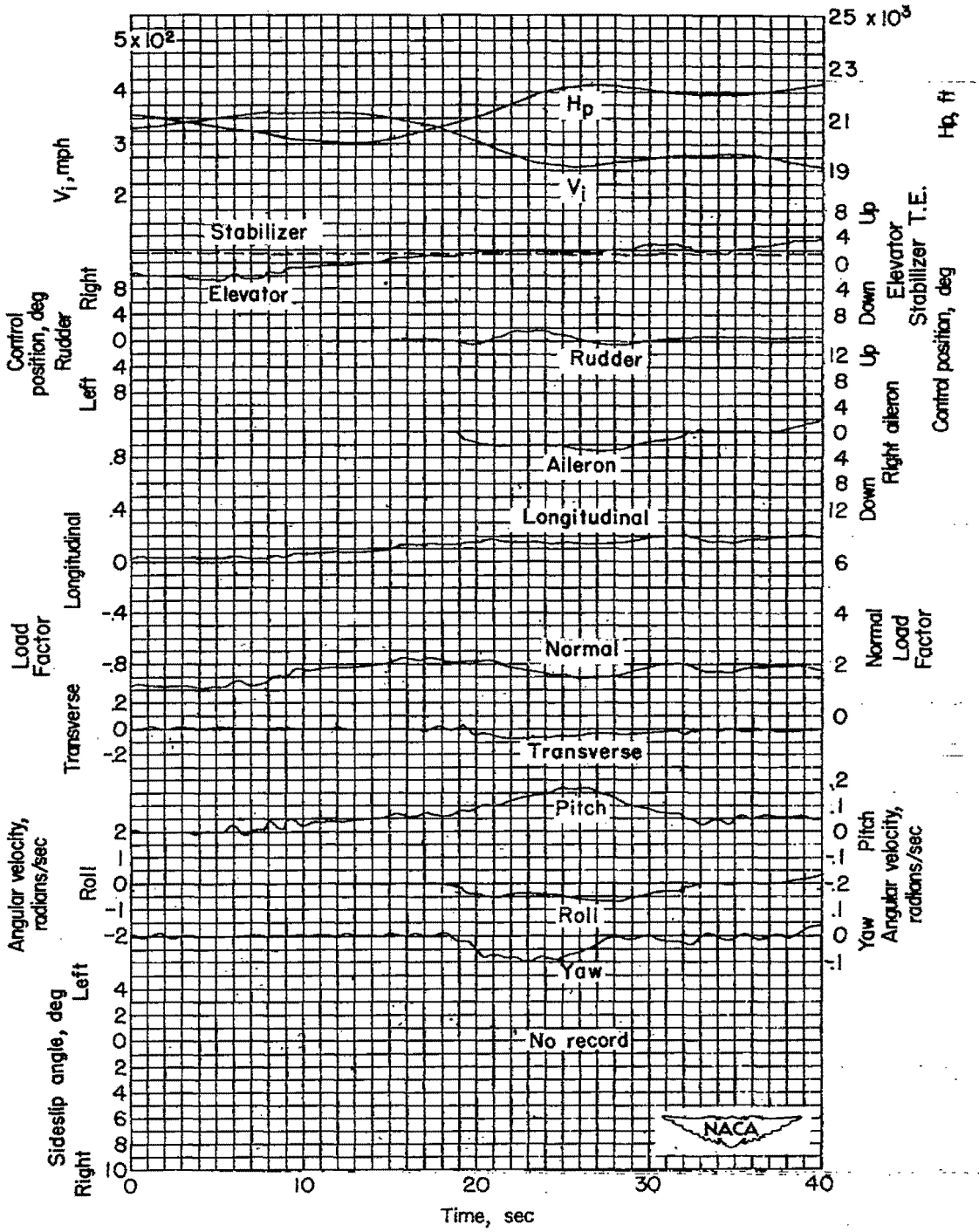


Figure 70.- Left and right barrel rolls followed by a left climbing turn. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

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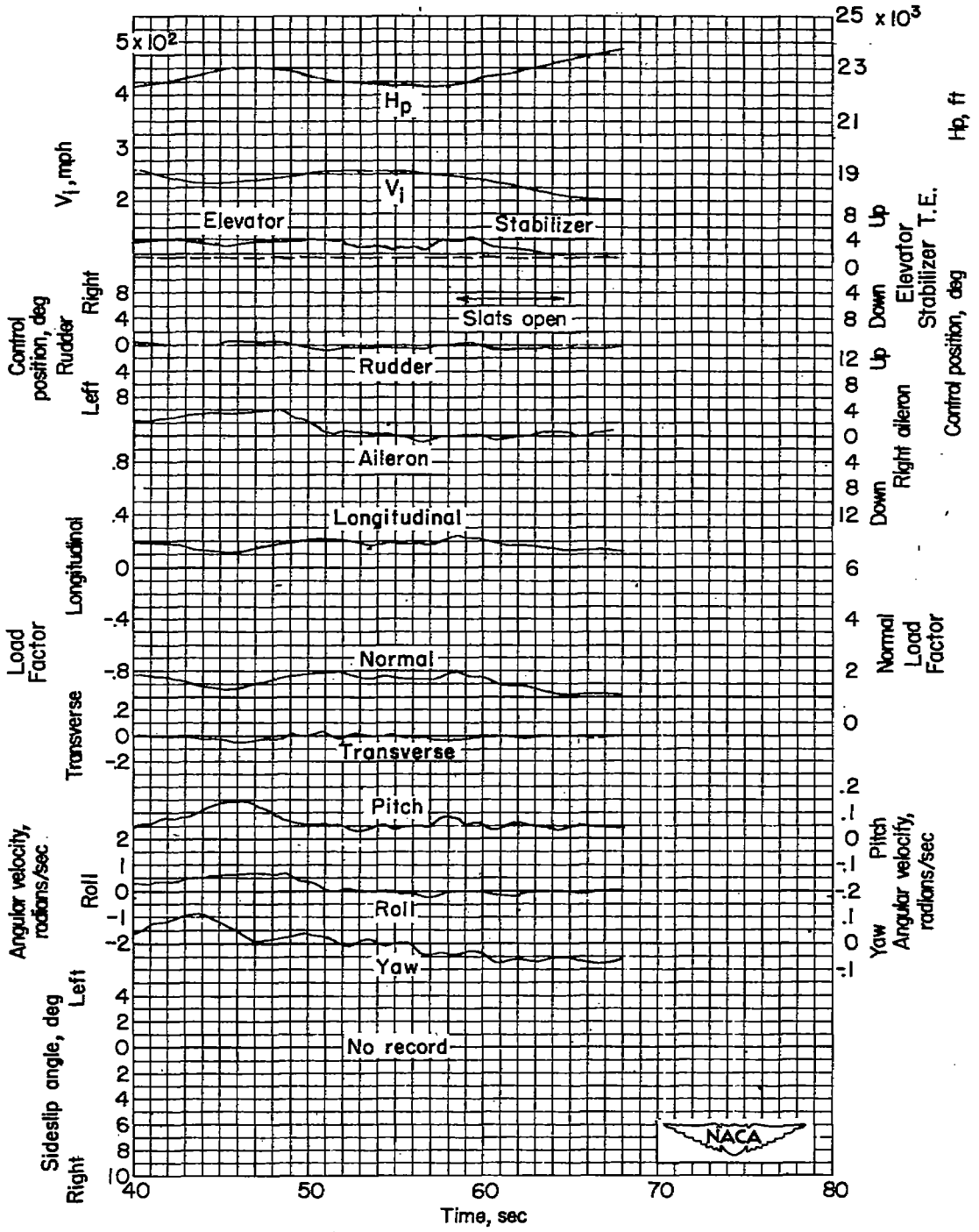


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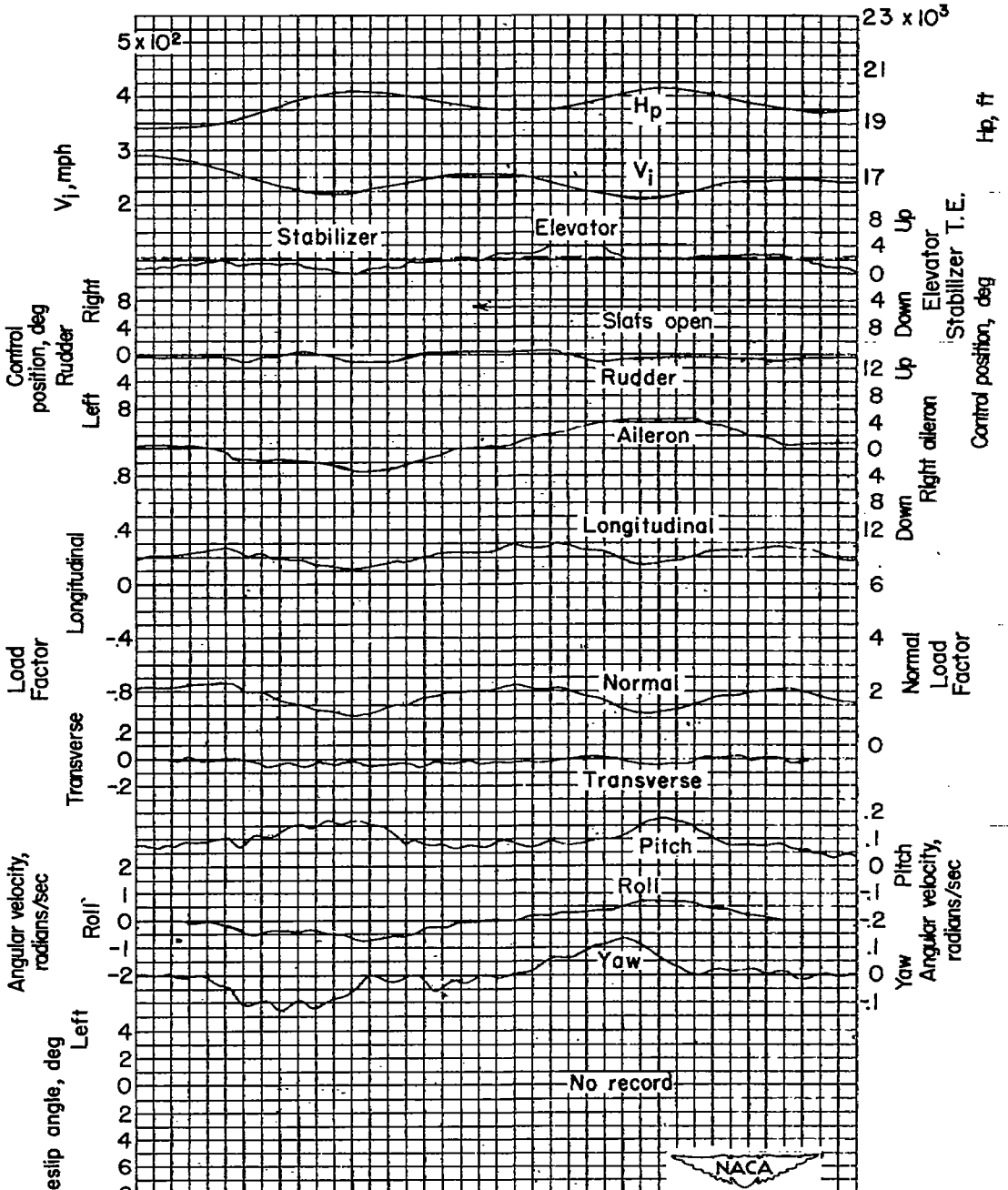


Figure 71.- Left and right barrel rolls. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

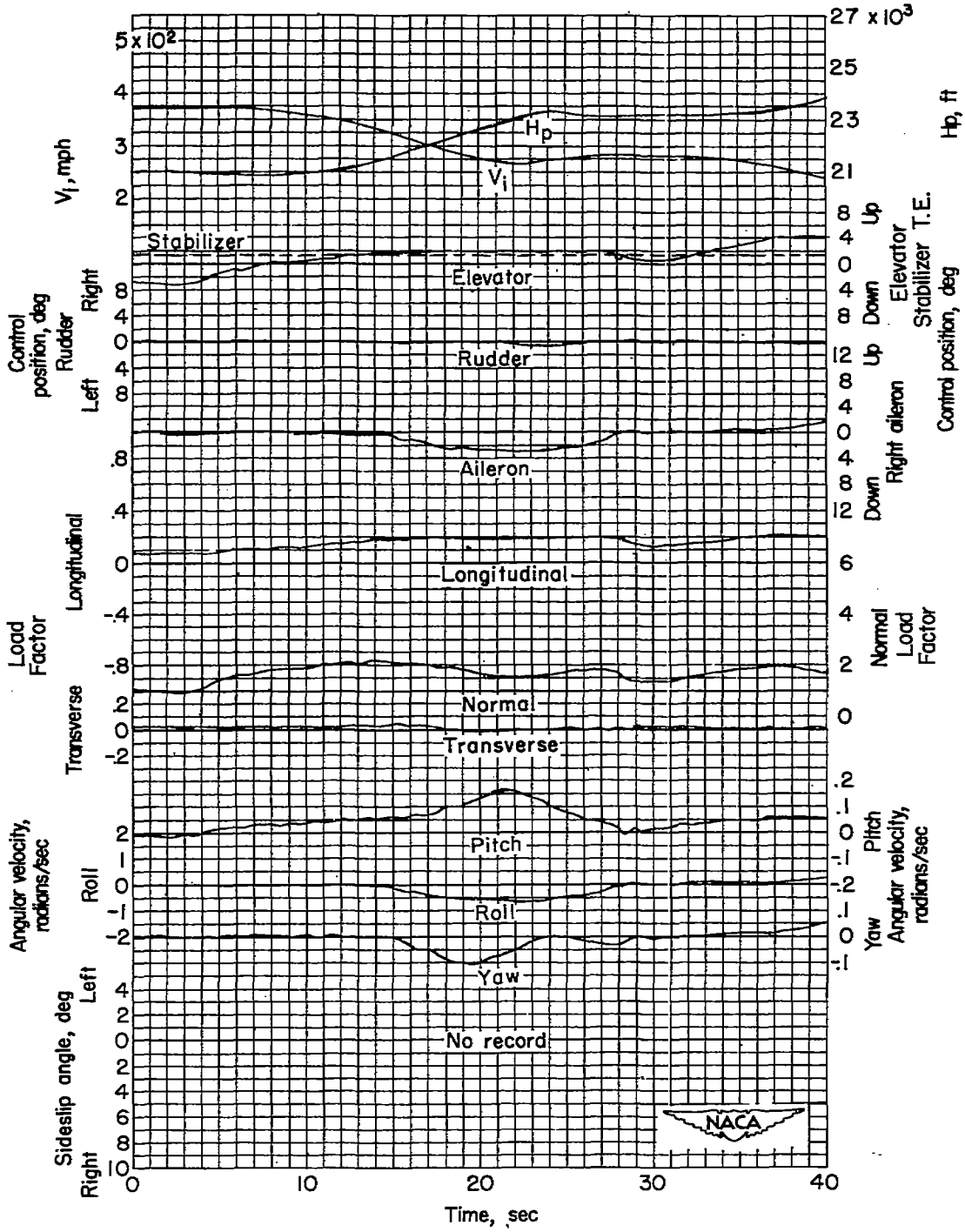


Figure 72.- Left and right barrel rolls followed by a left turn. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

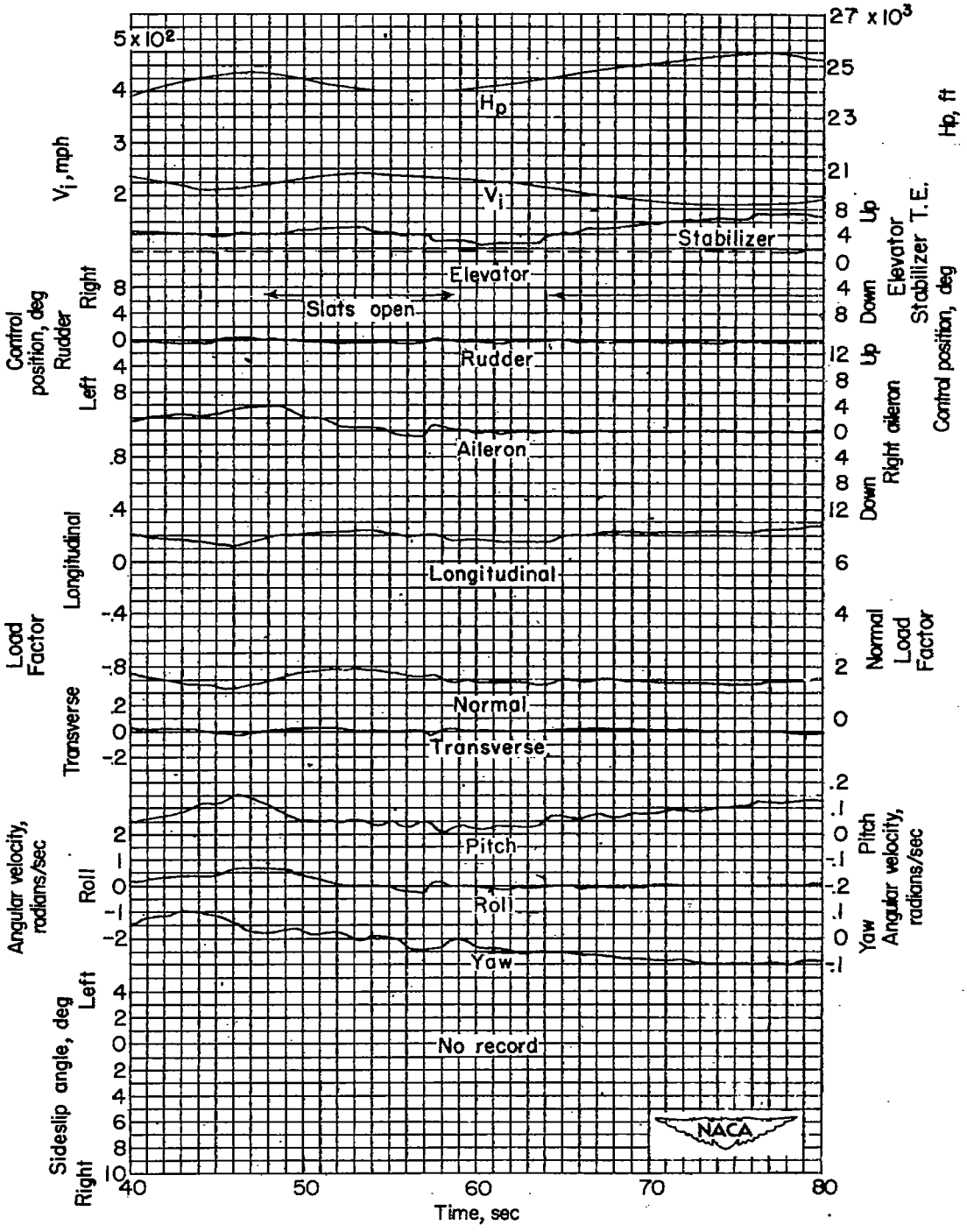


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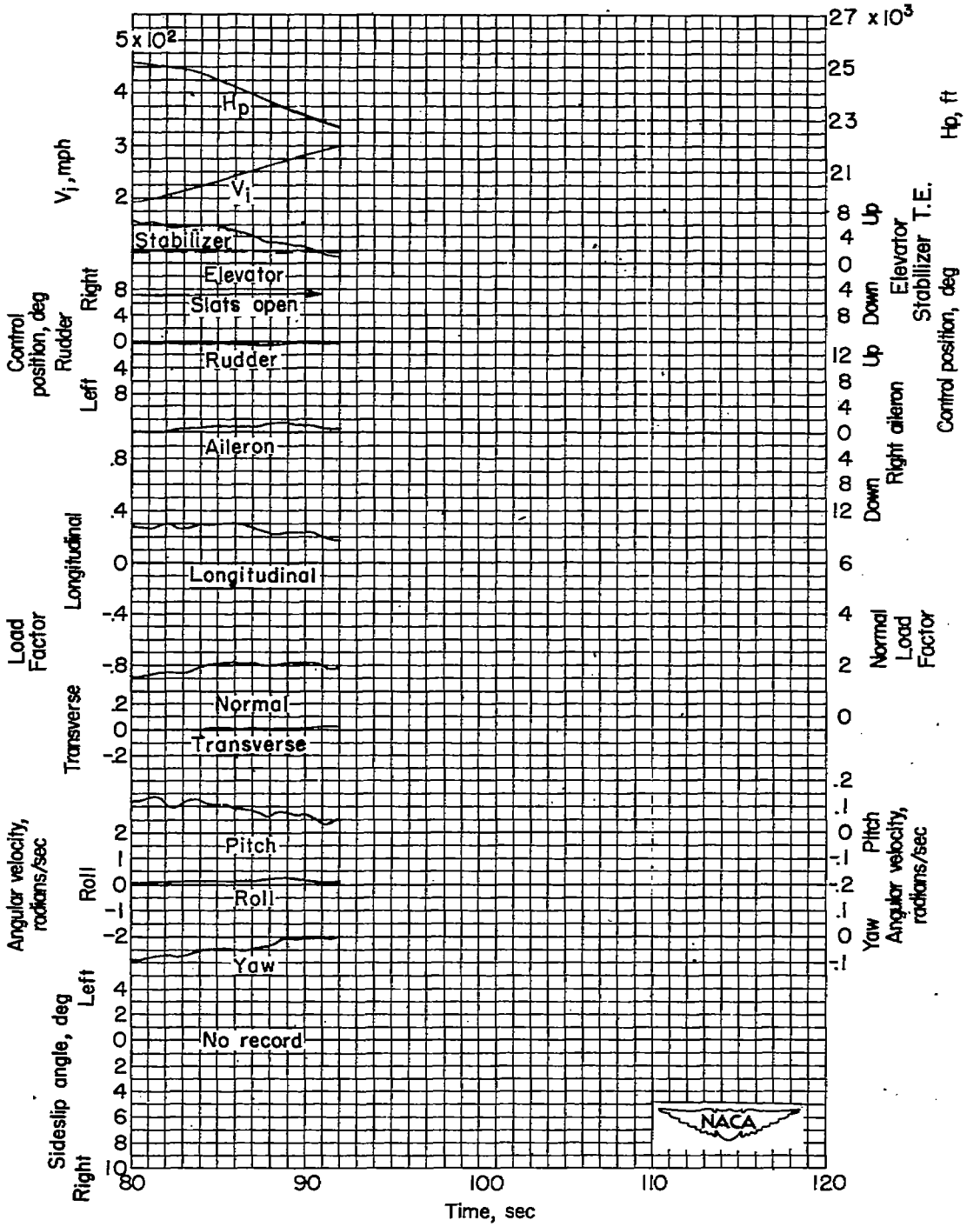


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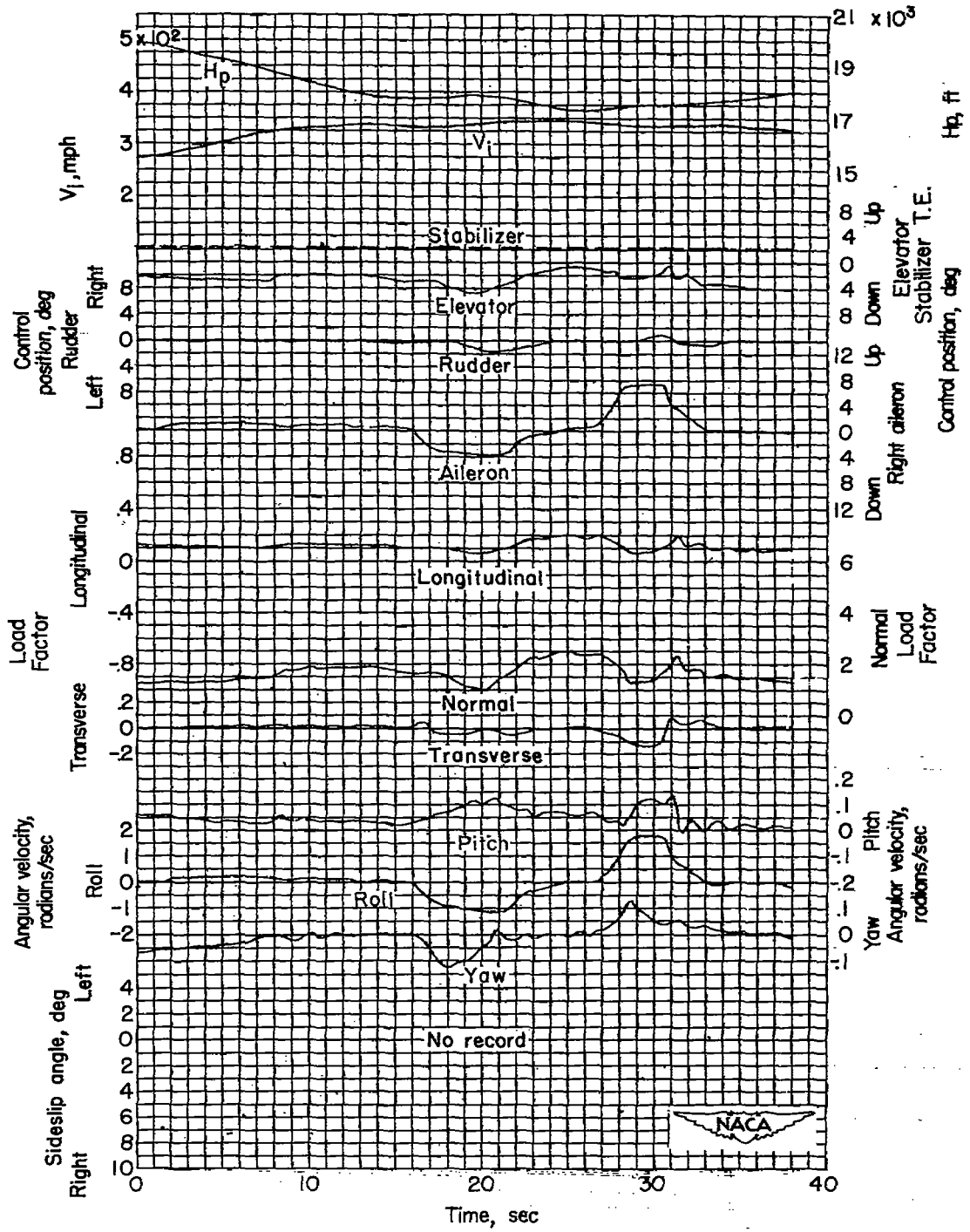


Figure 73.- Left and right barrel rolls. Airplane weight, 13,550 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

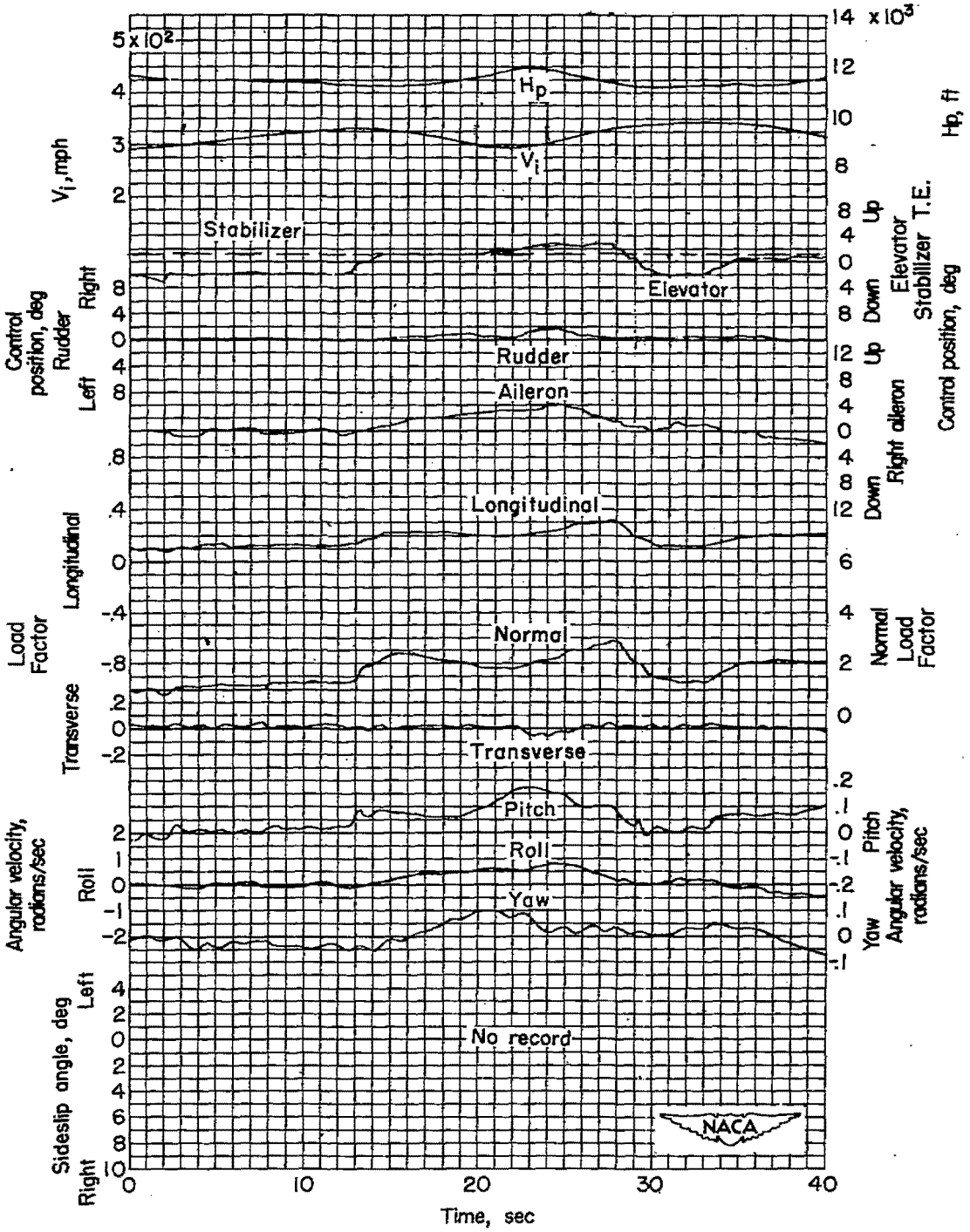


Figure 74.- Right and left barrel rolls. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

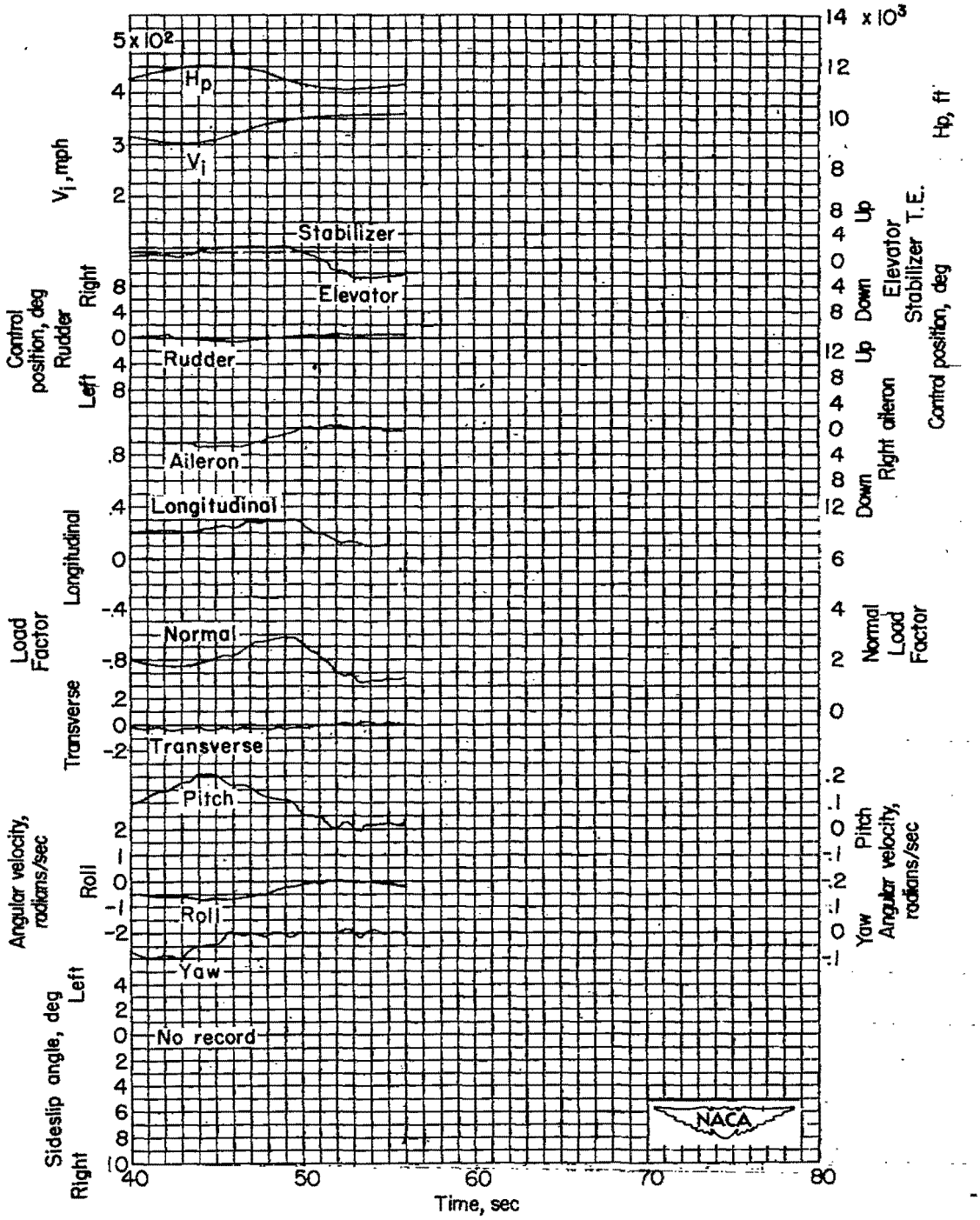


Figure 74.- Concluded.

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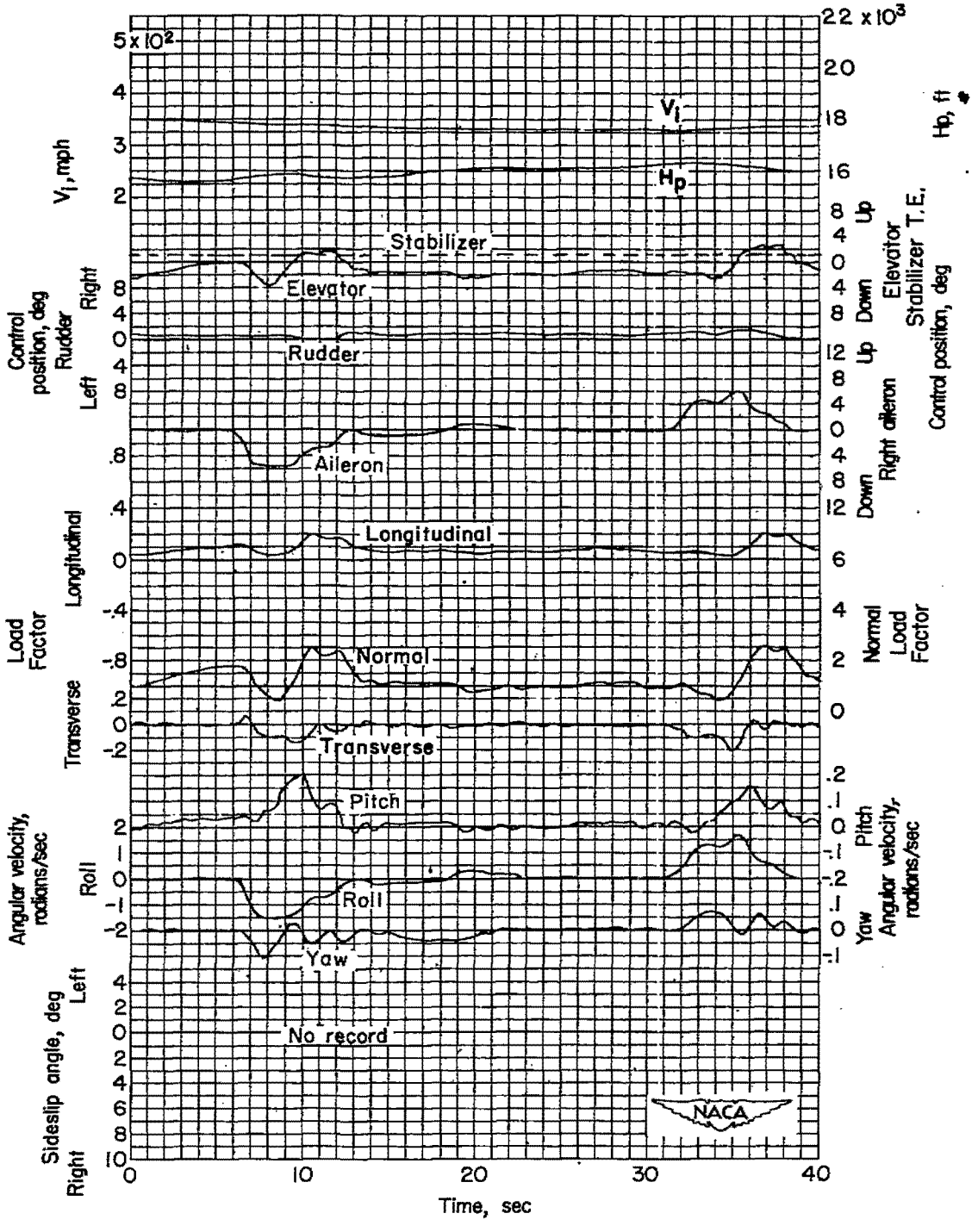


Figure 75.- Left and right barrel rolls. Airplane weight, 12,350 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

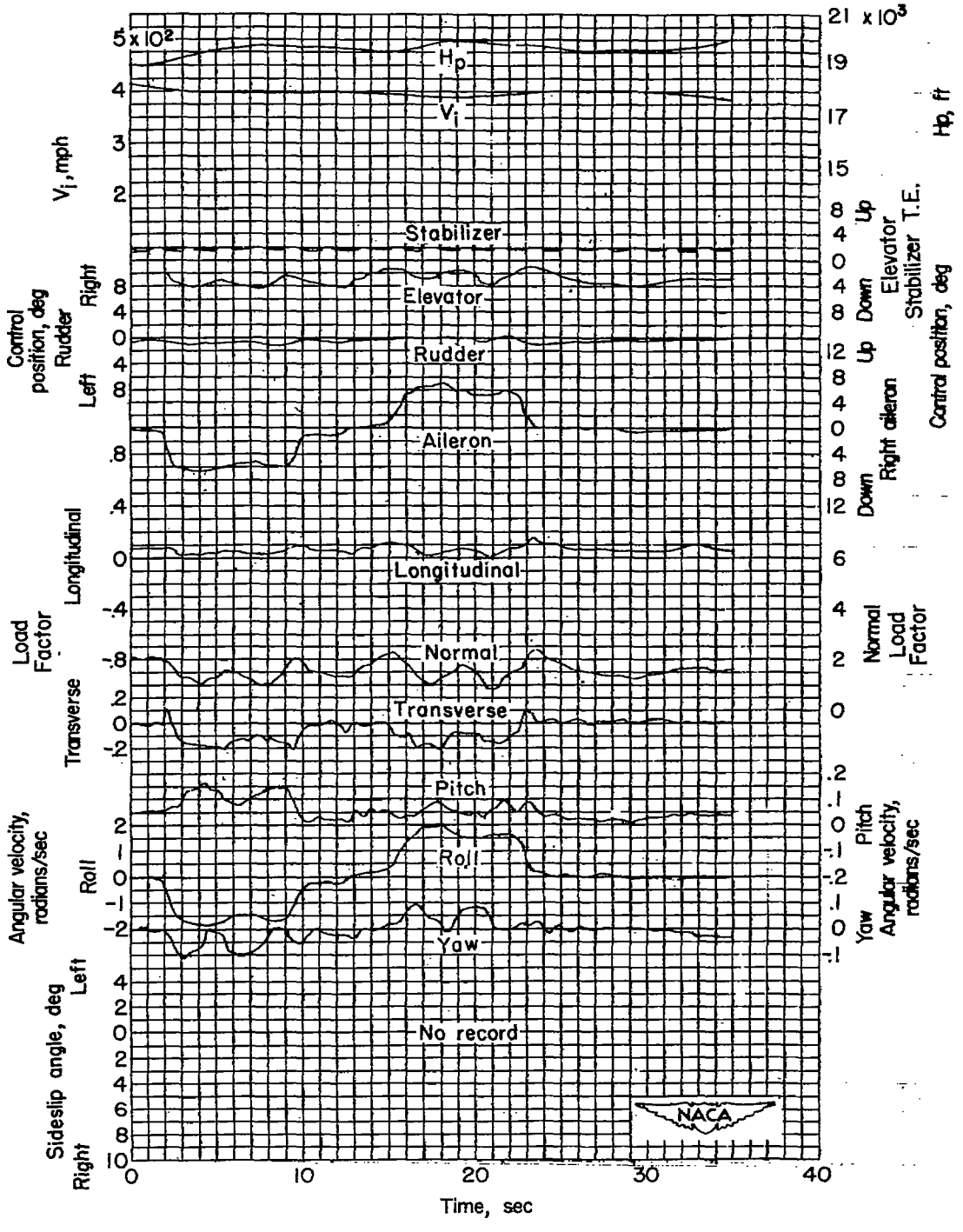


Figure 76.- Left and right barrel rolls. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

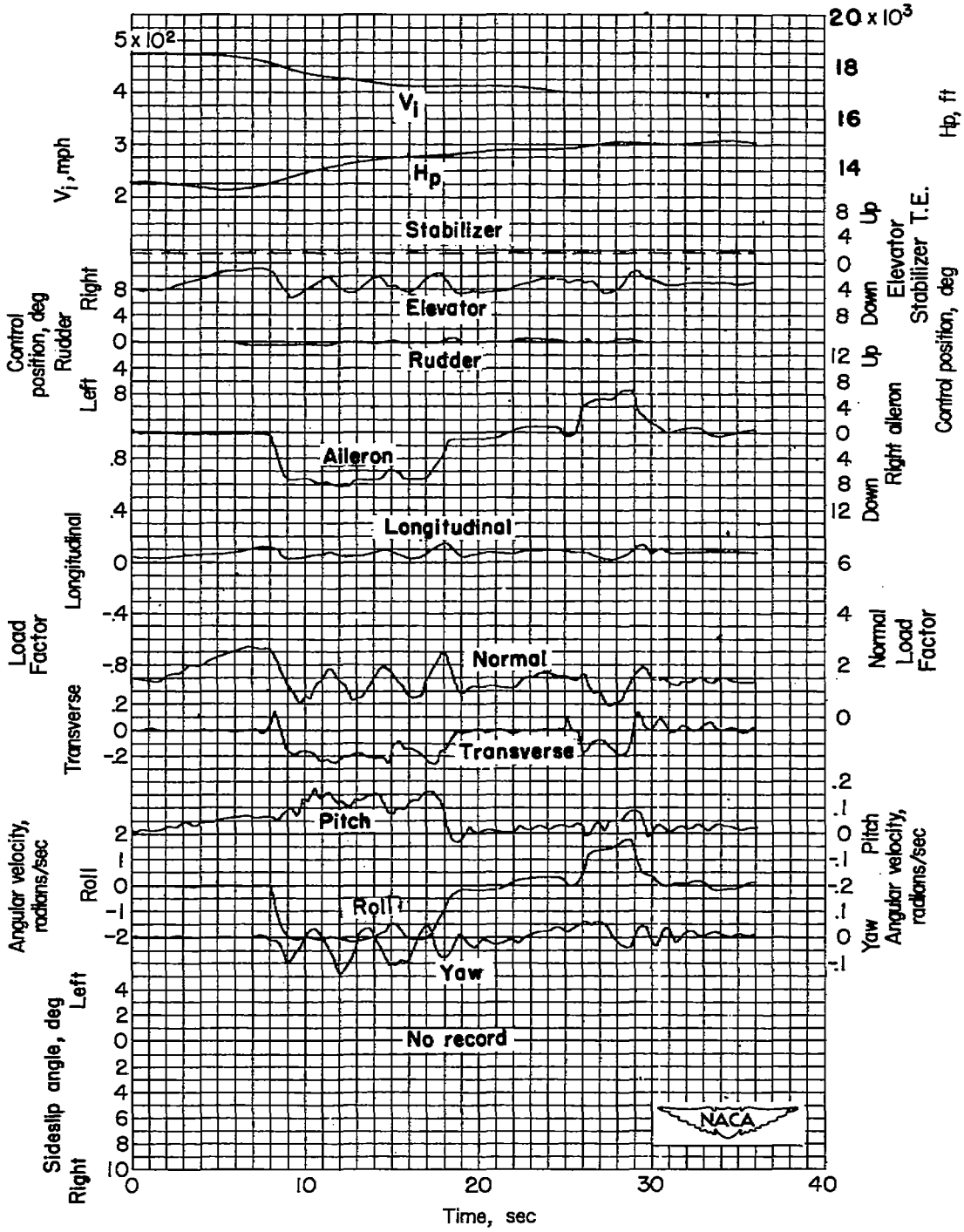


Figure 77.- Left and right barrel rolls. Airplane weight, 12,200 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

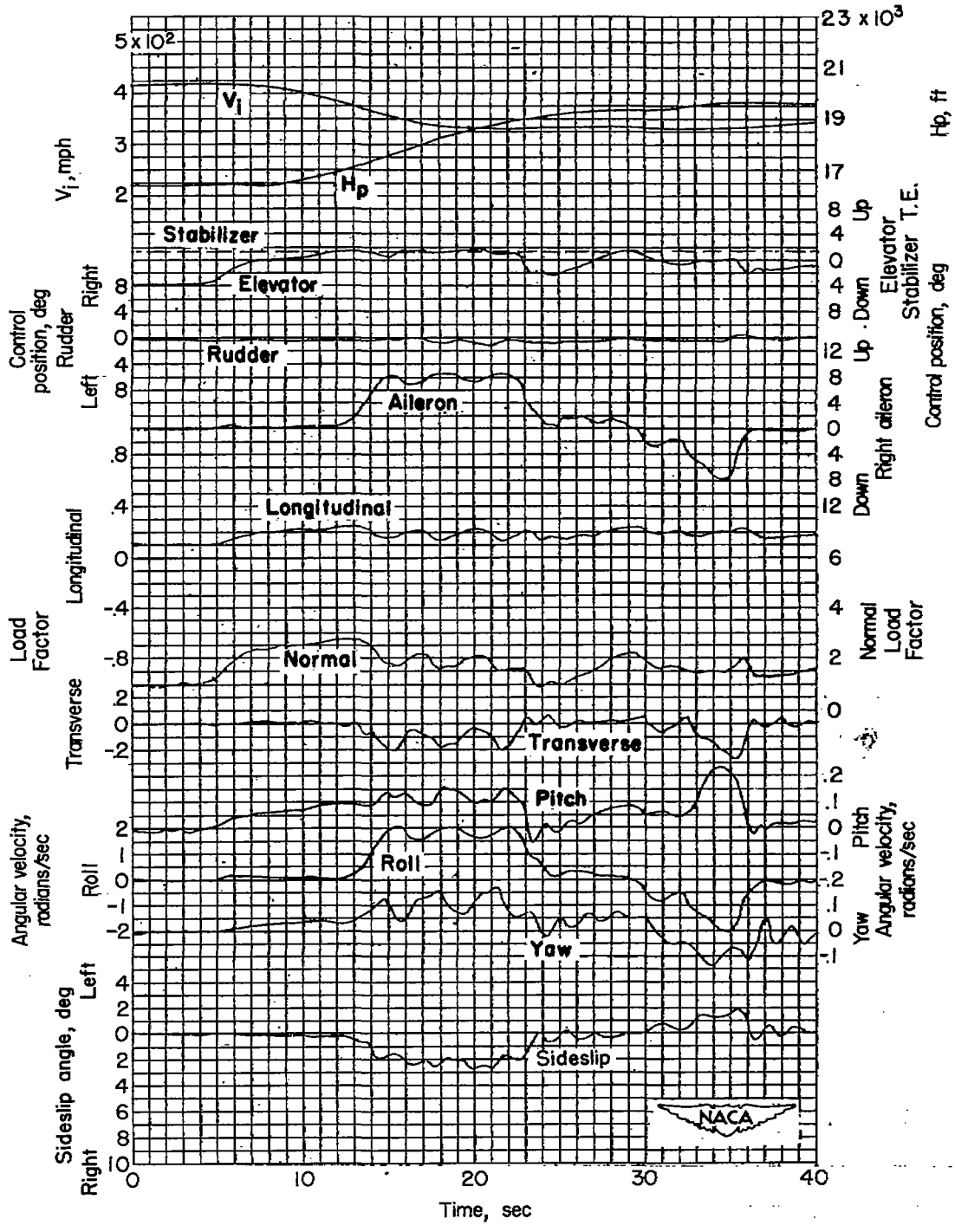


Figure 78.- Right and left barrel rolls. Airplane weight, 13,150 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

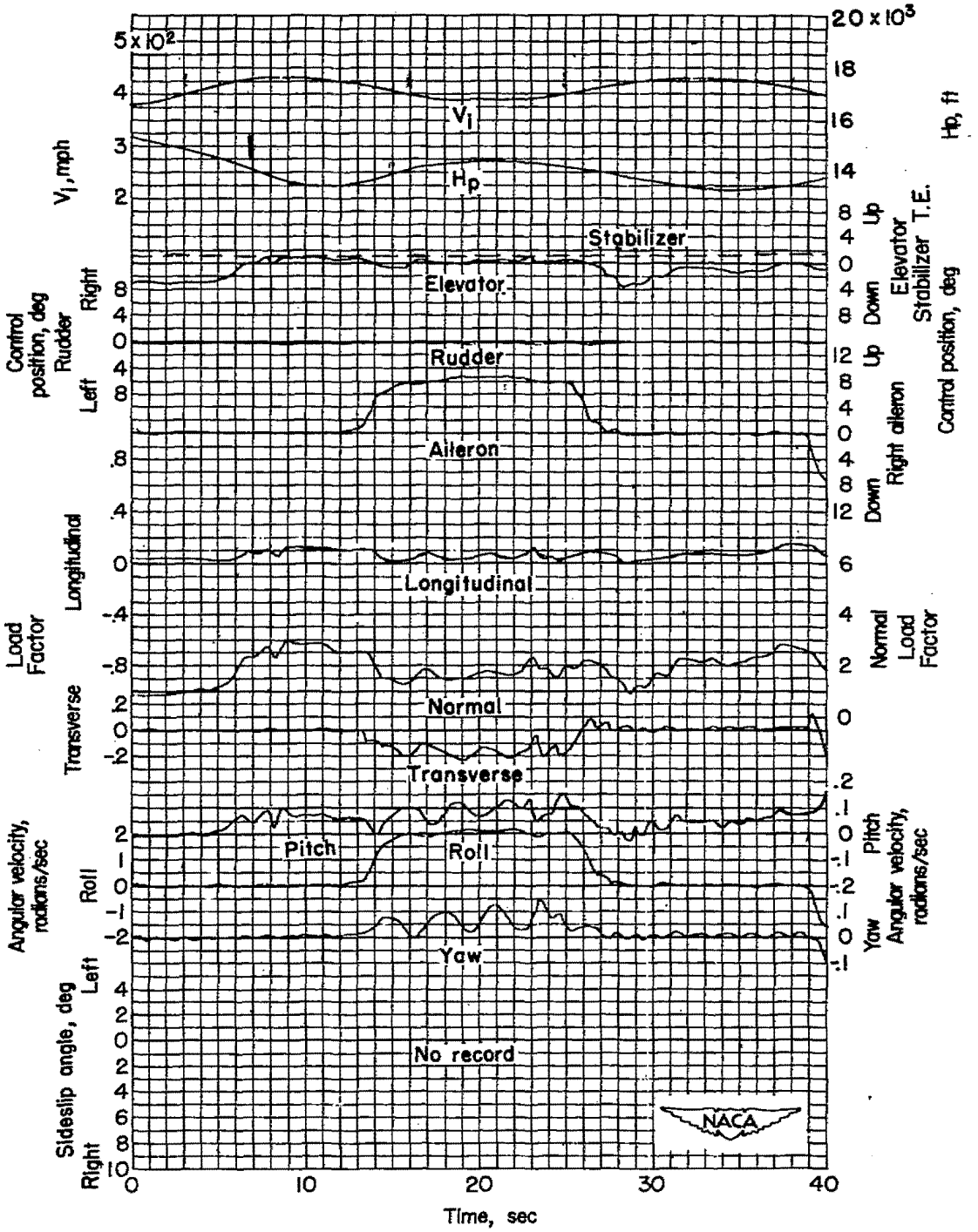


Figure 79.- Right and left barrel rolls. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

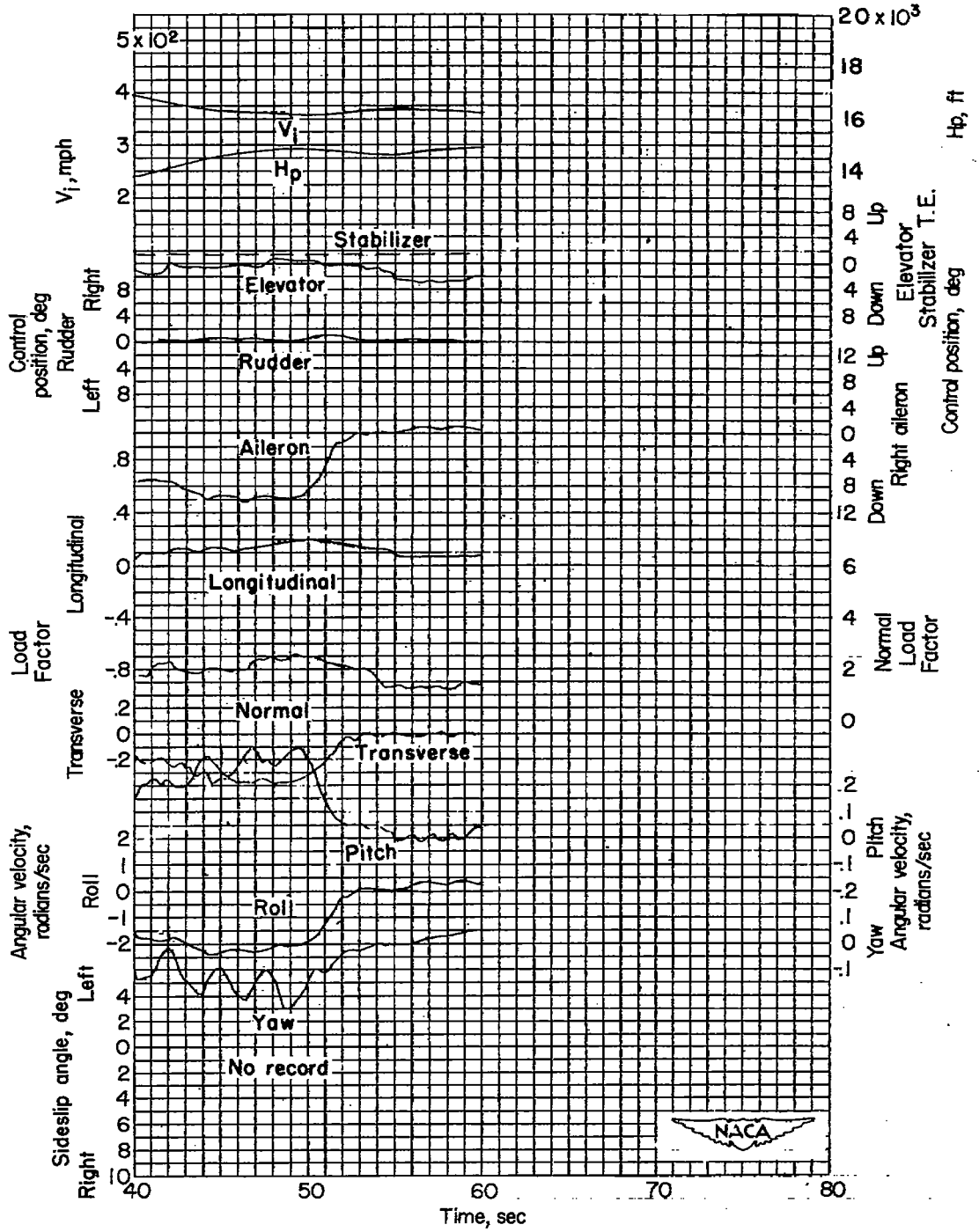


Figure 79.- Concluded.

[redacted]

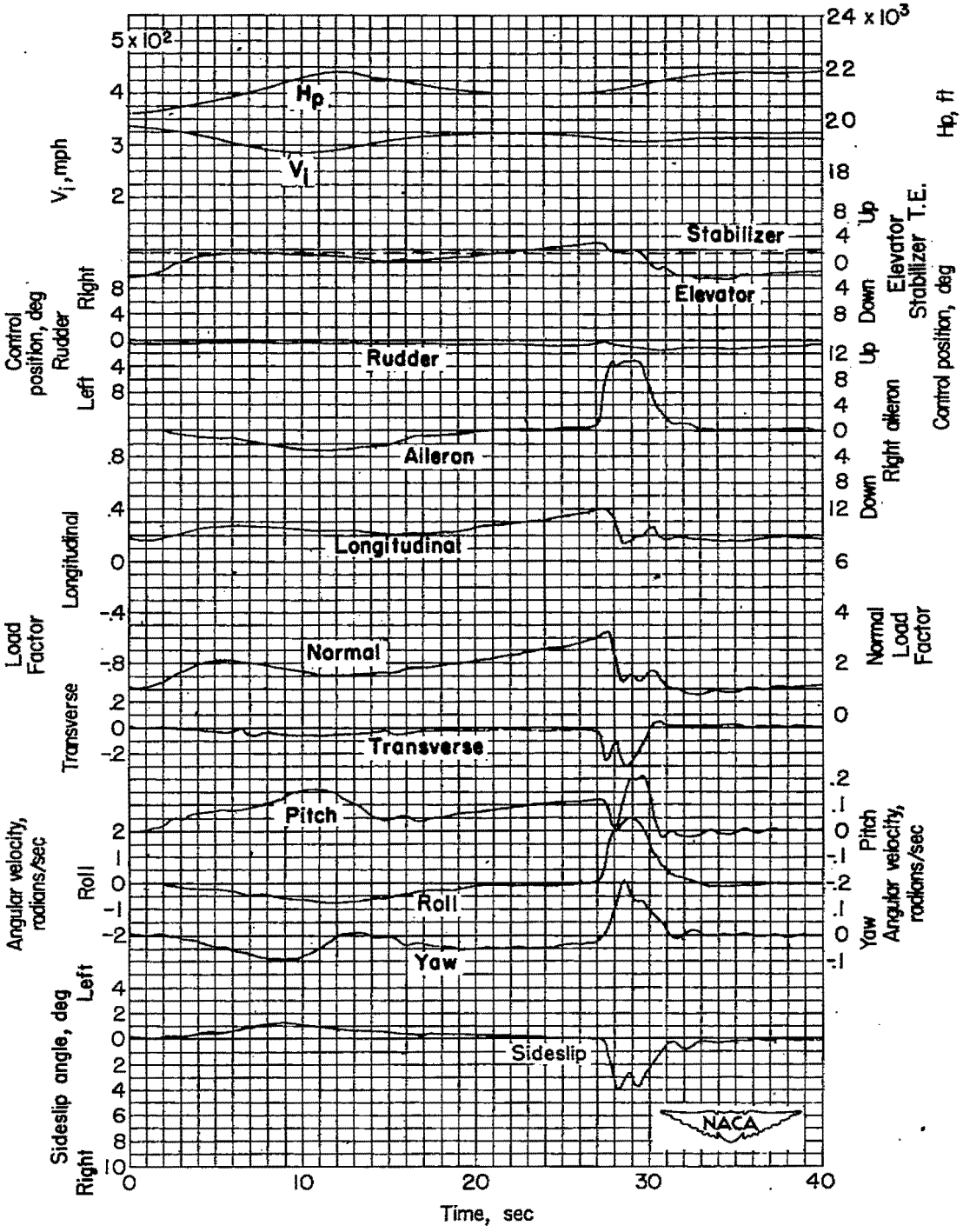


Figure 80.- Left and right barrel rolls. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

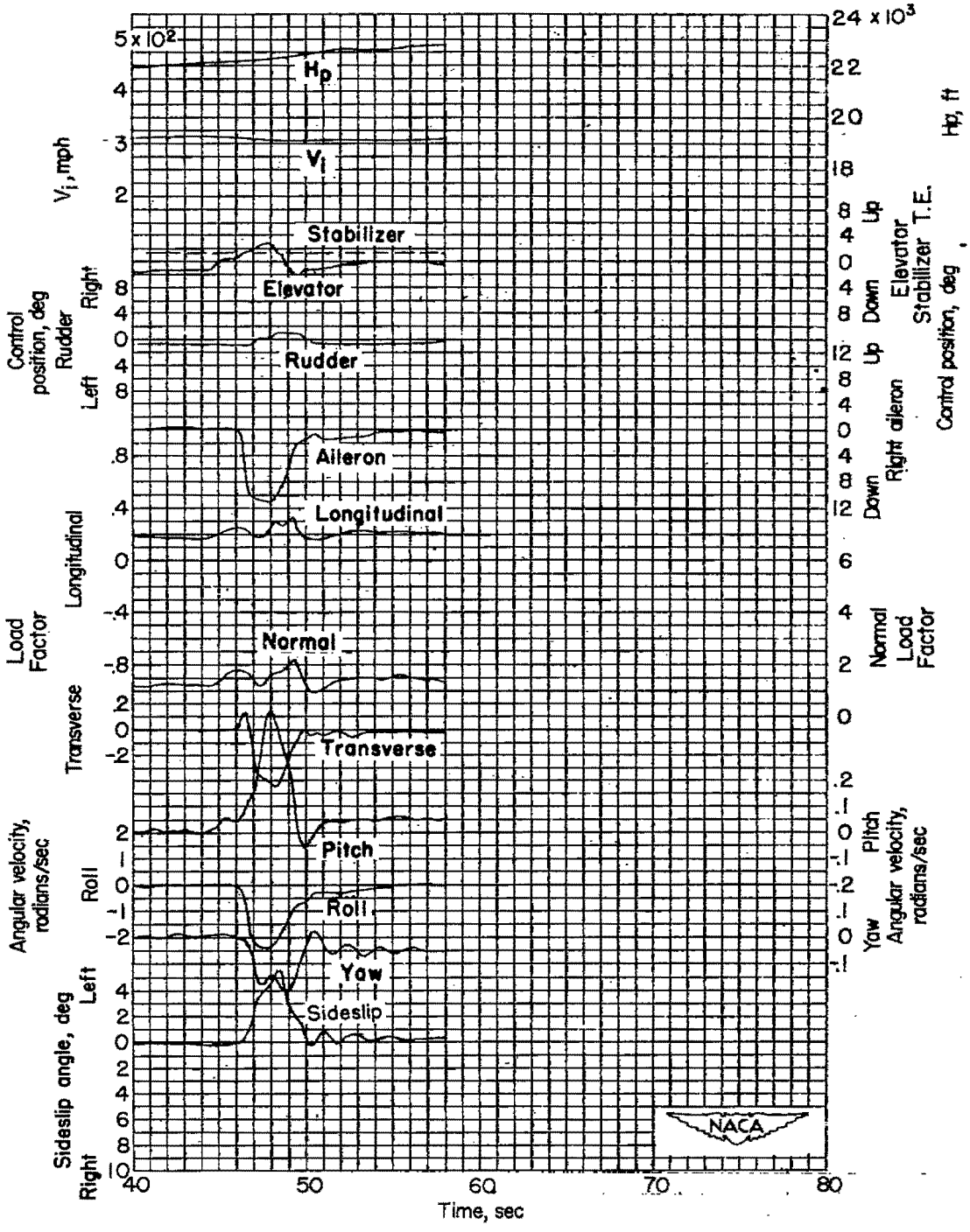


Figure 80.- Concluded.

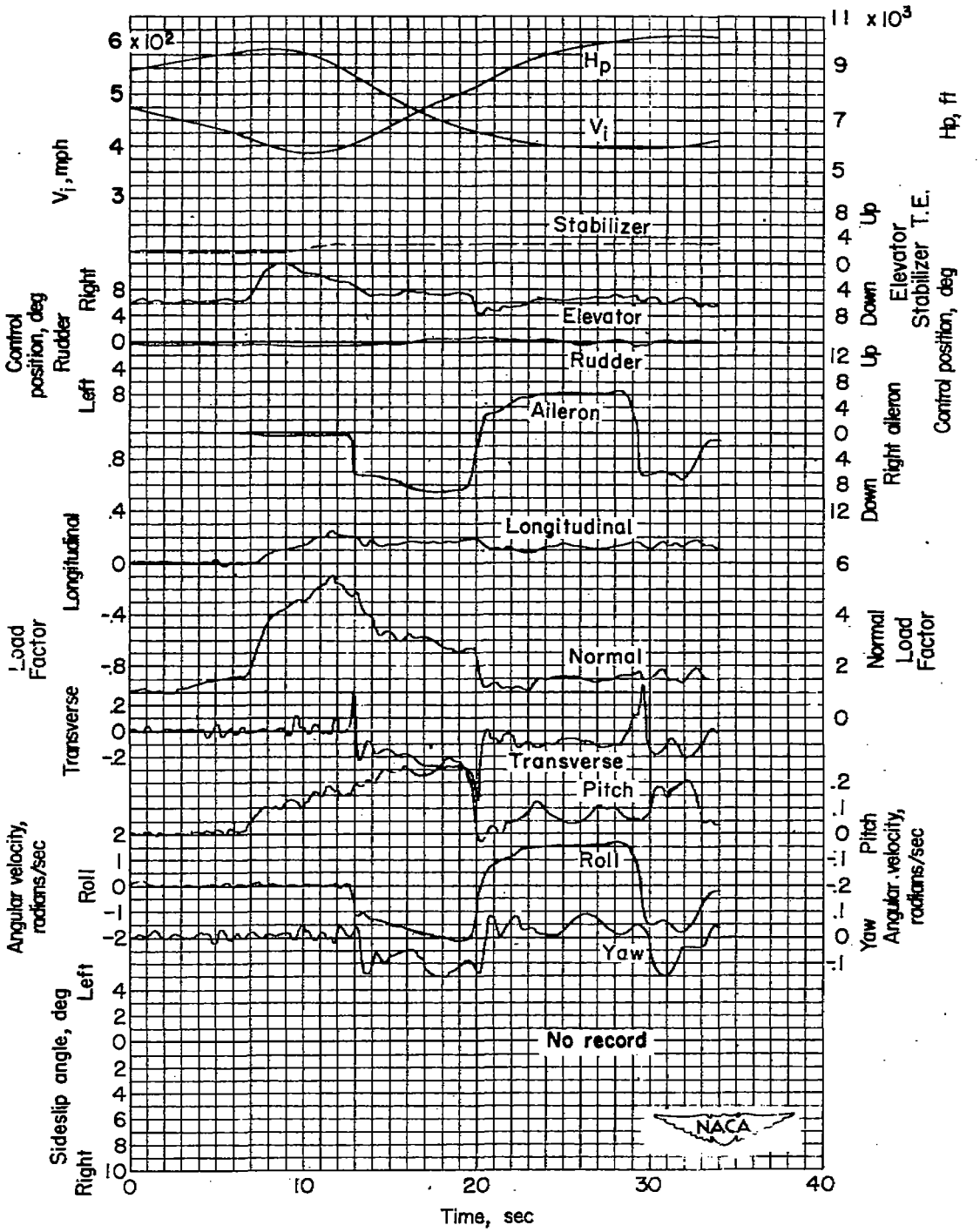


Figure 81.- Dive and pull-out followed by left and right barrel rolls. Airplane weight, 13,700 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

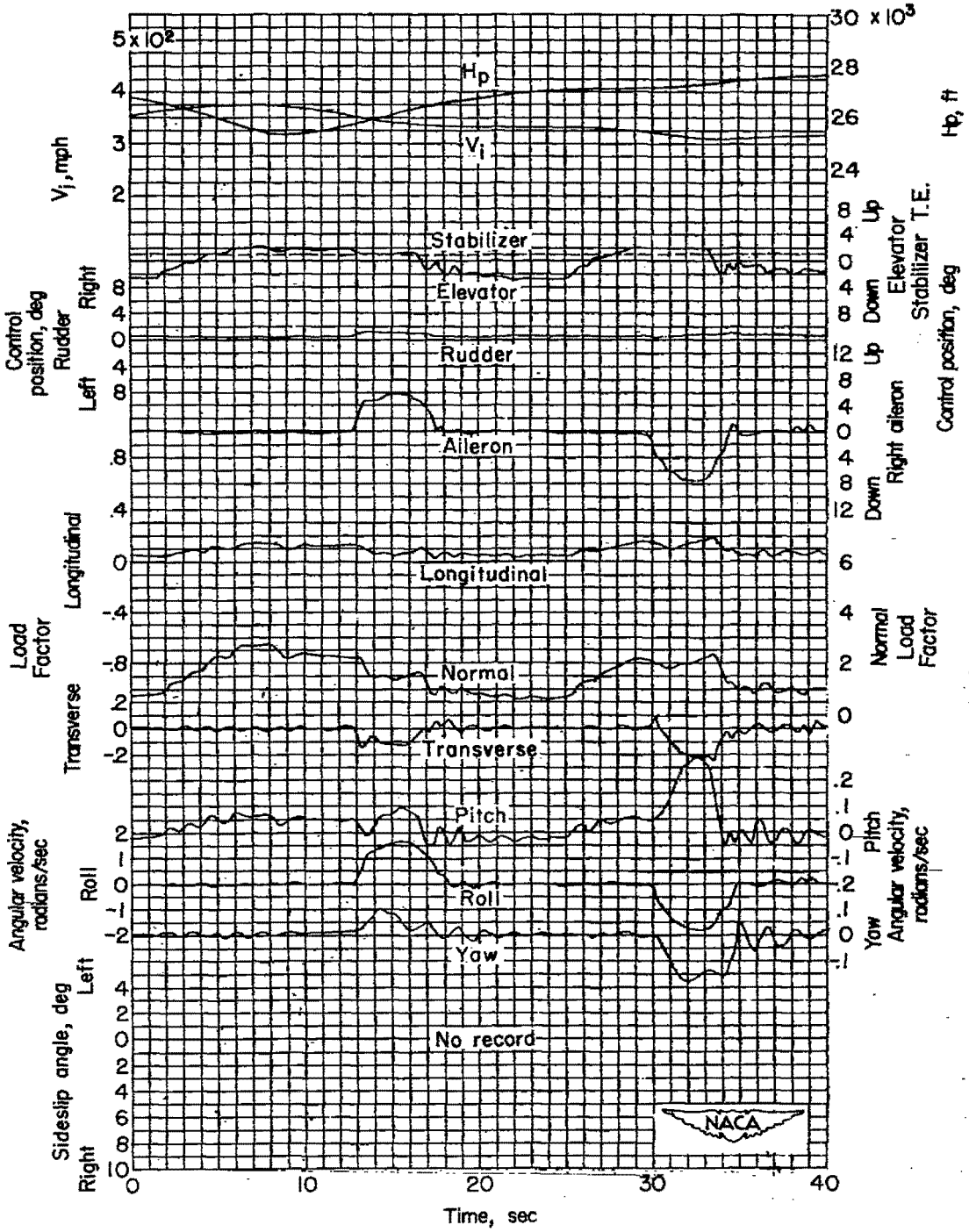


Figure 82.- Dive and pull-out followed by right and left barrel rolls. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

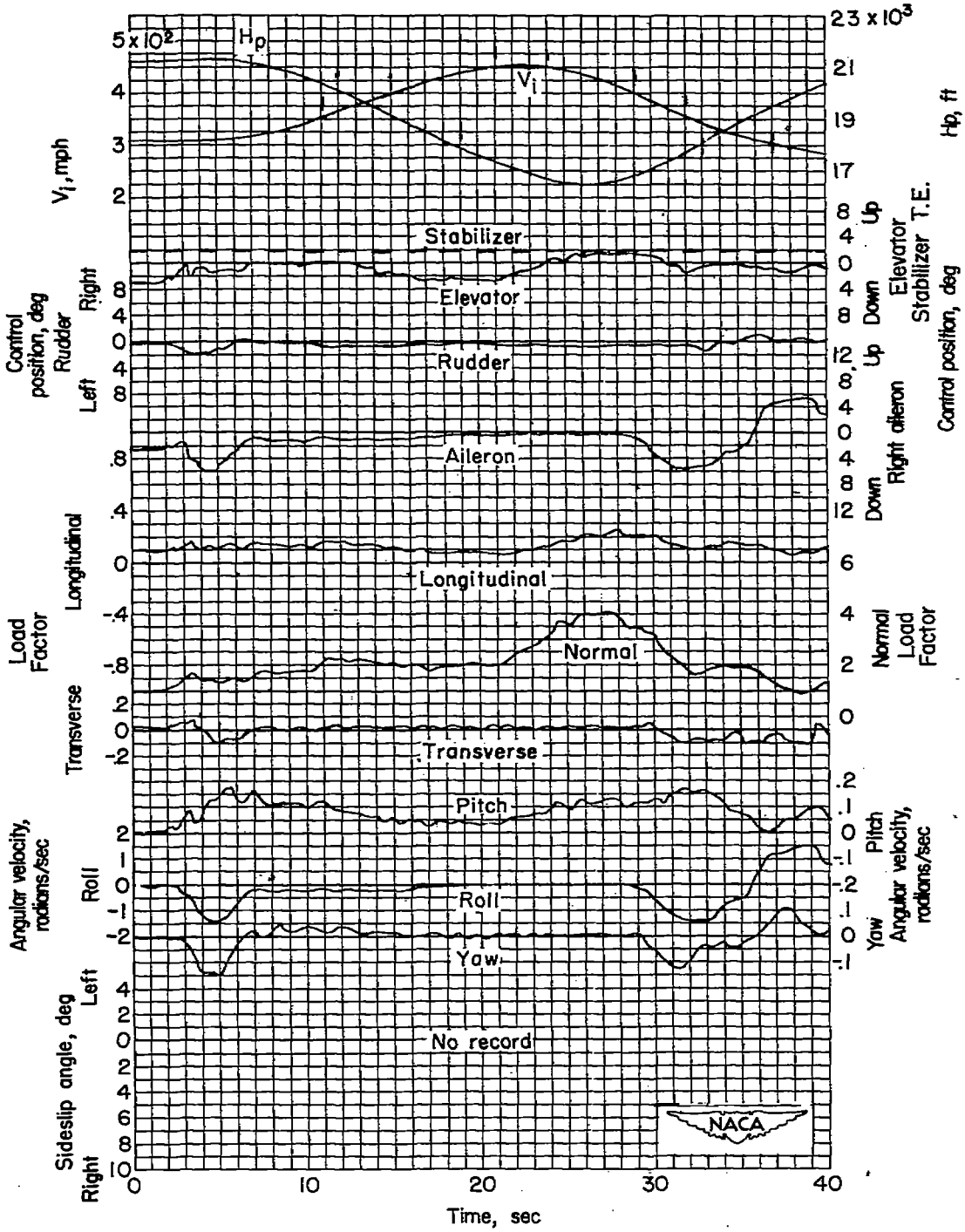


Figure 83.- Roll entry into a dive, pull-out, and left and right barrel rolls in a steep climb. Airplane weight, 13,750 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

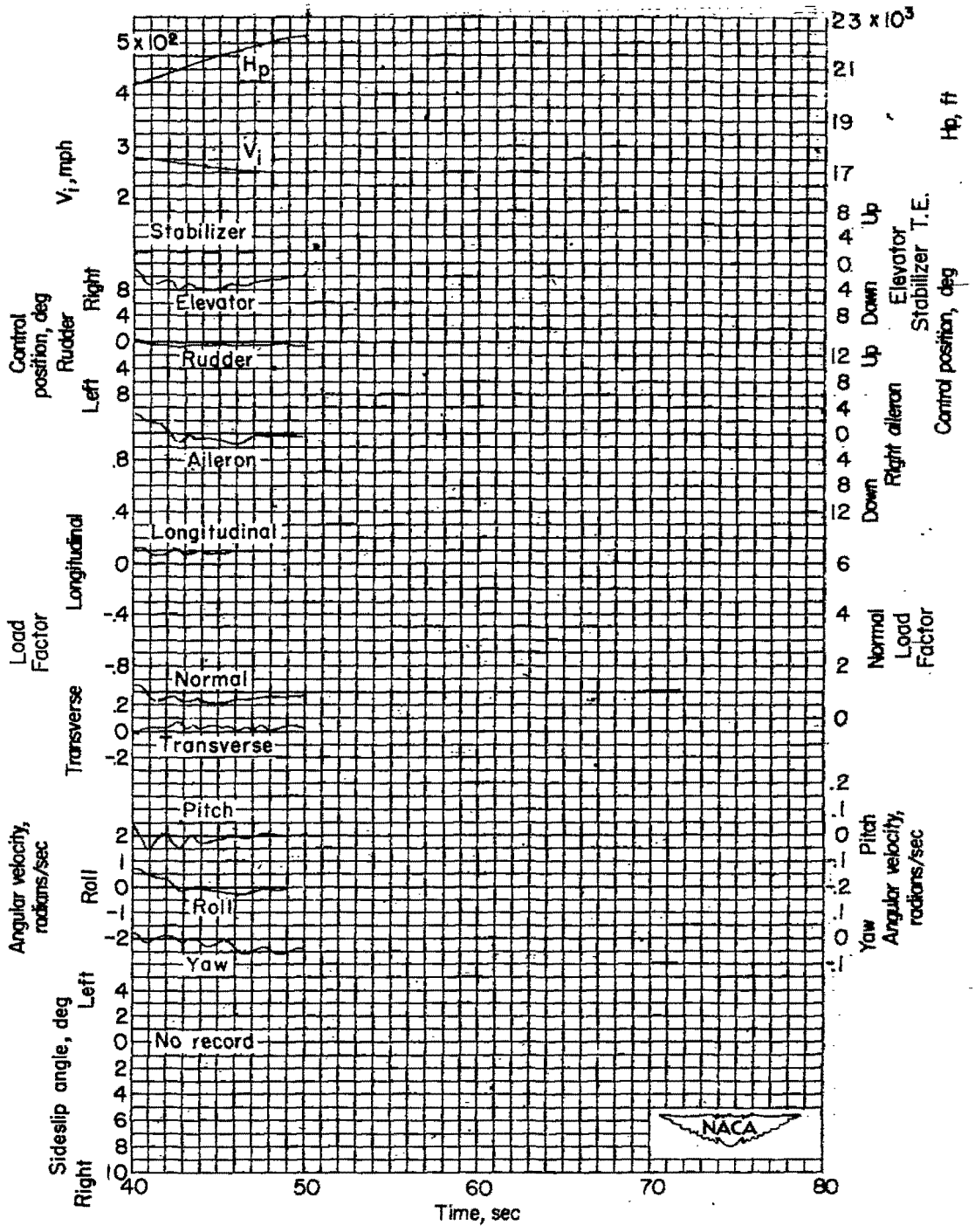


Figure 83.- Concluded.

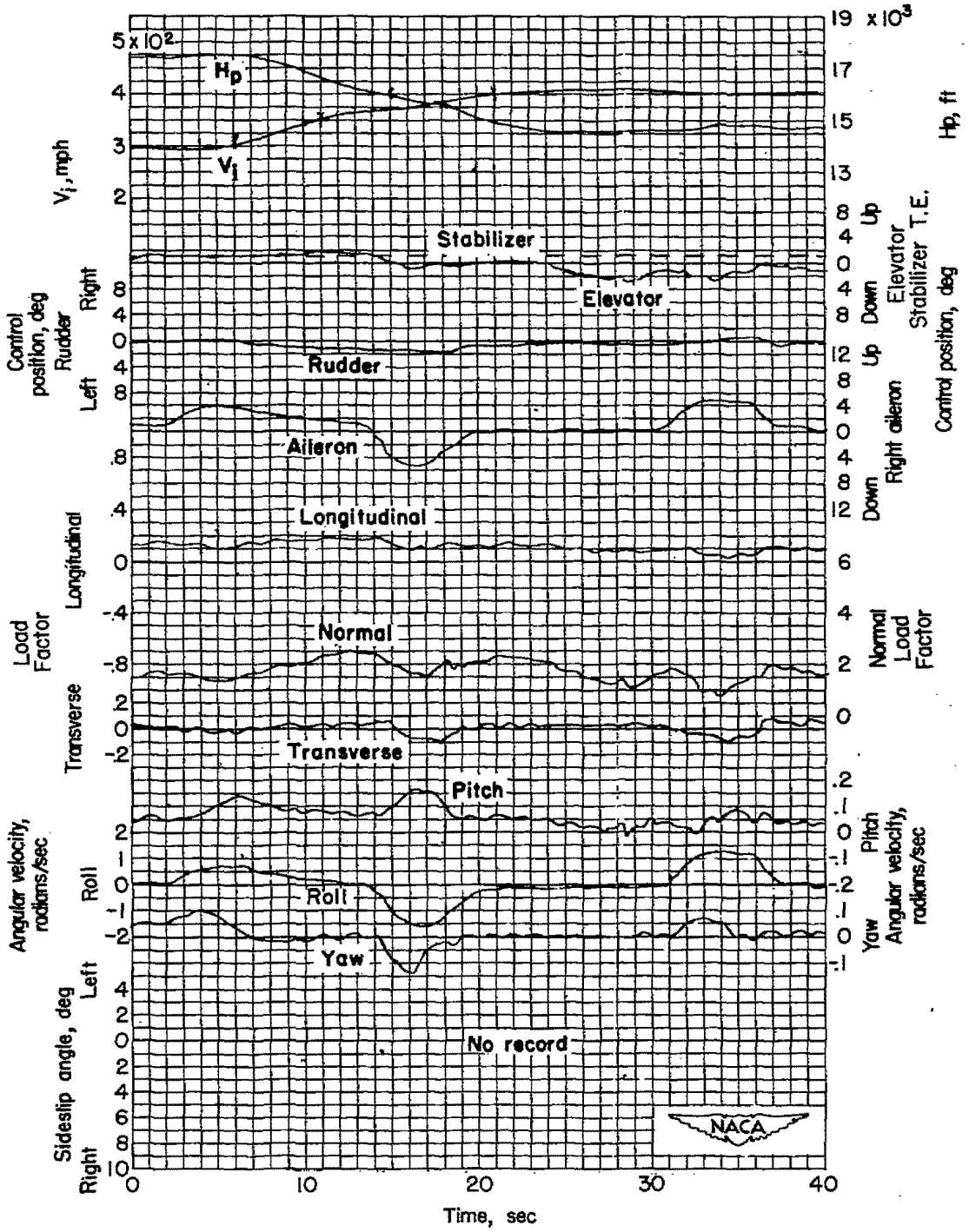


Figure 84.- Roll entry into a dive followed by left and right barrel rolls. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

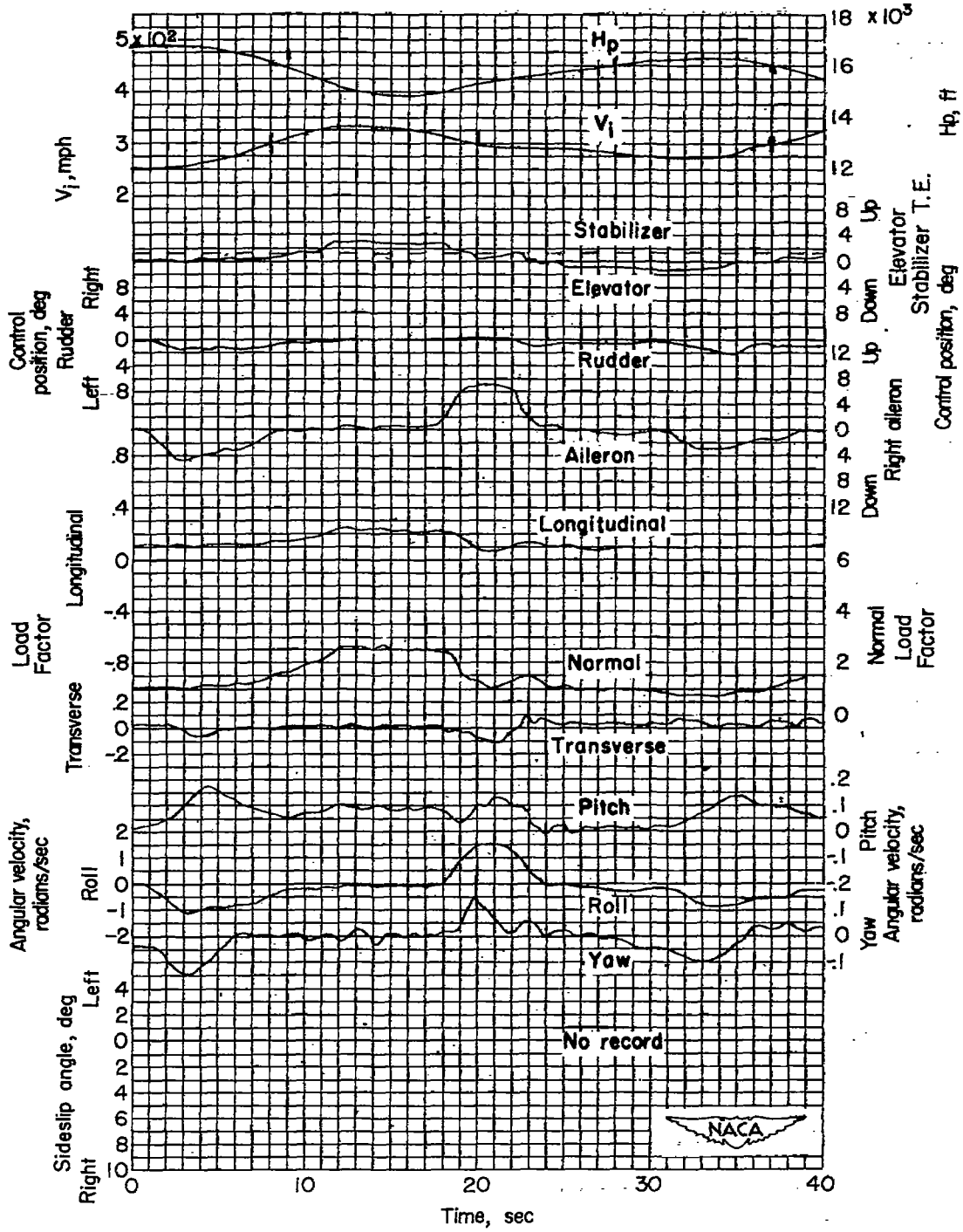


Figure 85.- Roll entry into a dive, pull-out, and barrel roll, and repeat. Airplane weight, 12,950 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

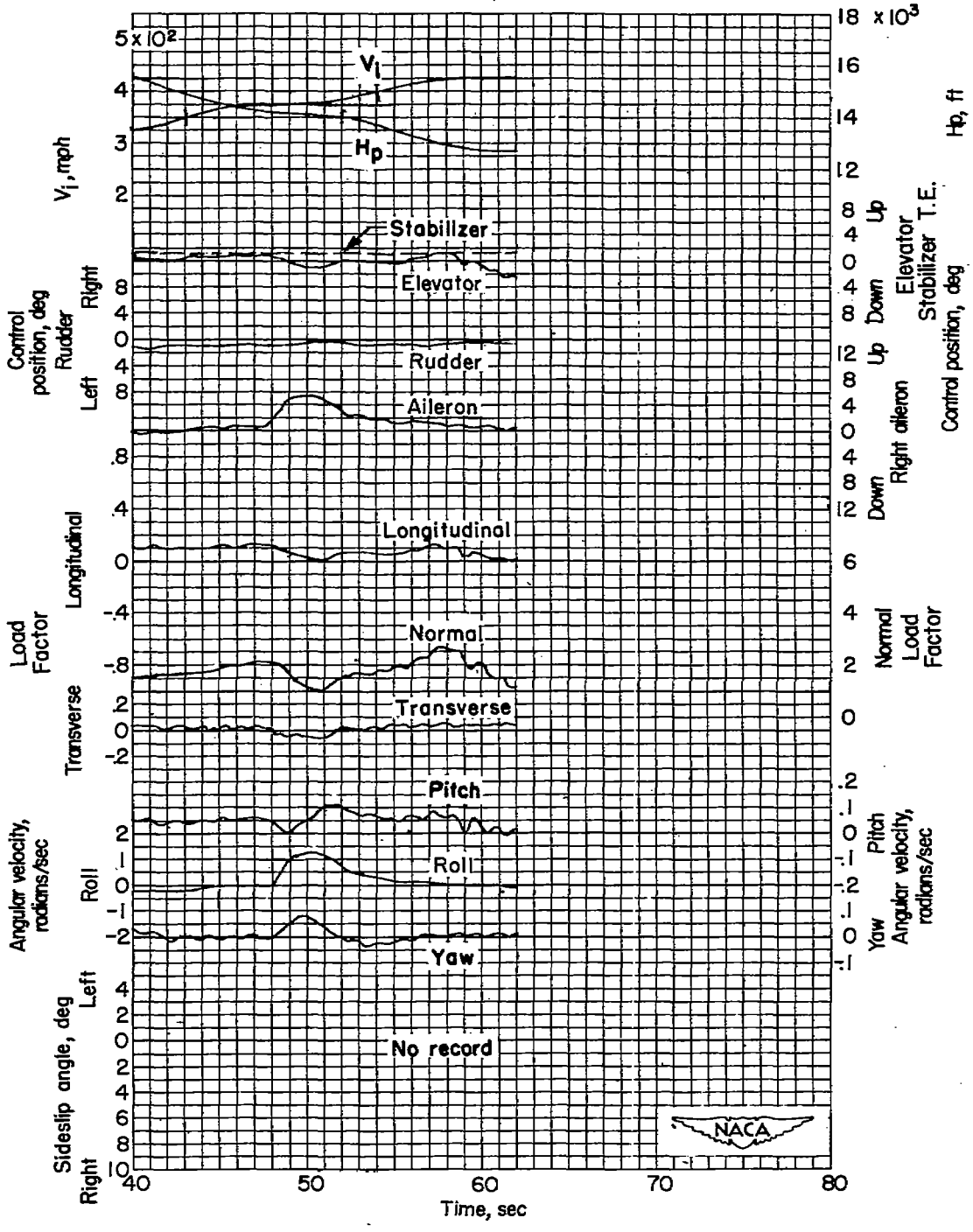


Figure 85.- Concluded.

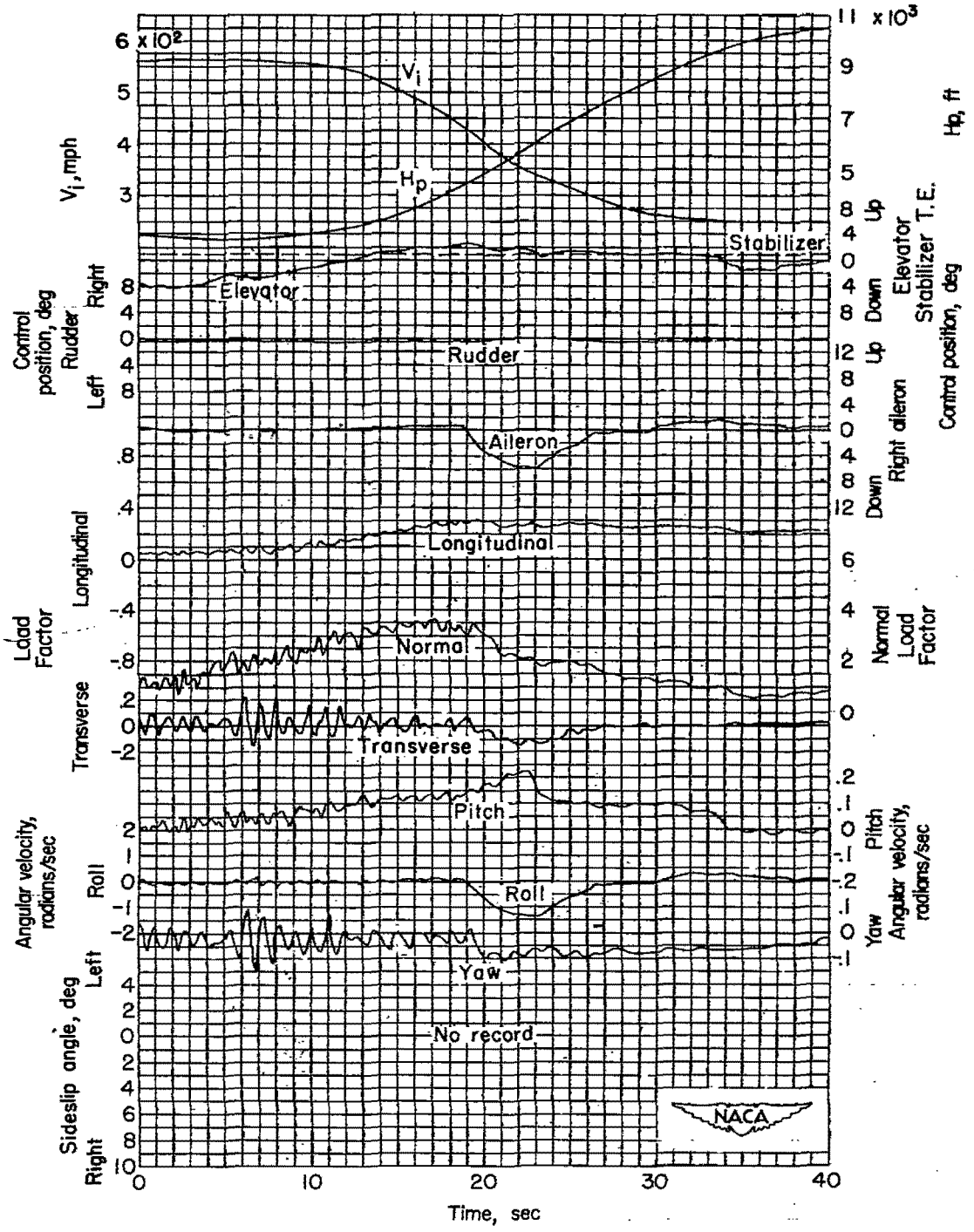


Figure 86.- Pull-up into a left barrel roll followed by a climbing turn to the left. Airplane weight, 13,200 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

[redacted]

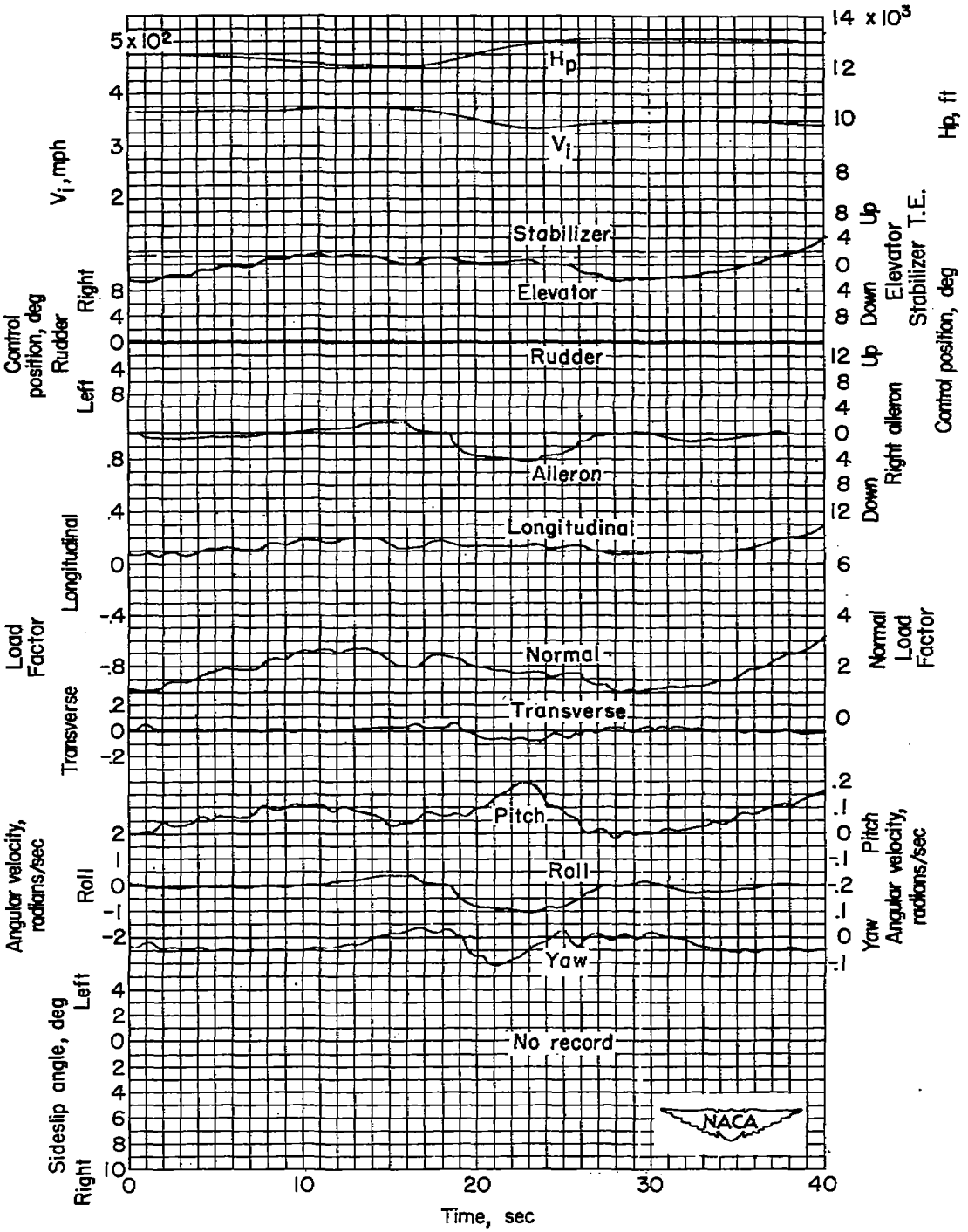


Figure 87.- Left turns and barrel rolls. Airplane weight, 12,950 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

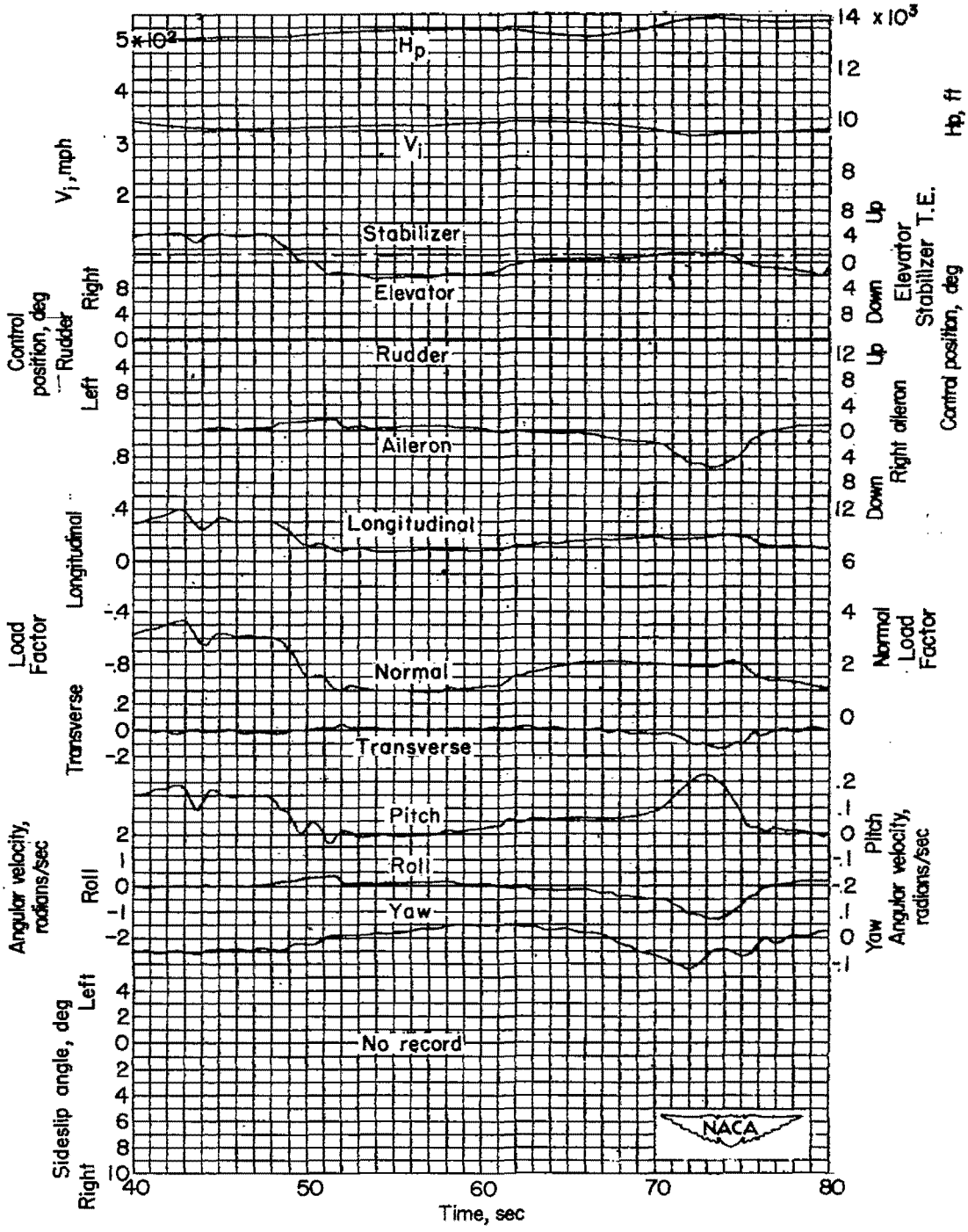


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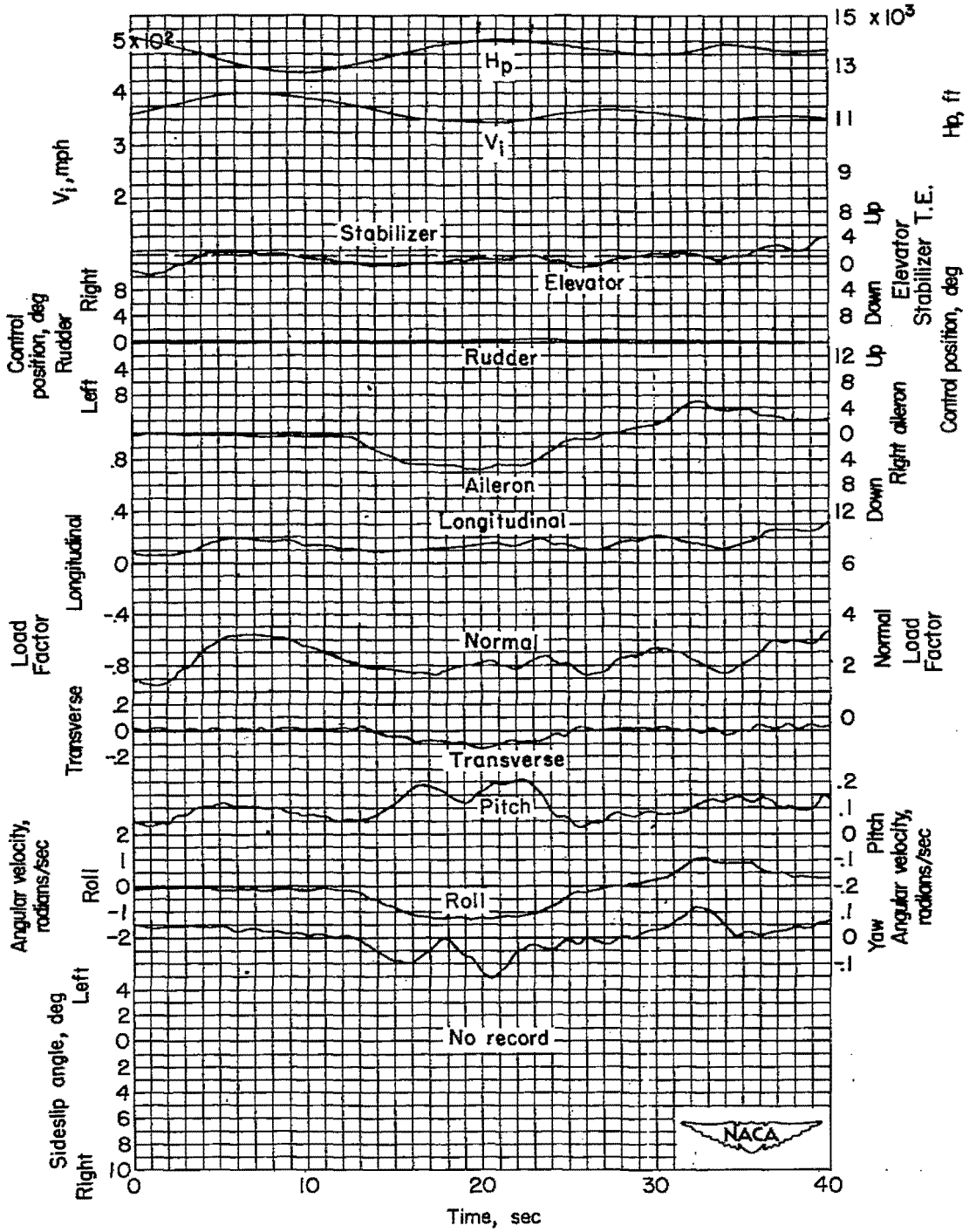


Figure 88.- Dive and pull-out, left and right barrel rolls followed by a right turn. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

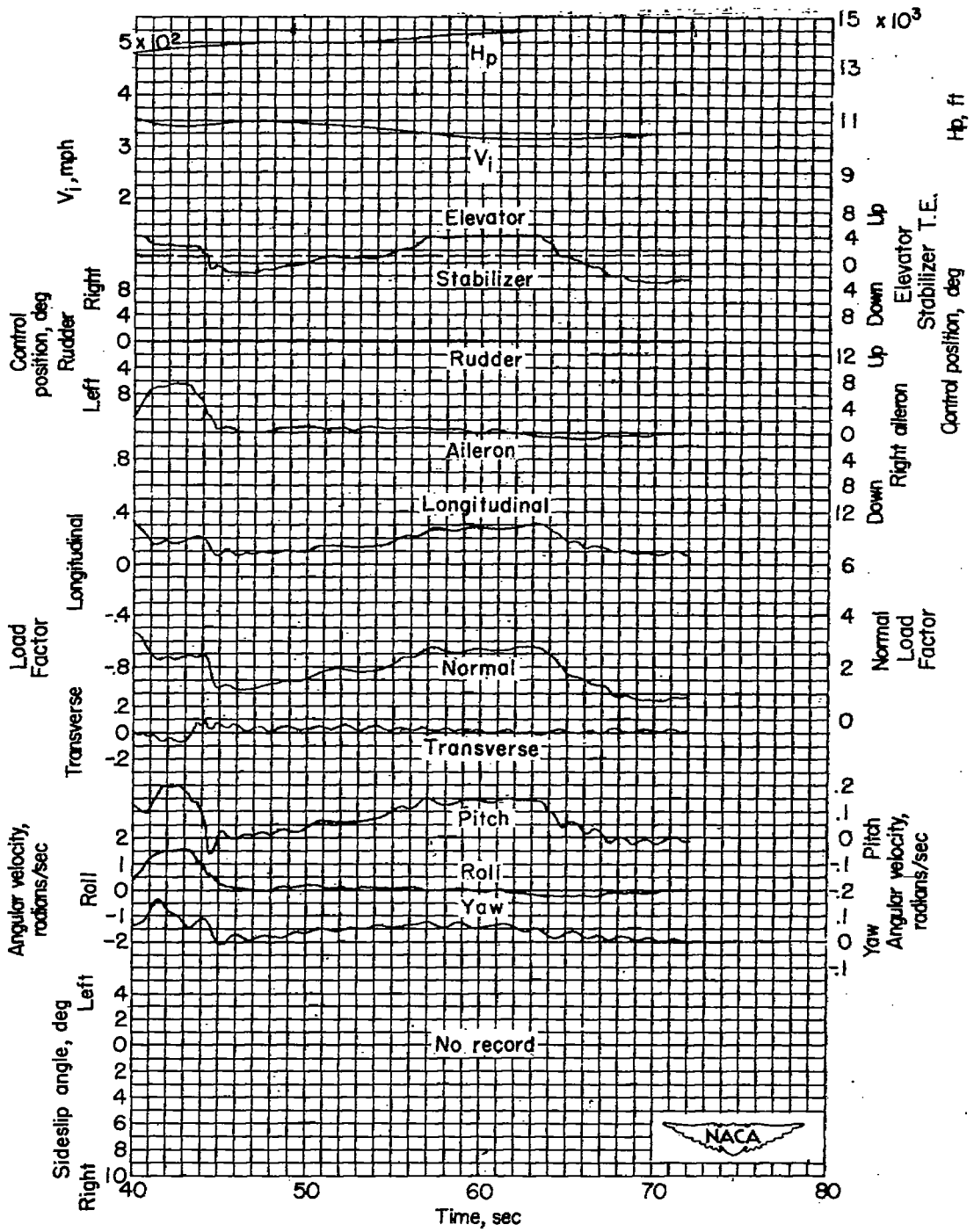


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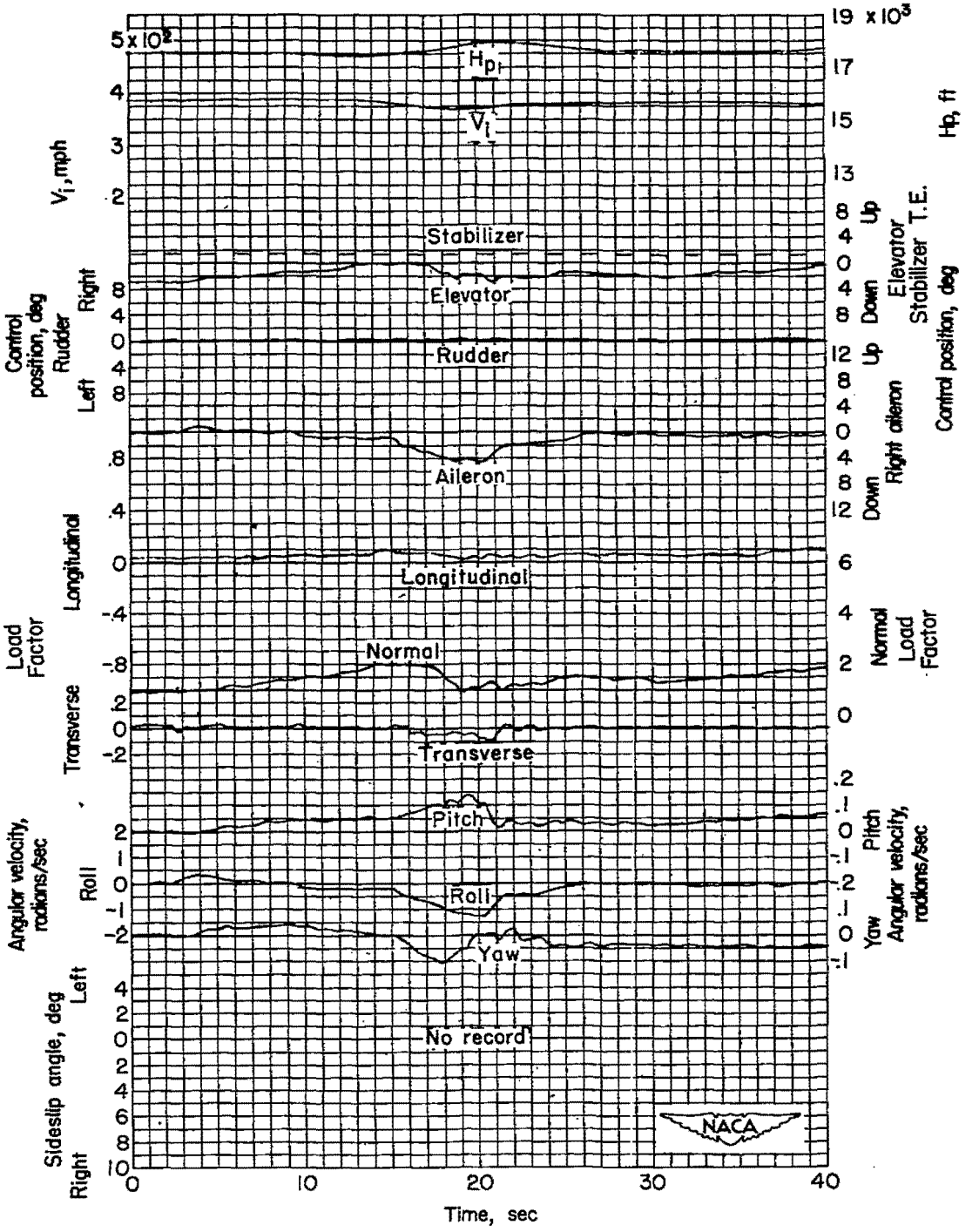


Figure 89.- Right turn followed by left barrel roll and turn. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

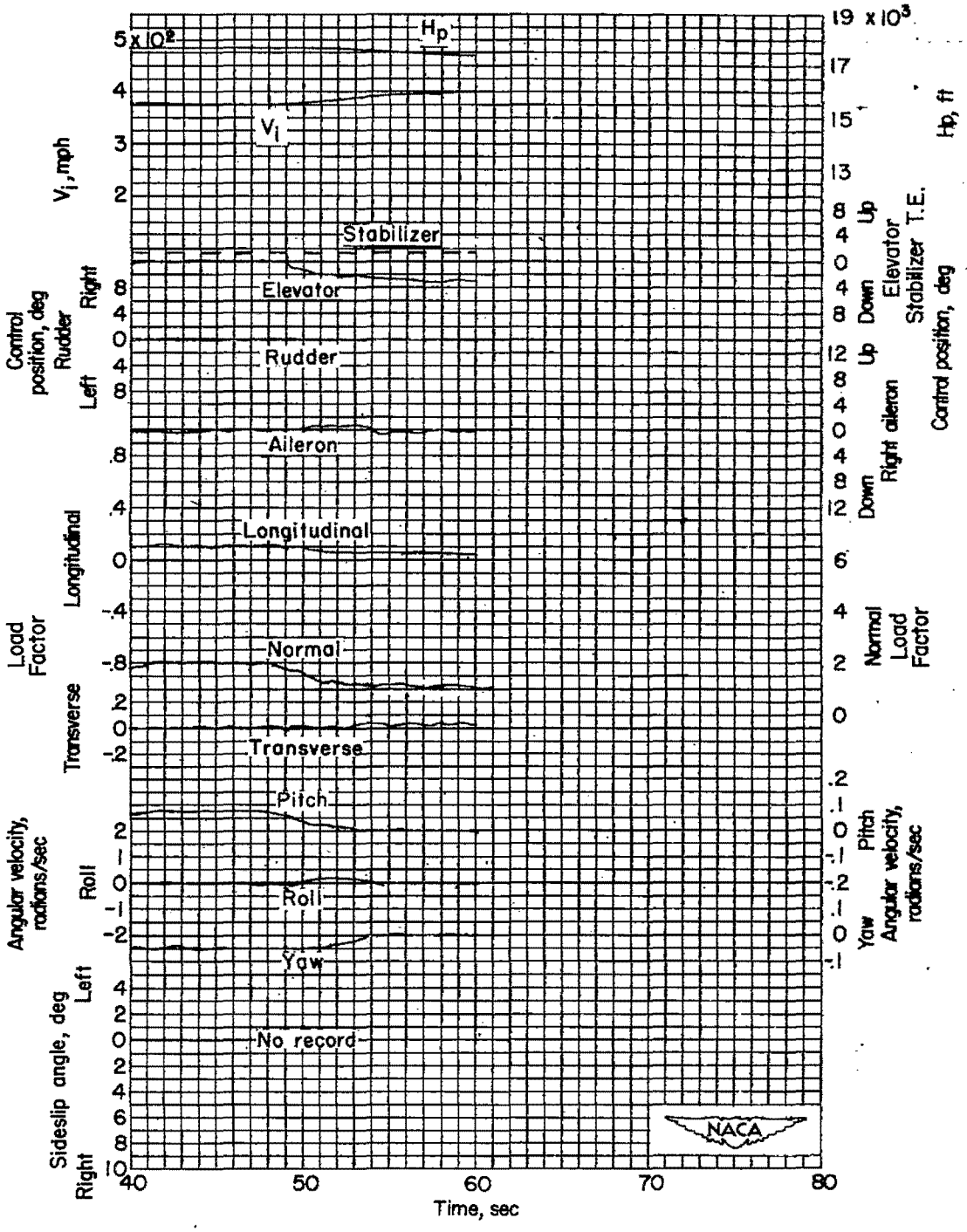


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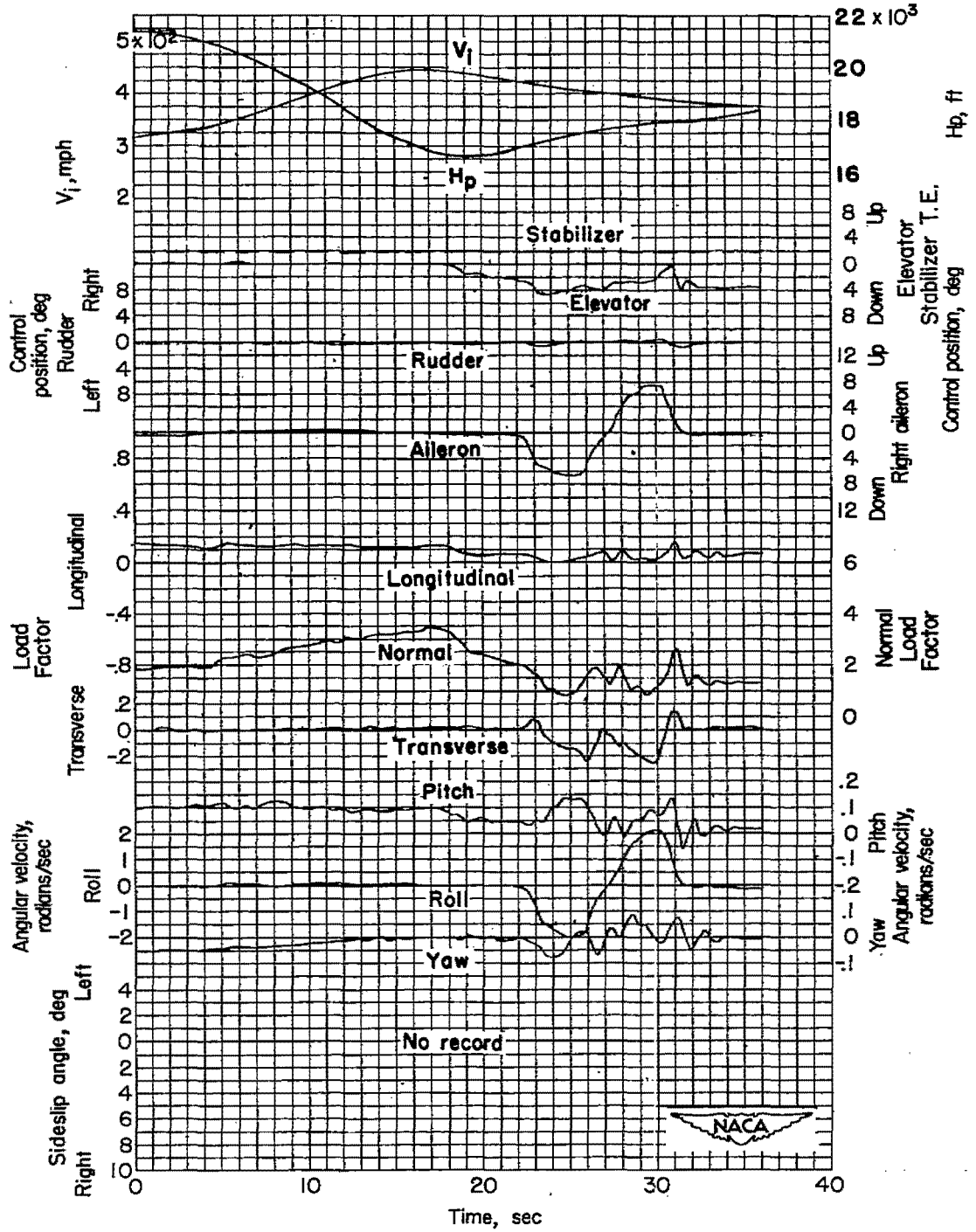


Figure 90.- Diving left turn, pull-up, and left and right barrel rolls. Airplane weight, 12,650 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

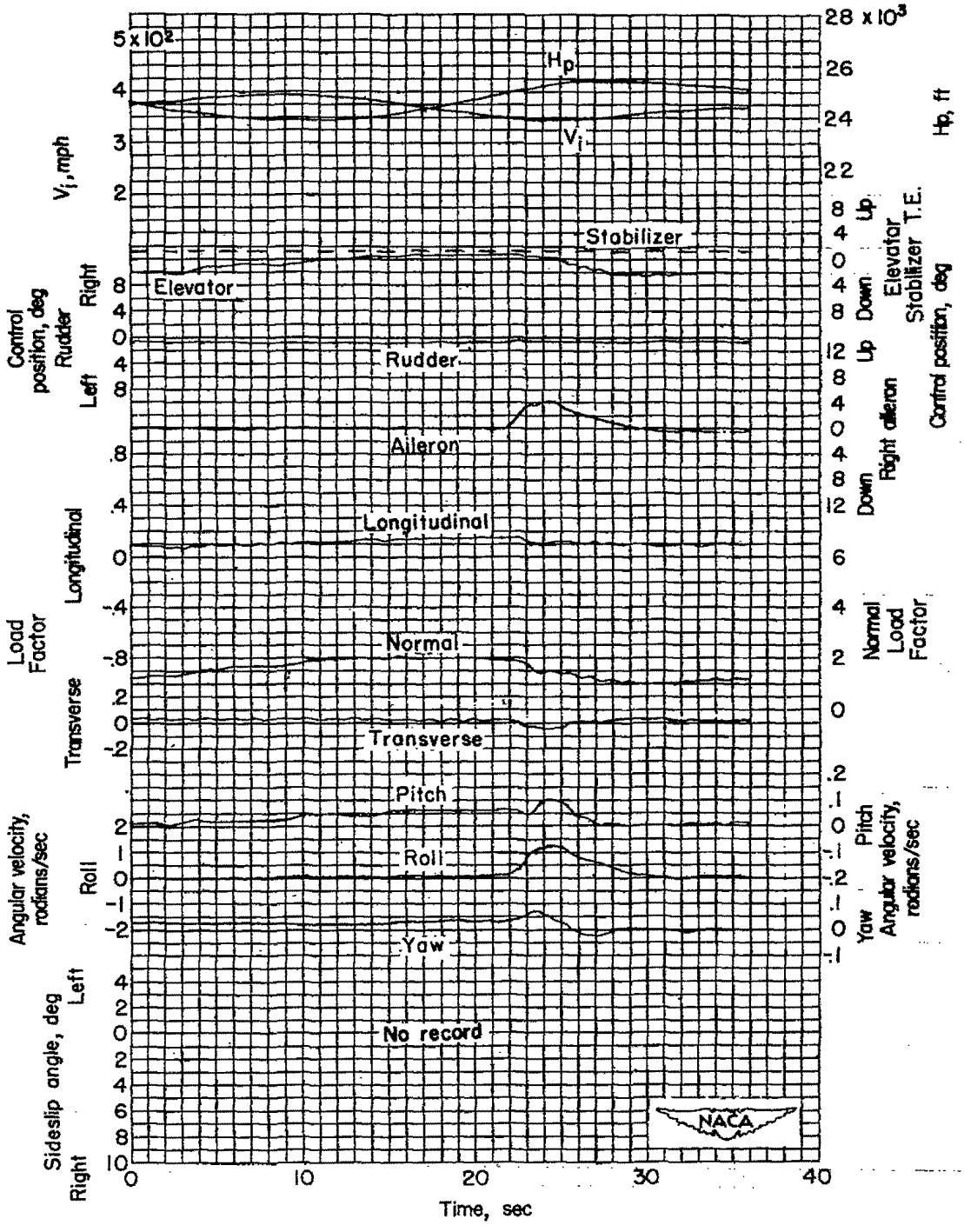


Figure 91.- Right turn followed by a right barrel roll. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

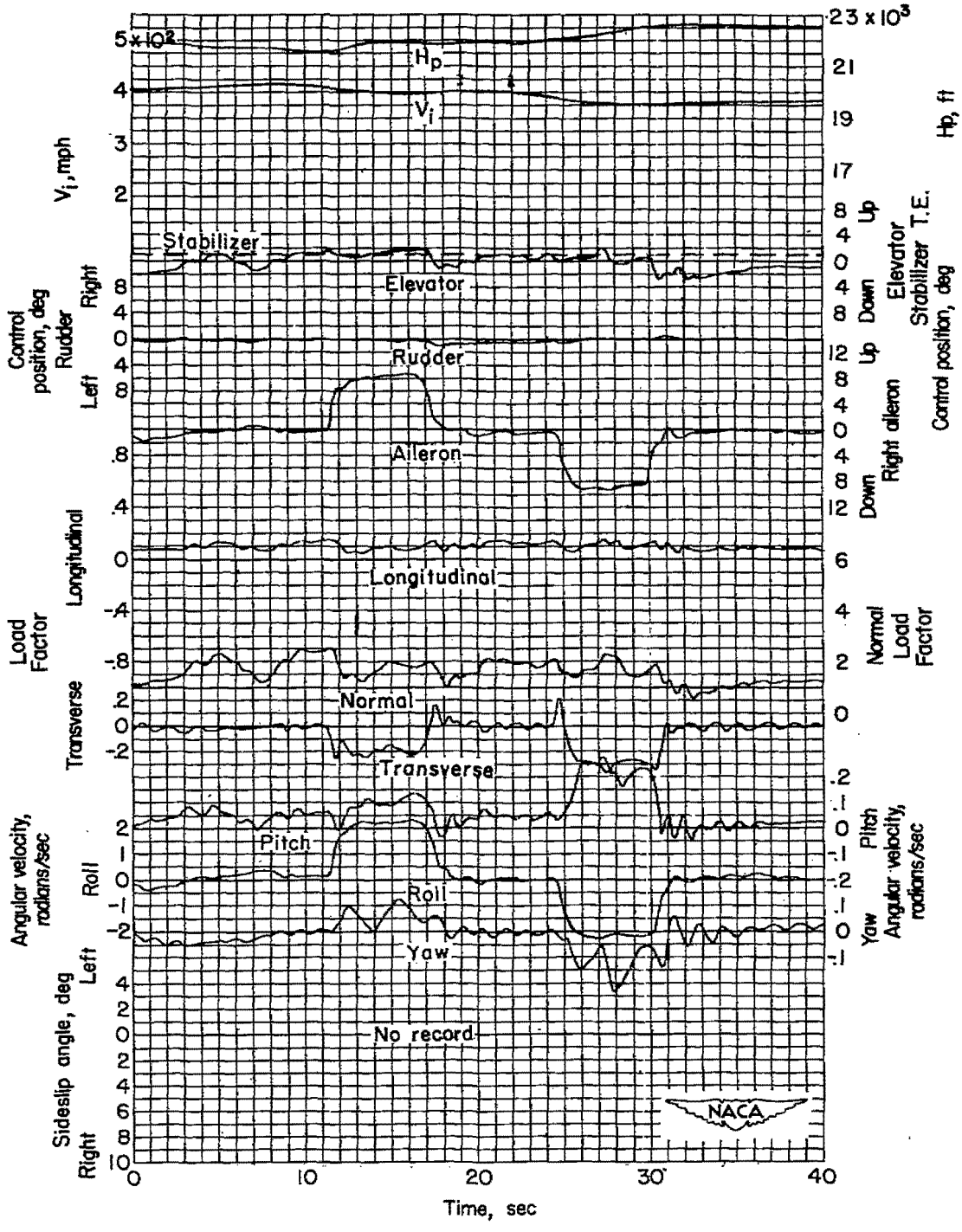


Figure 92.- Left turn followed by right and left barrel rolls. Airplane weight, 13,400 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

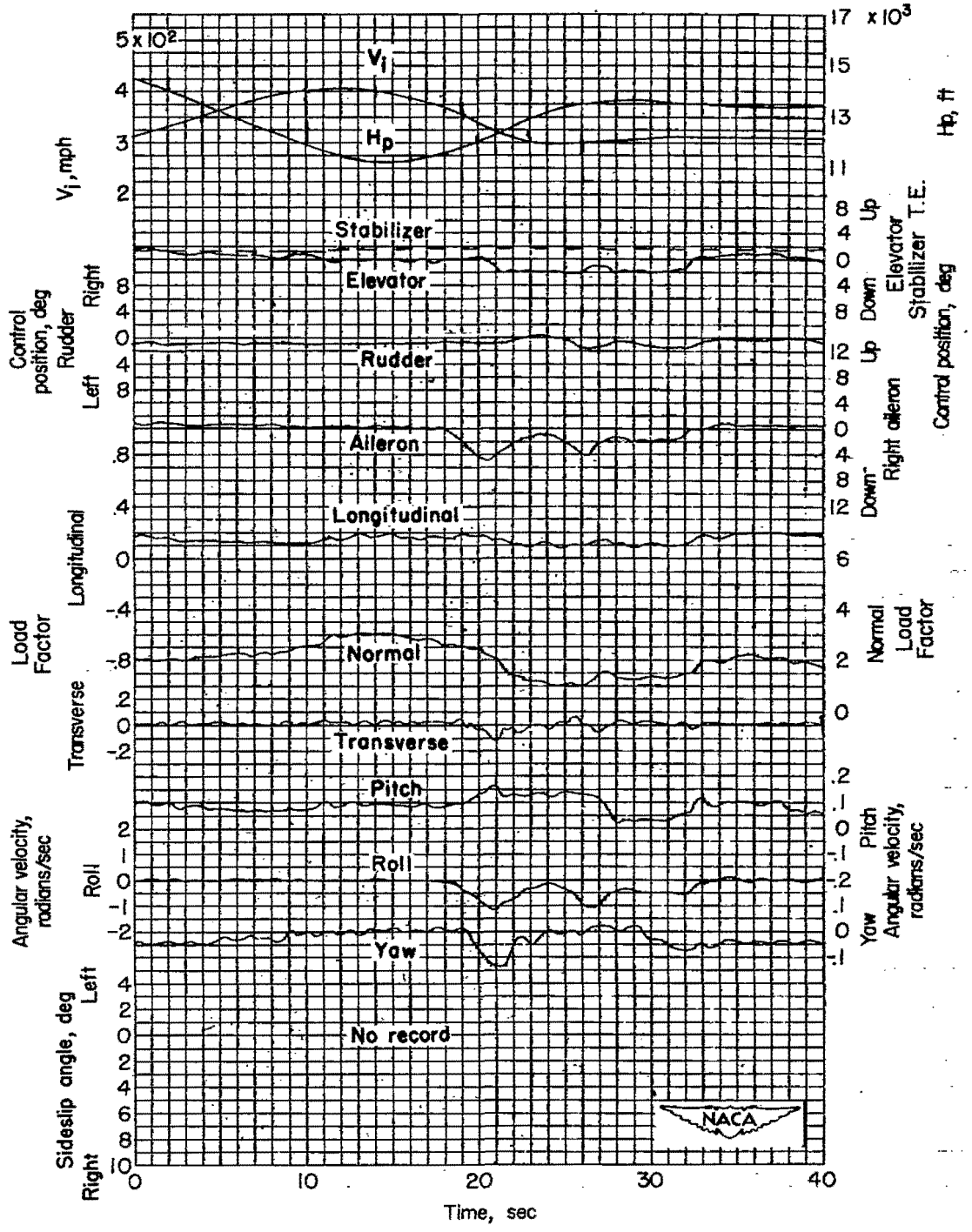


Figure 93.- Dive, pull-out, and climbing slow roll followed by a left turn. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

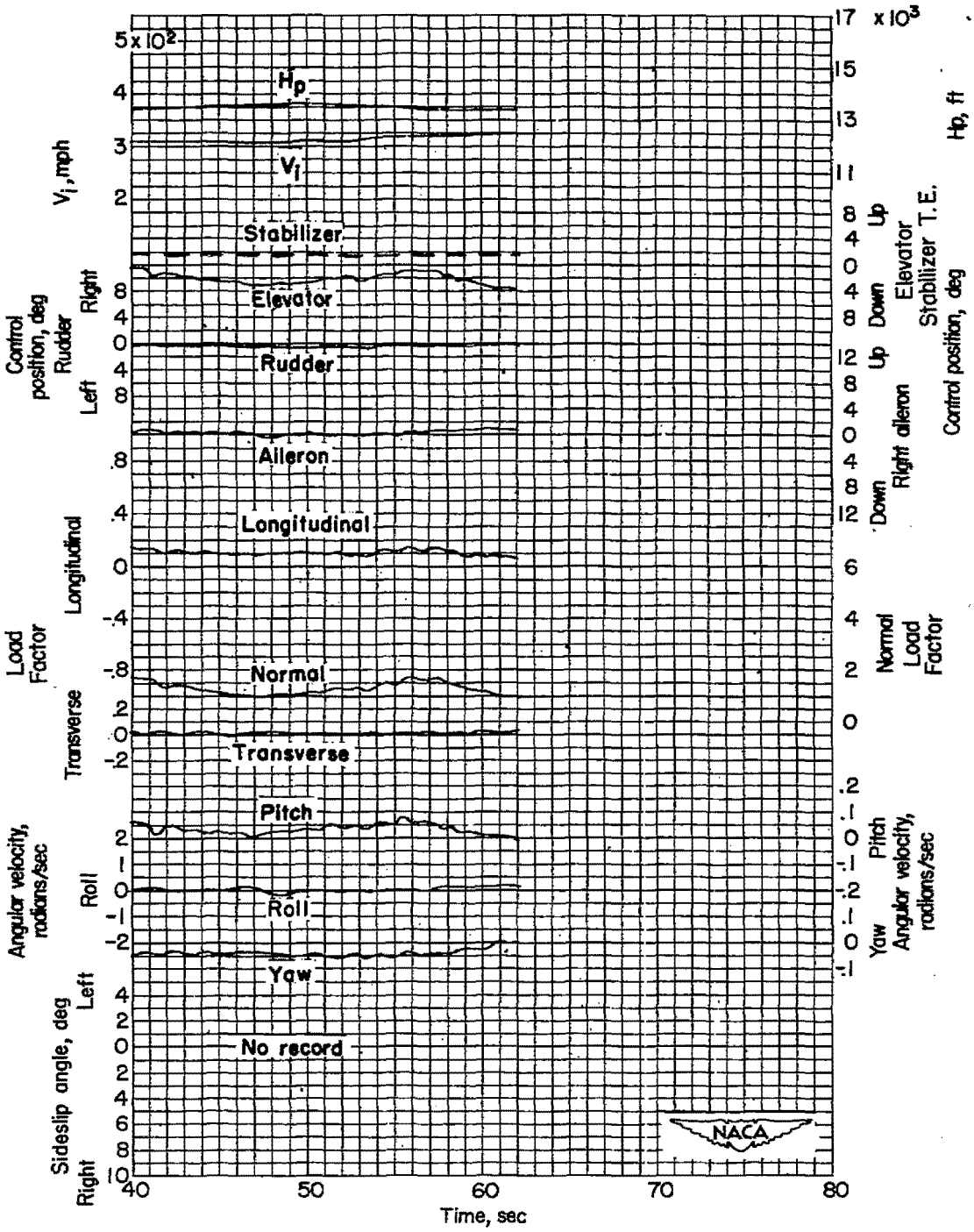


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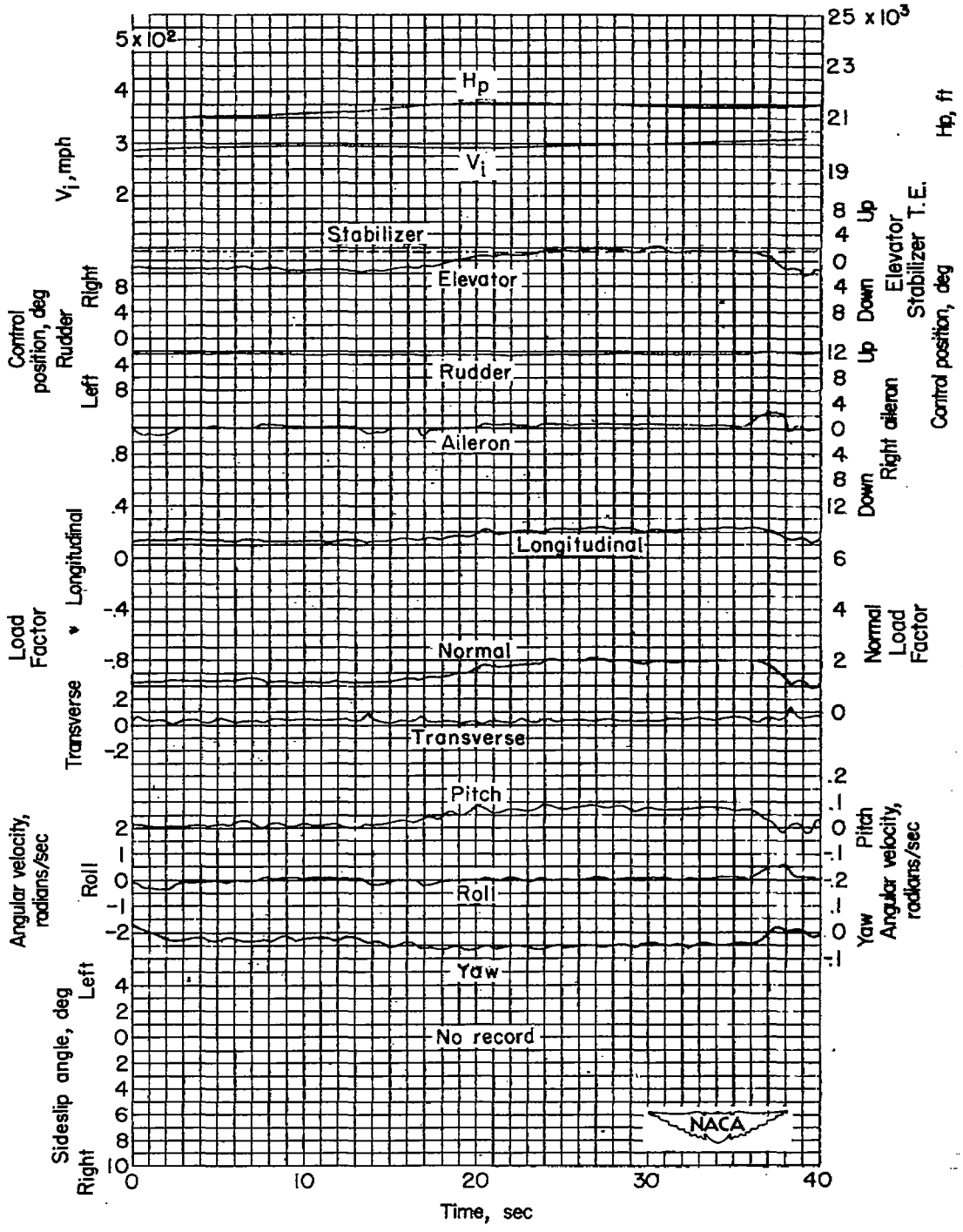


Figure 94.- Left turn. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

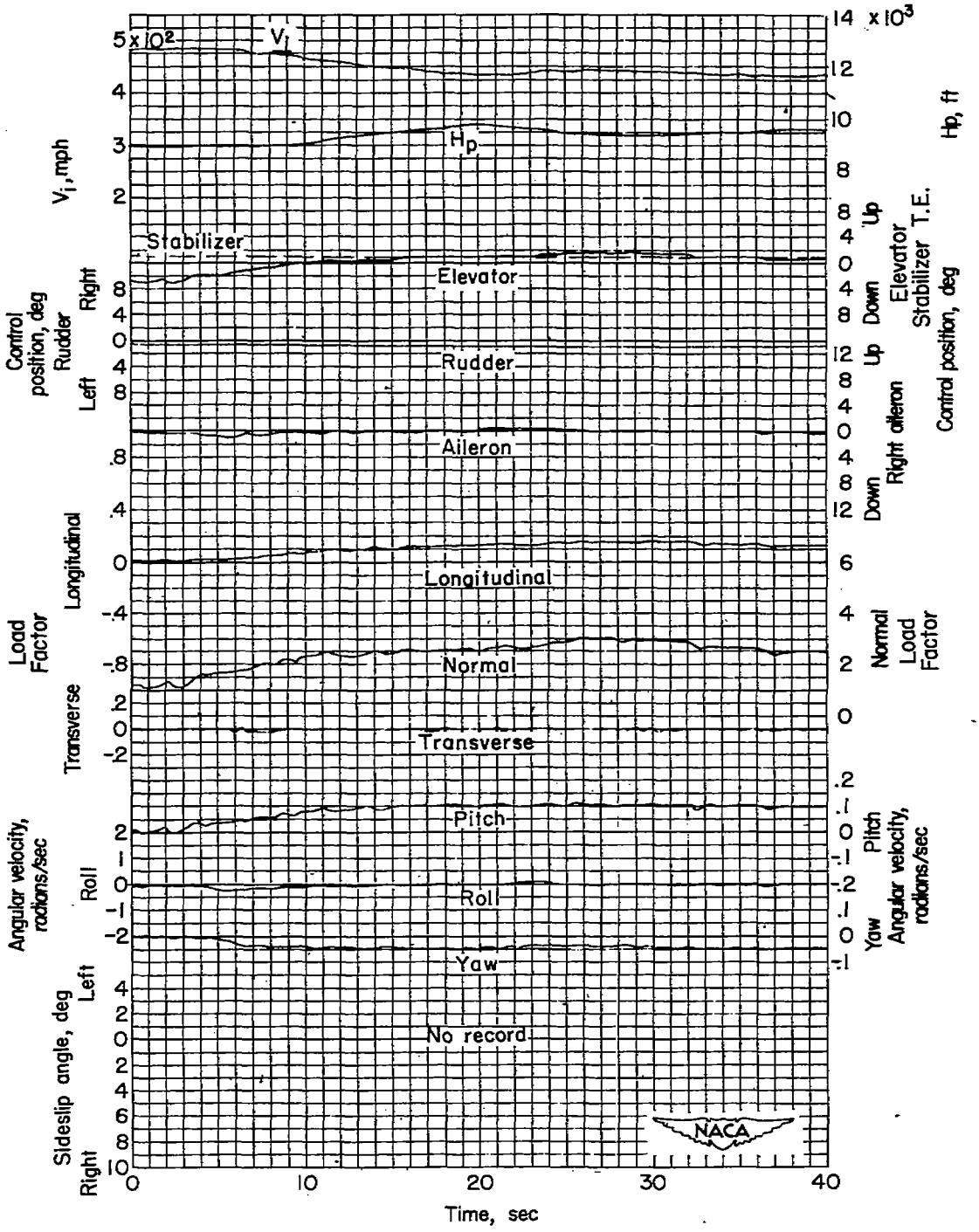


Figure 95.- Left turn. Airplane weight, 13,650 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

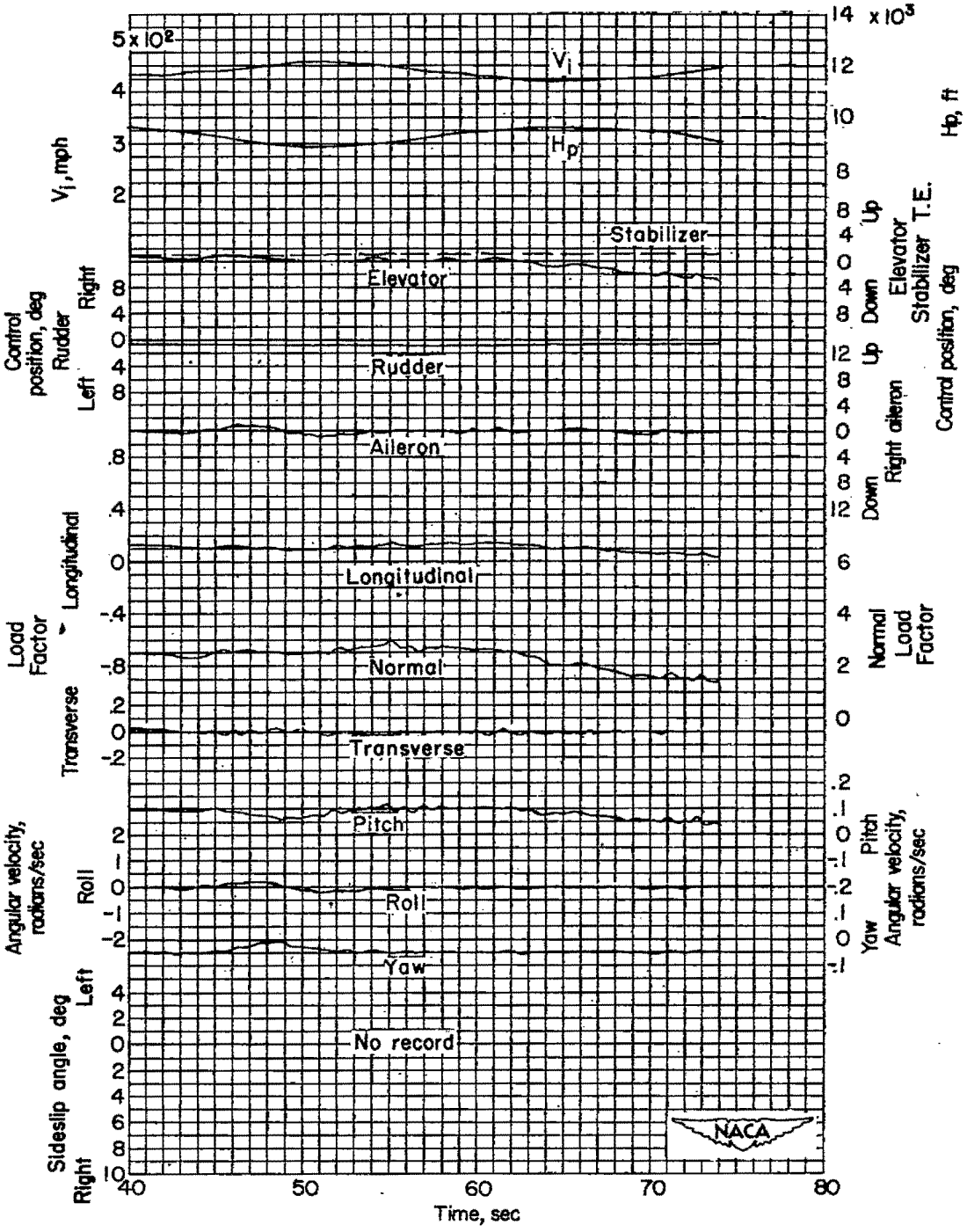


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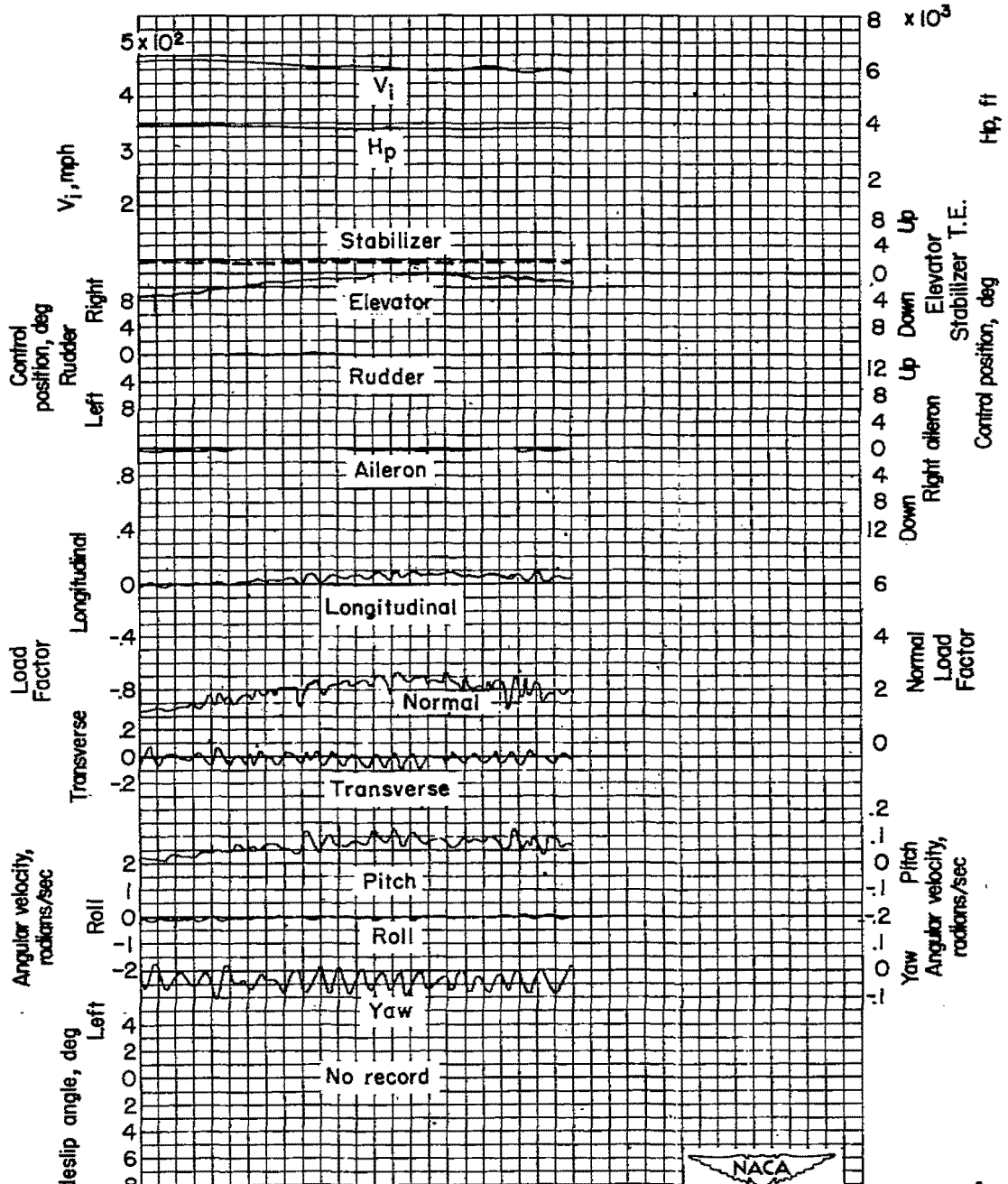


Figure 96.- Left turn. Airplane weight, 13,850 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

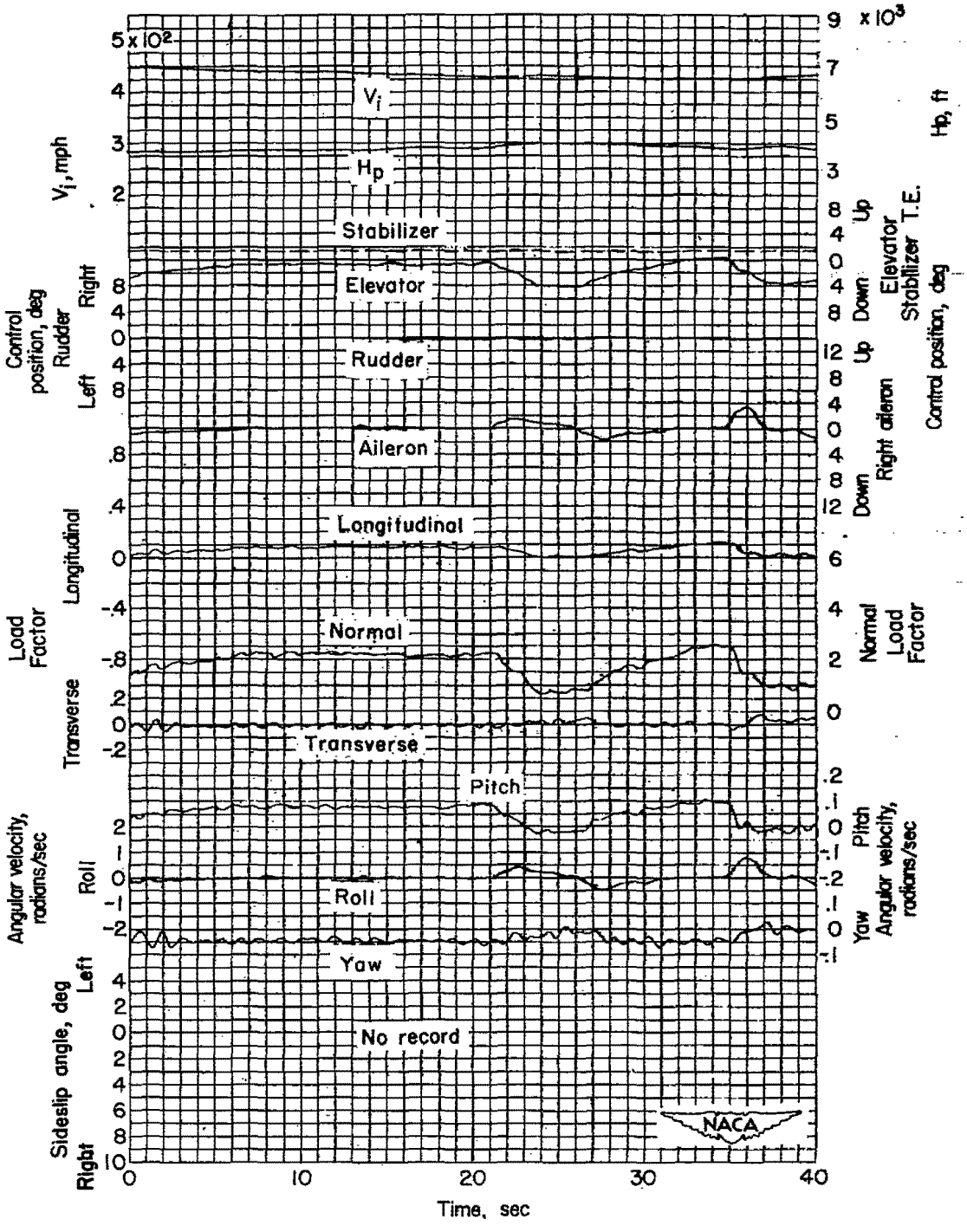


Figure 97.- Left turns. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

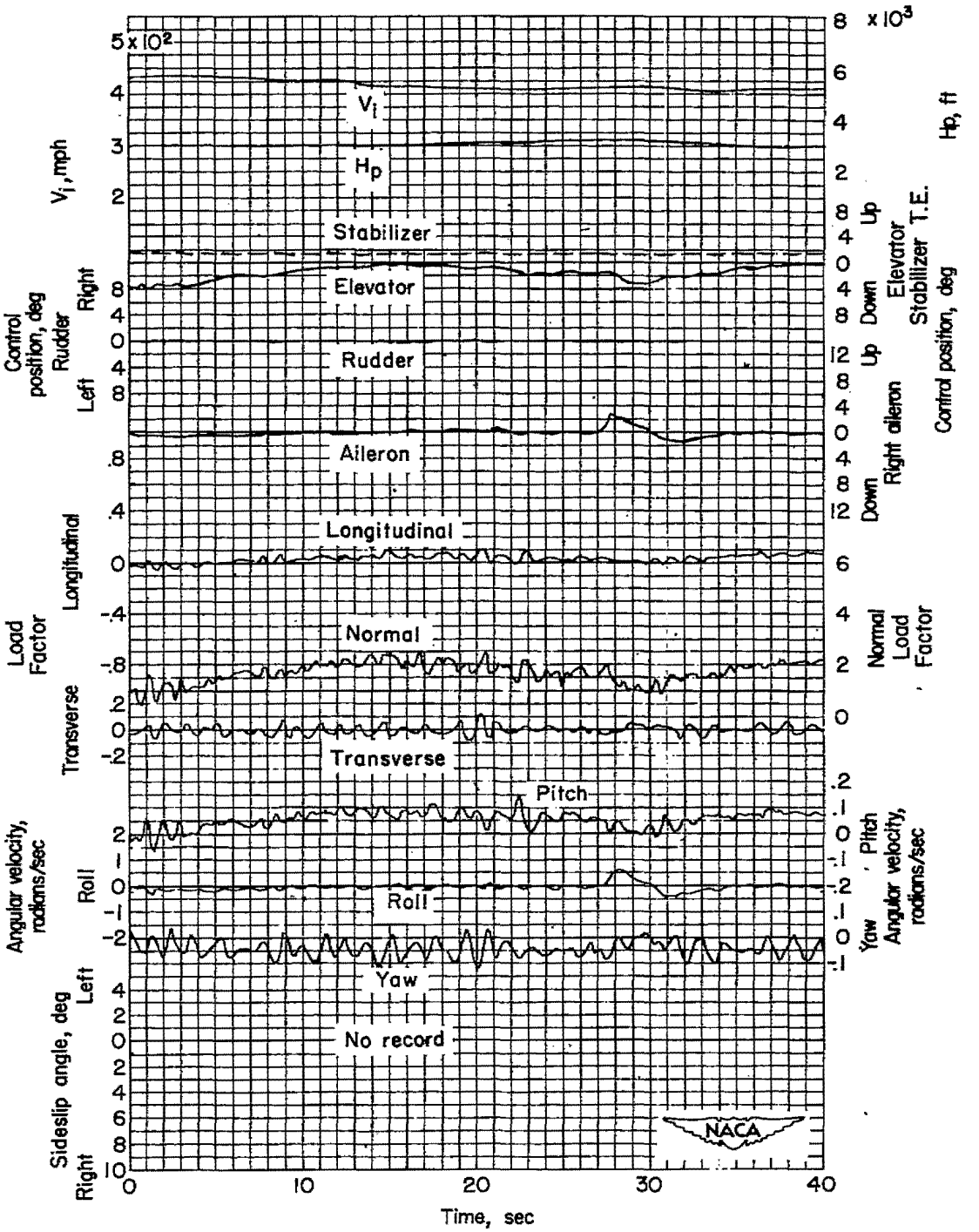


Figure 98.- Left turns. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

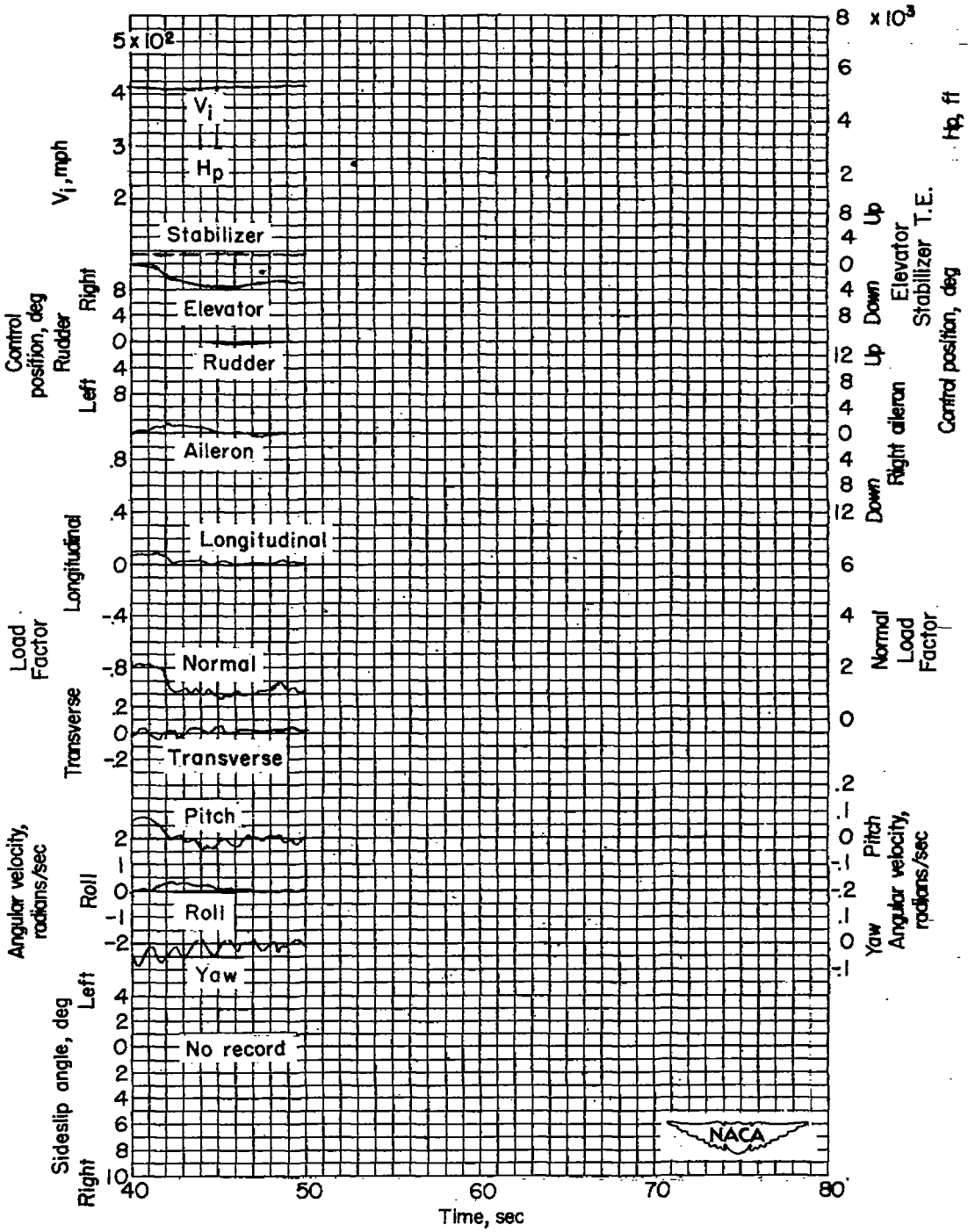


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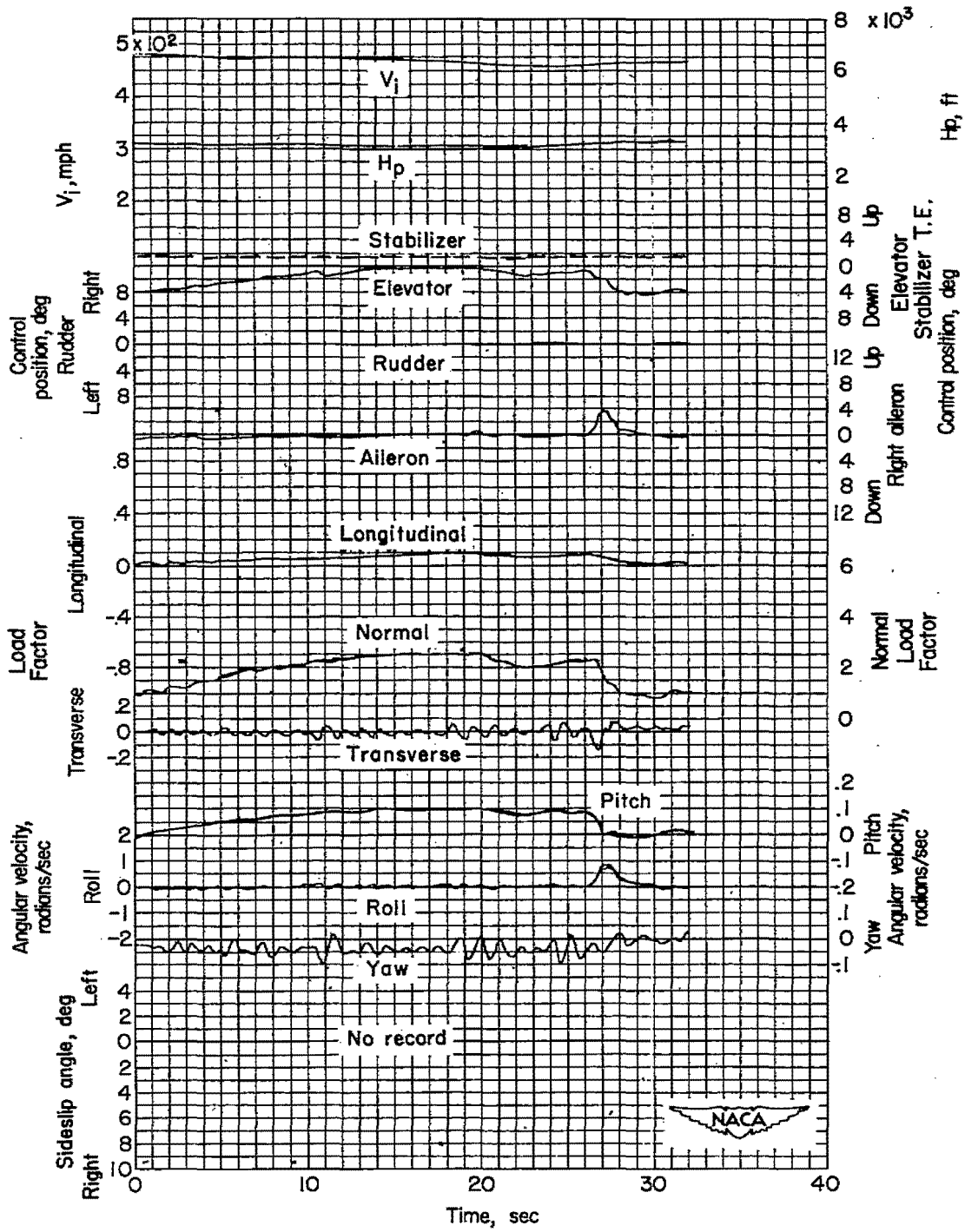


Figure 99.- Left turn. Airplane weight, 12,950 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

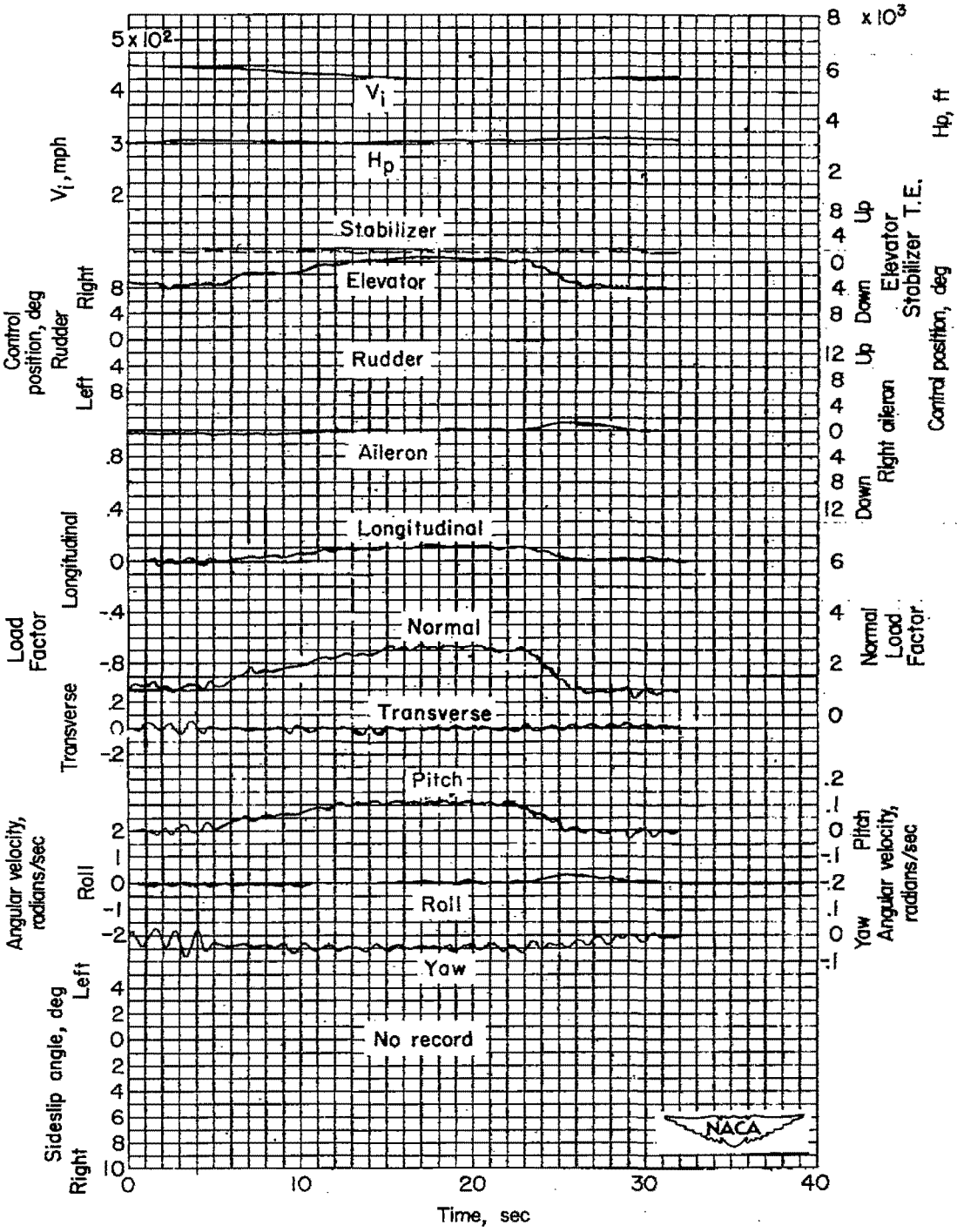


Figure 100.- Left turn. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

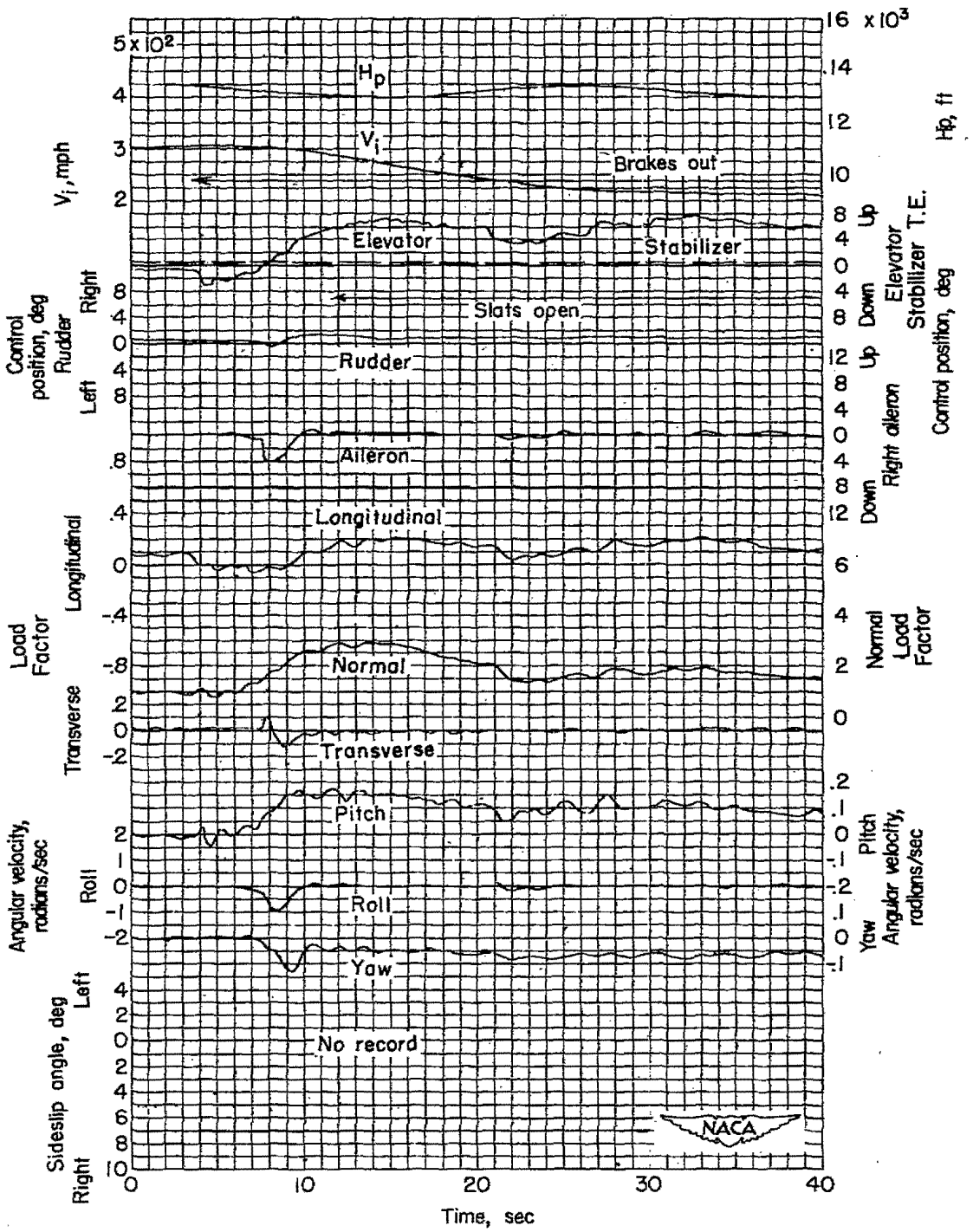


Figure 101.- Left turn. Airplane weight, 12,650 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

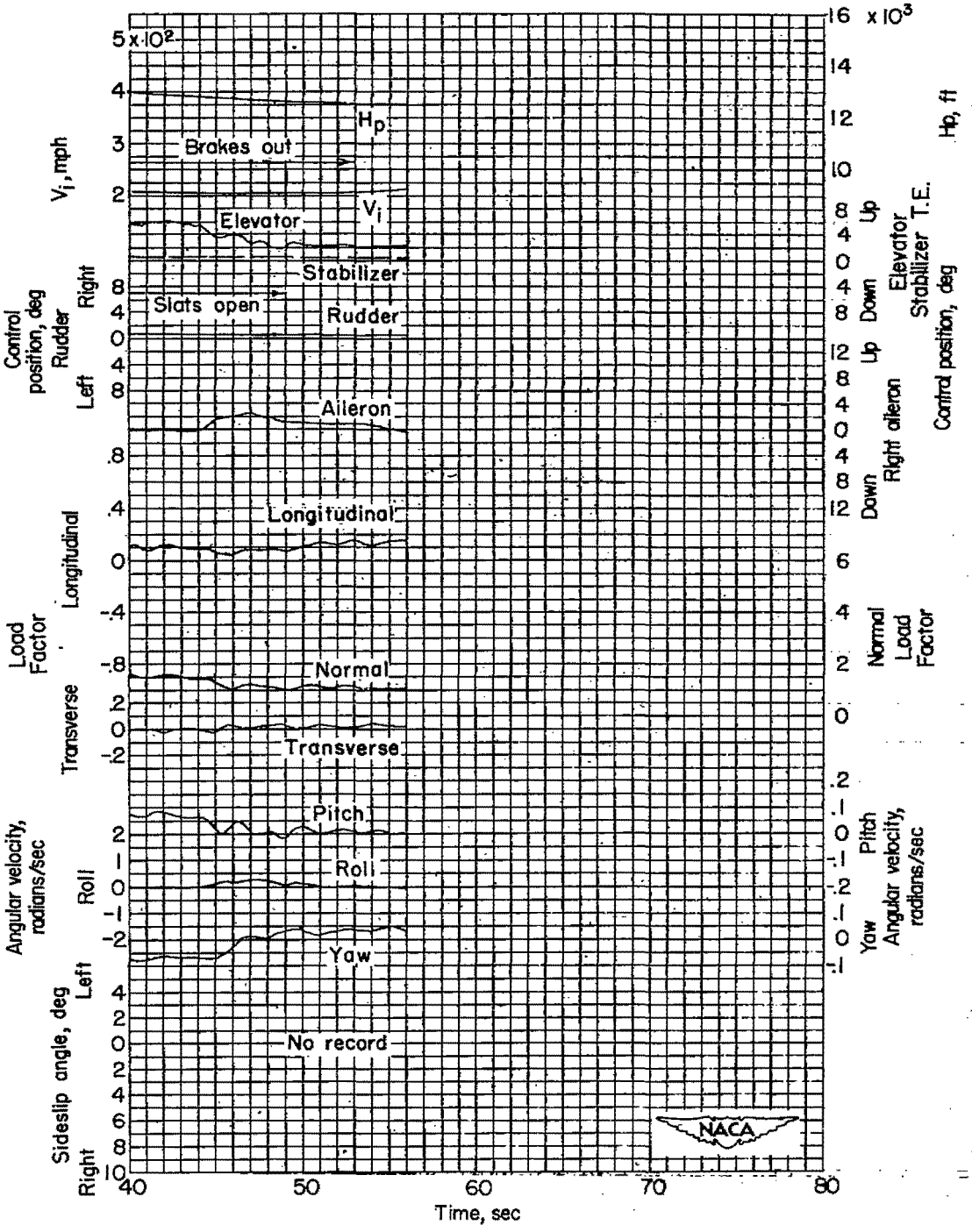


Figure 101.- Concluded.

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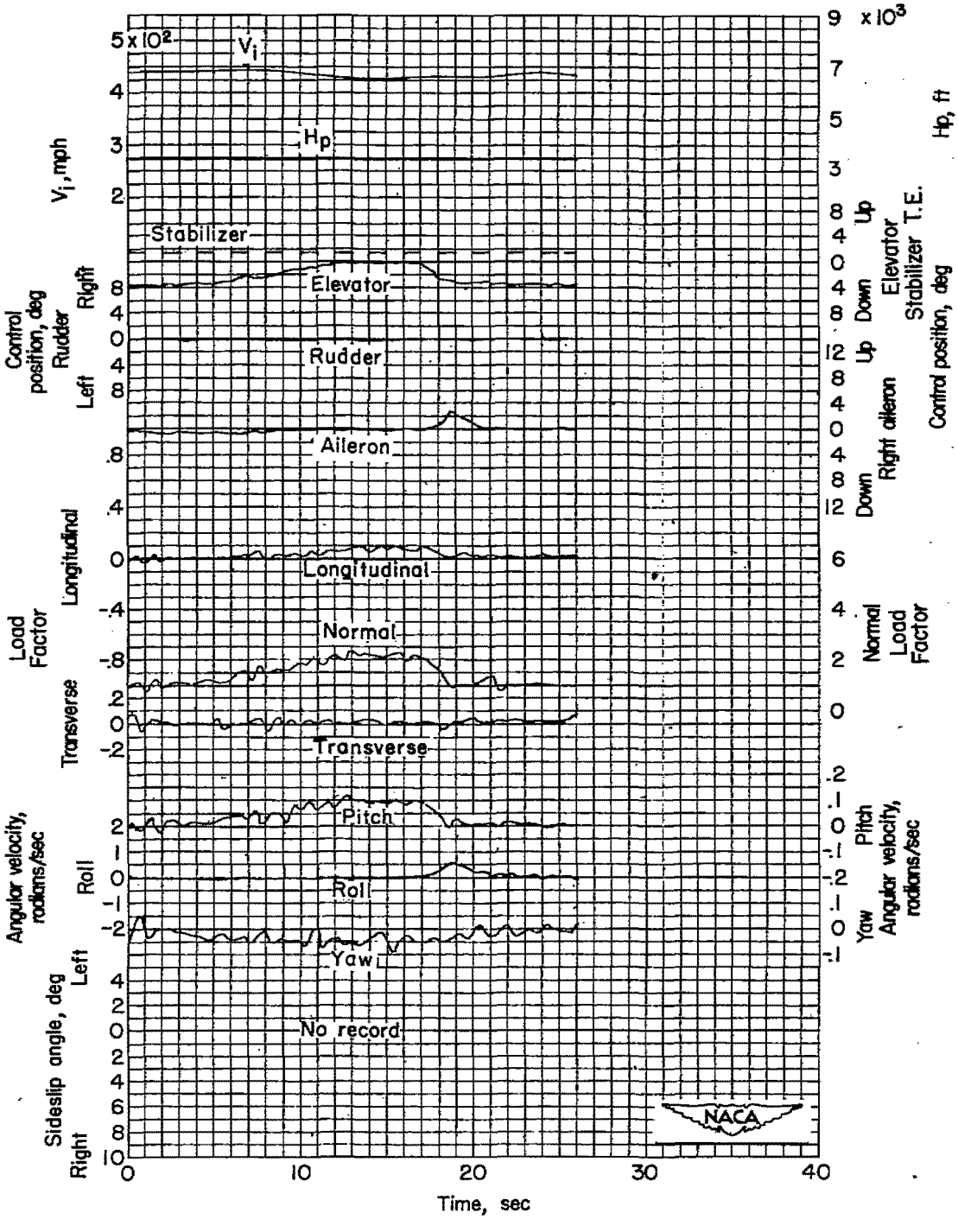


Figure 102.- Left turn. Airplane weight, 13,900 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

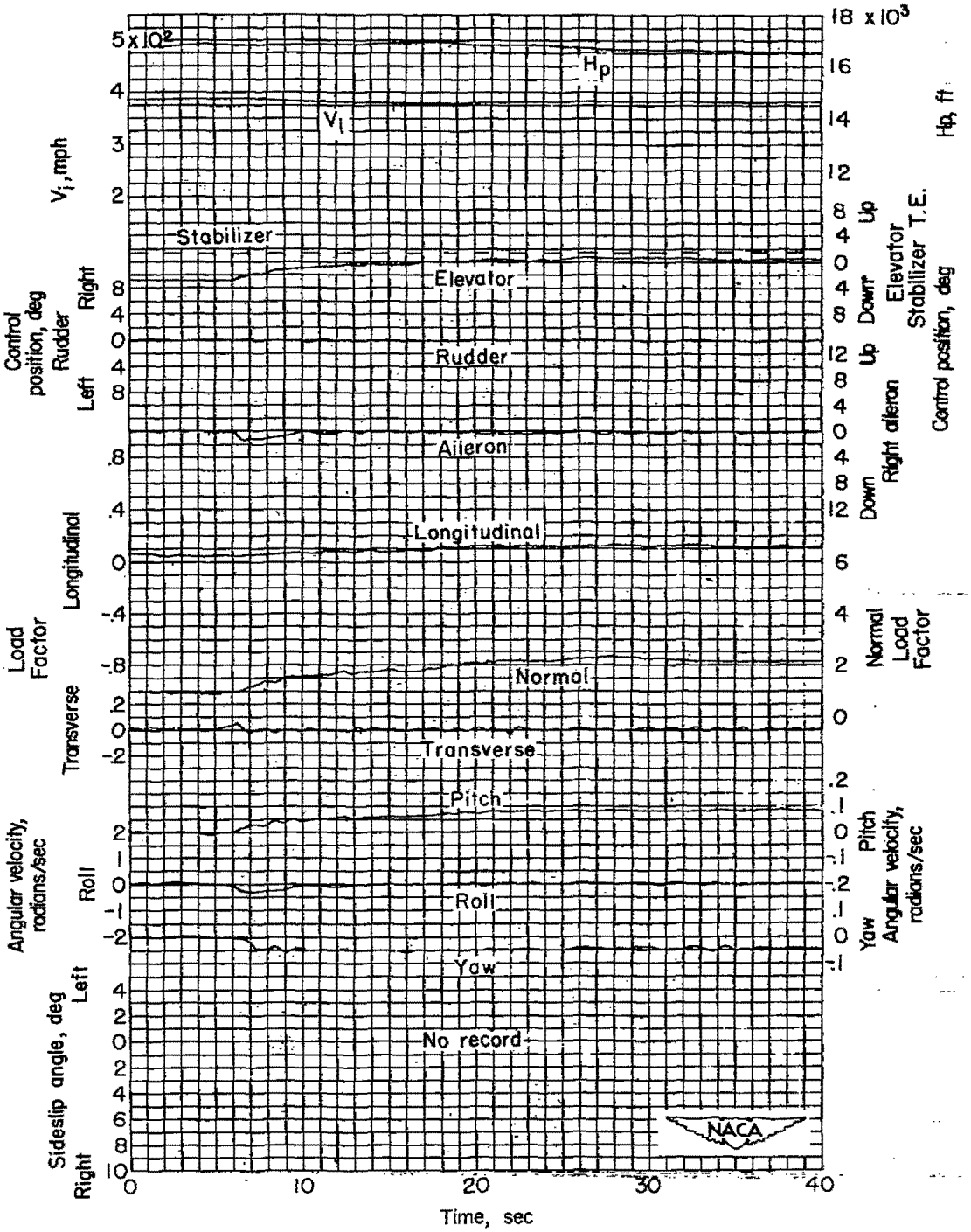


Figure 103.- Left turn. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

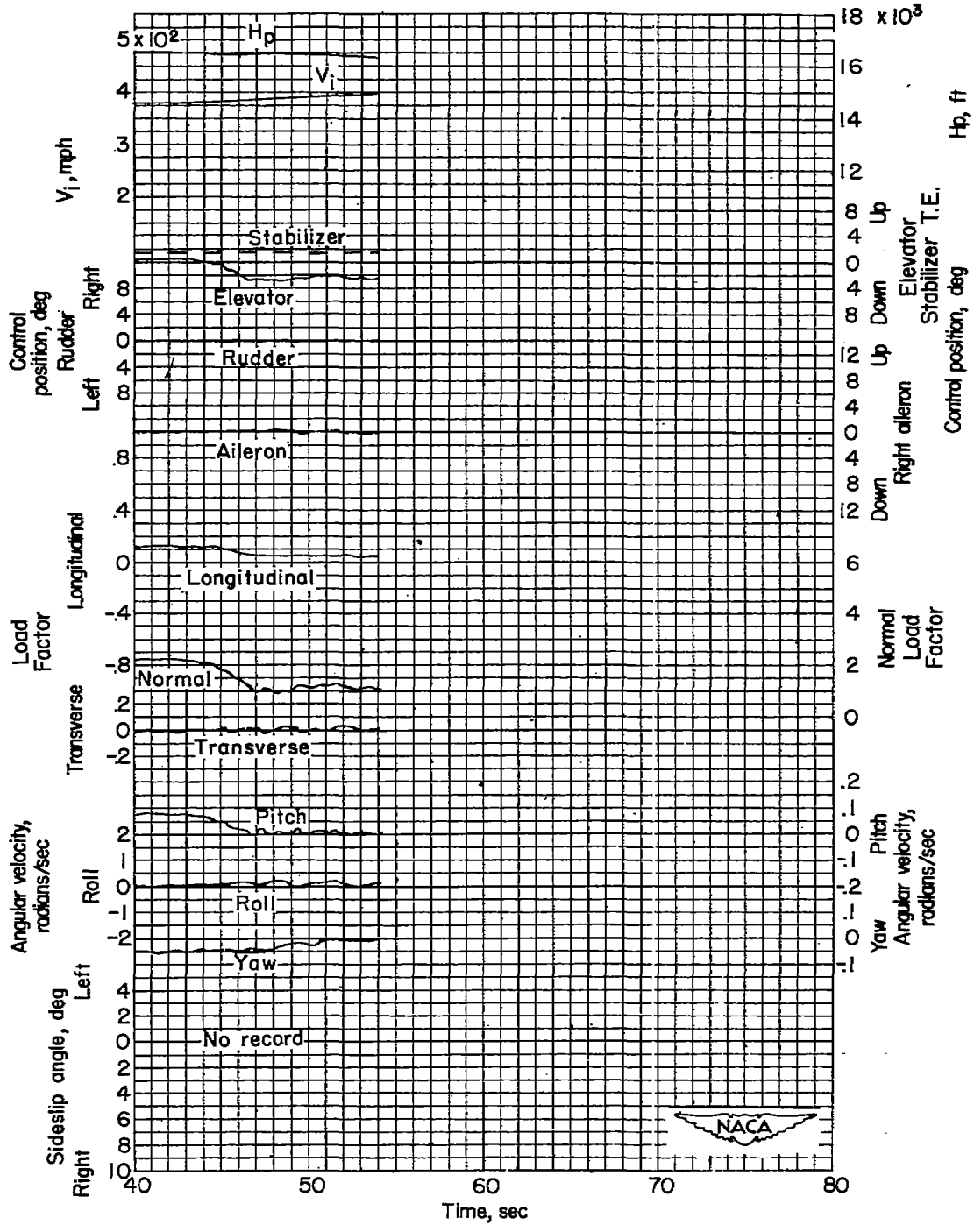


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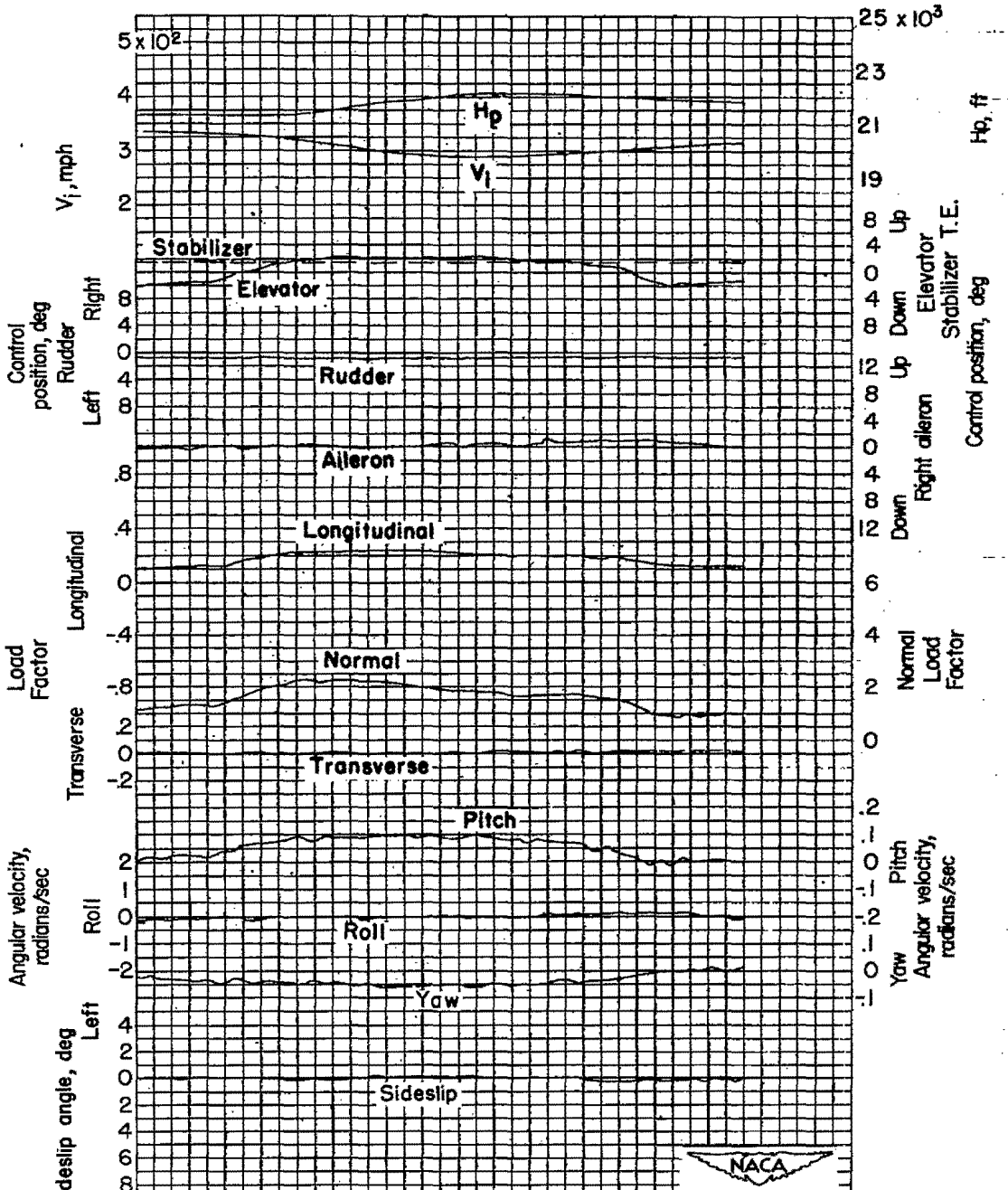


Figure 104.- Left turn. Airplane weight, 13,650 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

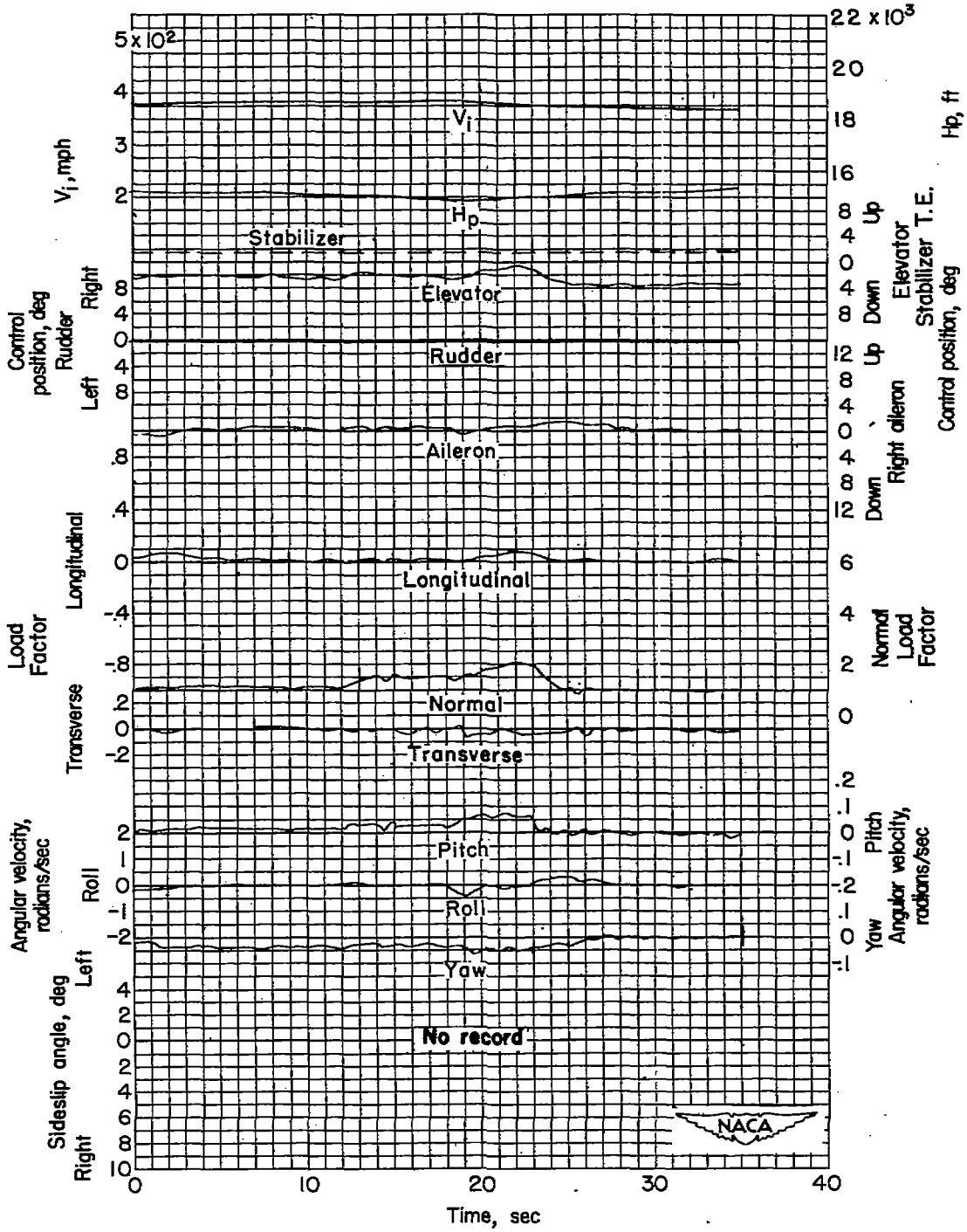


Figure 105.- Left turn. Airplane weight, 13,850 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

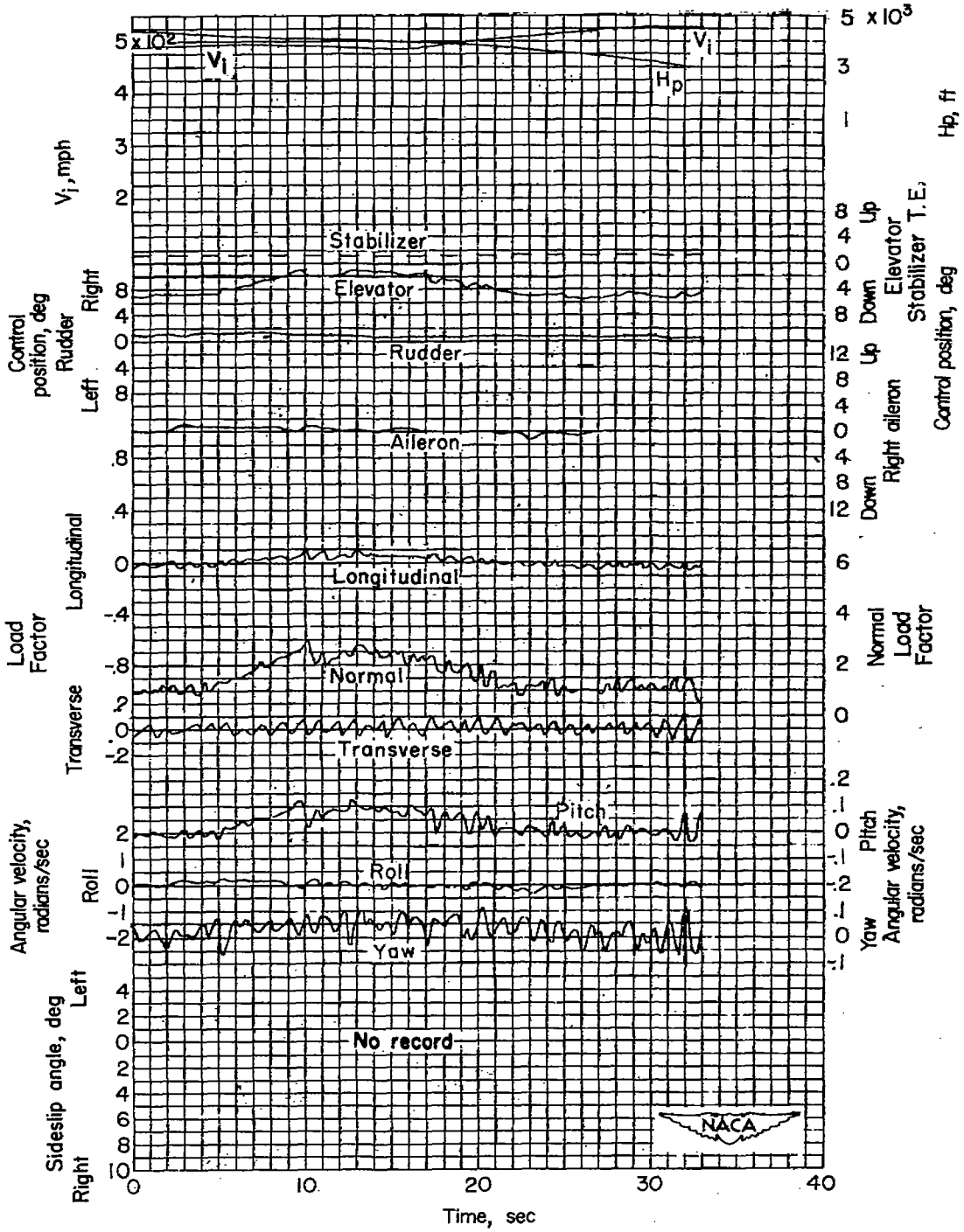


Figure 106.- Right turn. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

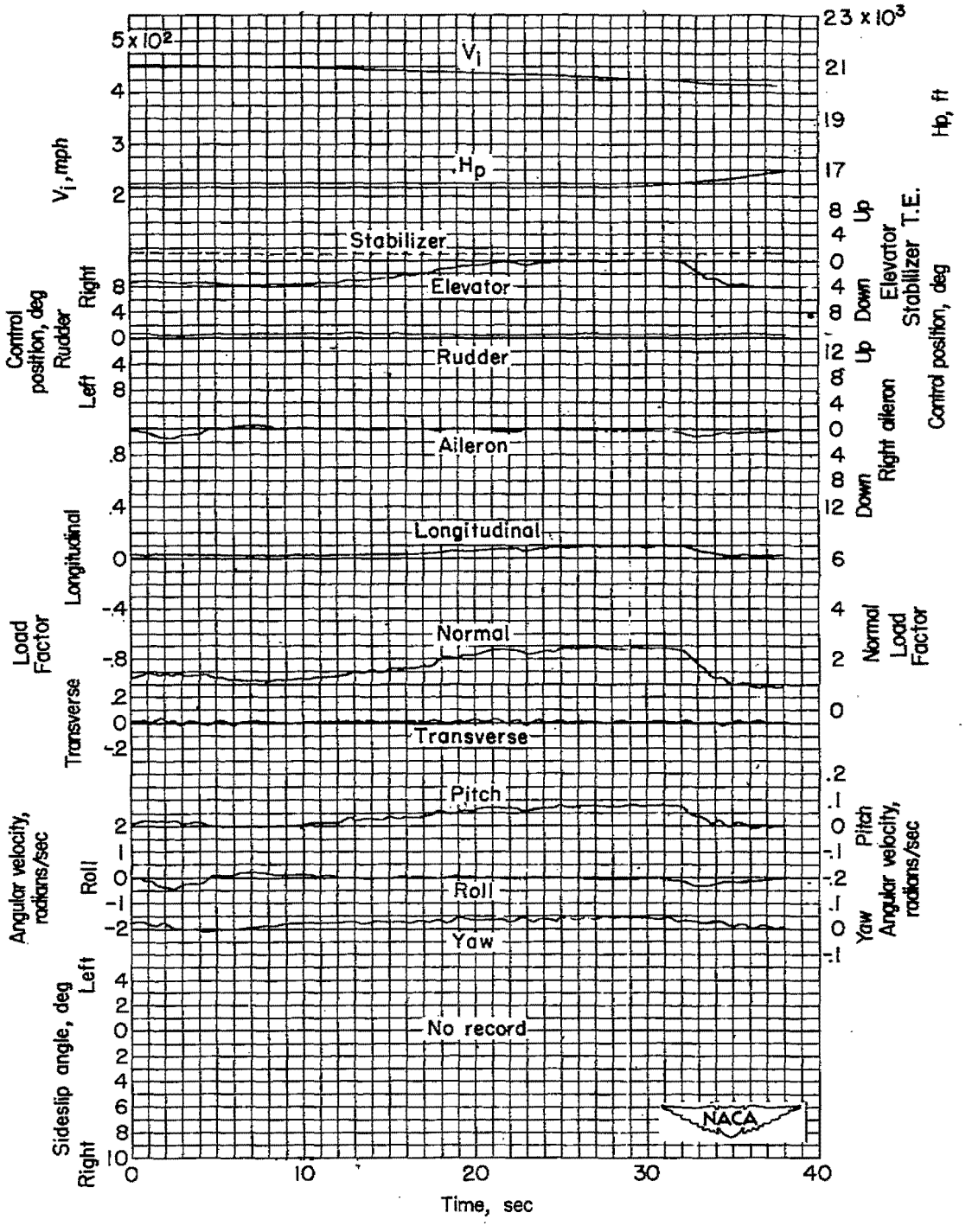


Figure 107.- Right turn. Airplane weight, 13,050 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

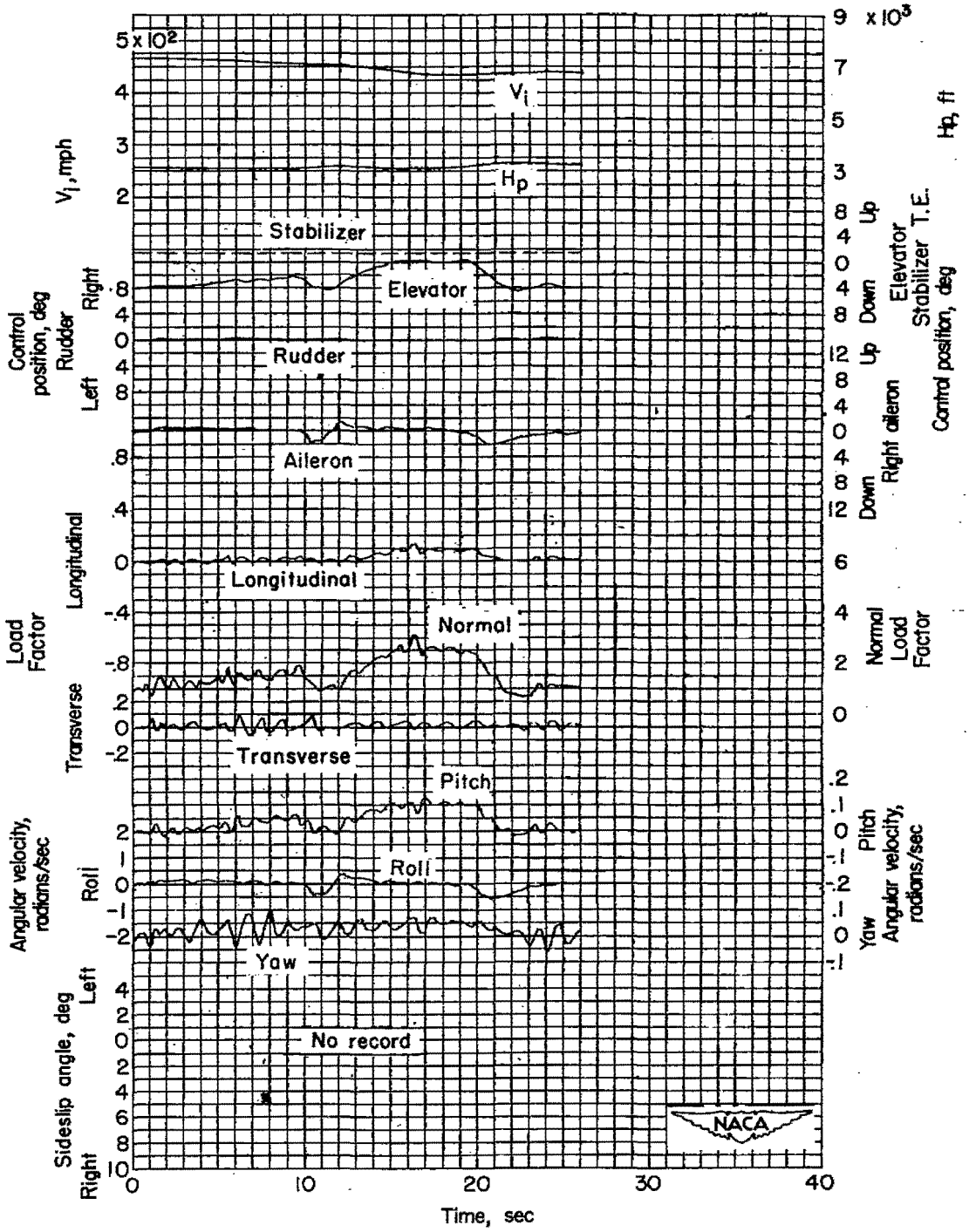


Figure 108.- Right turns. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

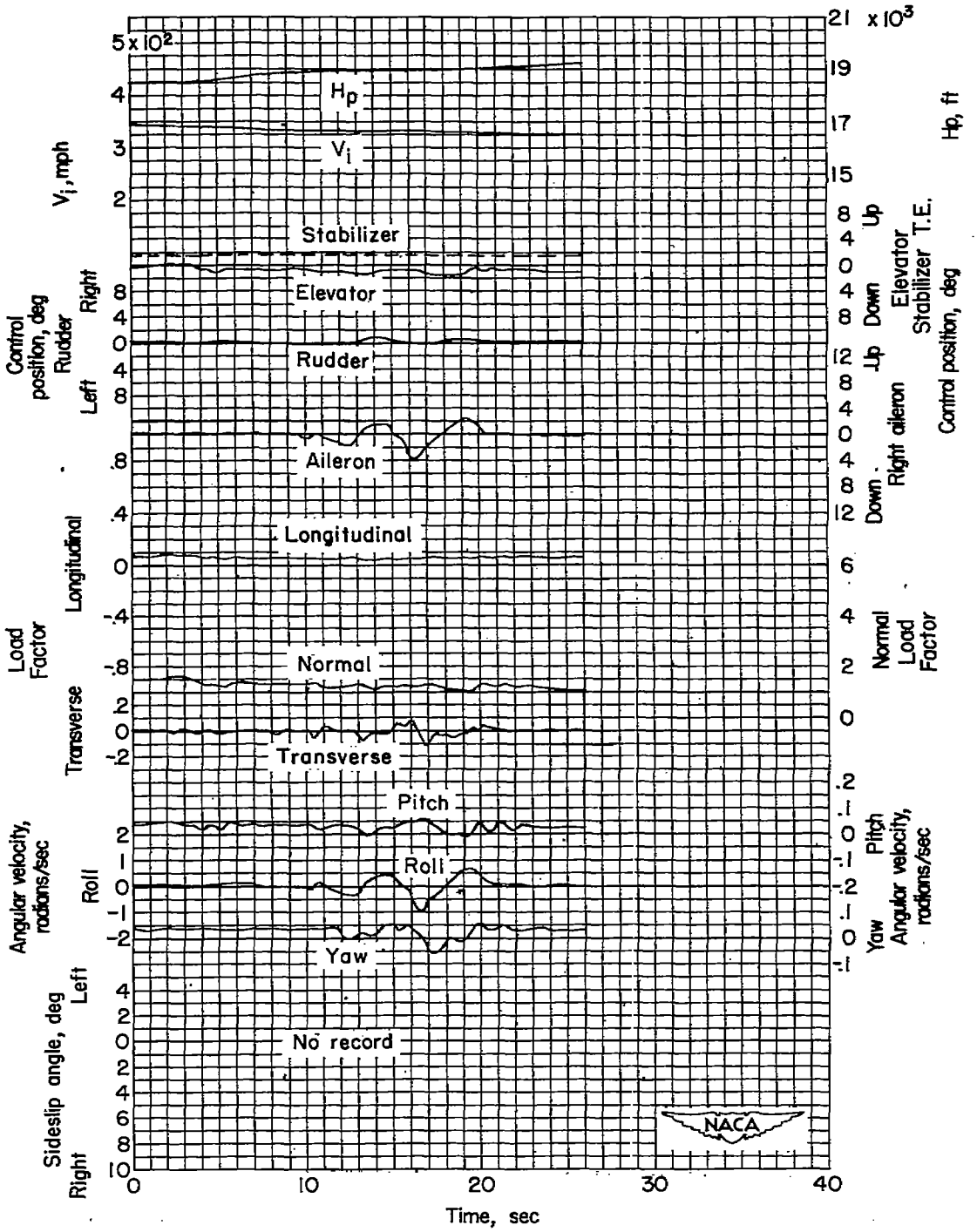


Figure 109.- Right turns. Airplane weight, 13,850 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

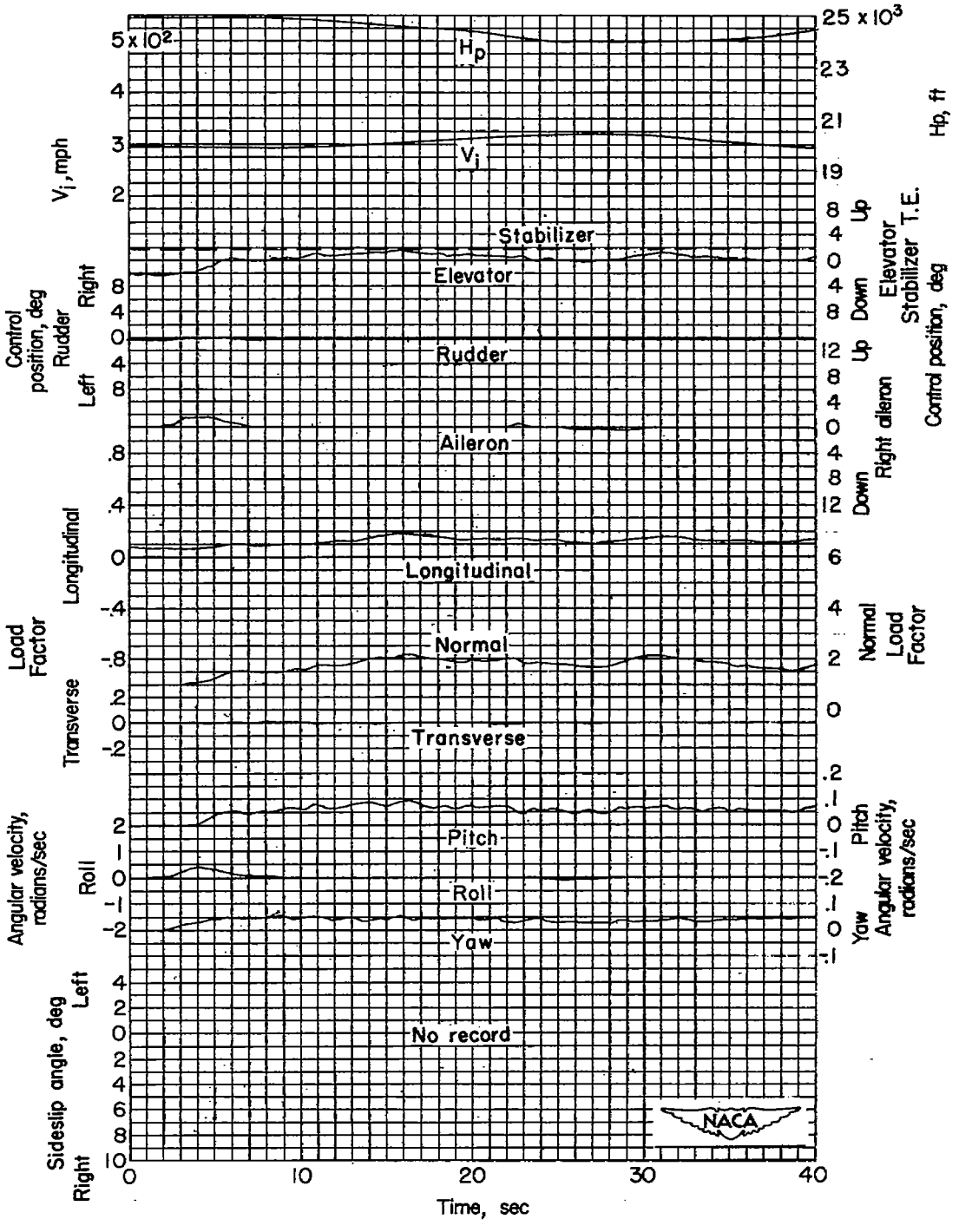


Figure 110.- Right turn. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

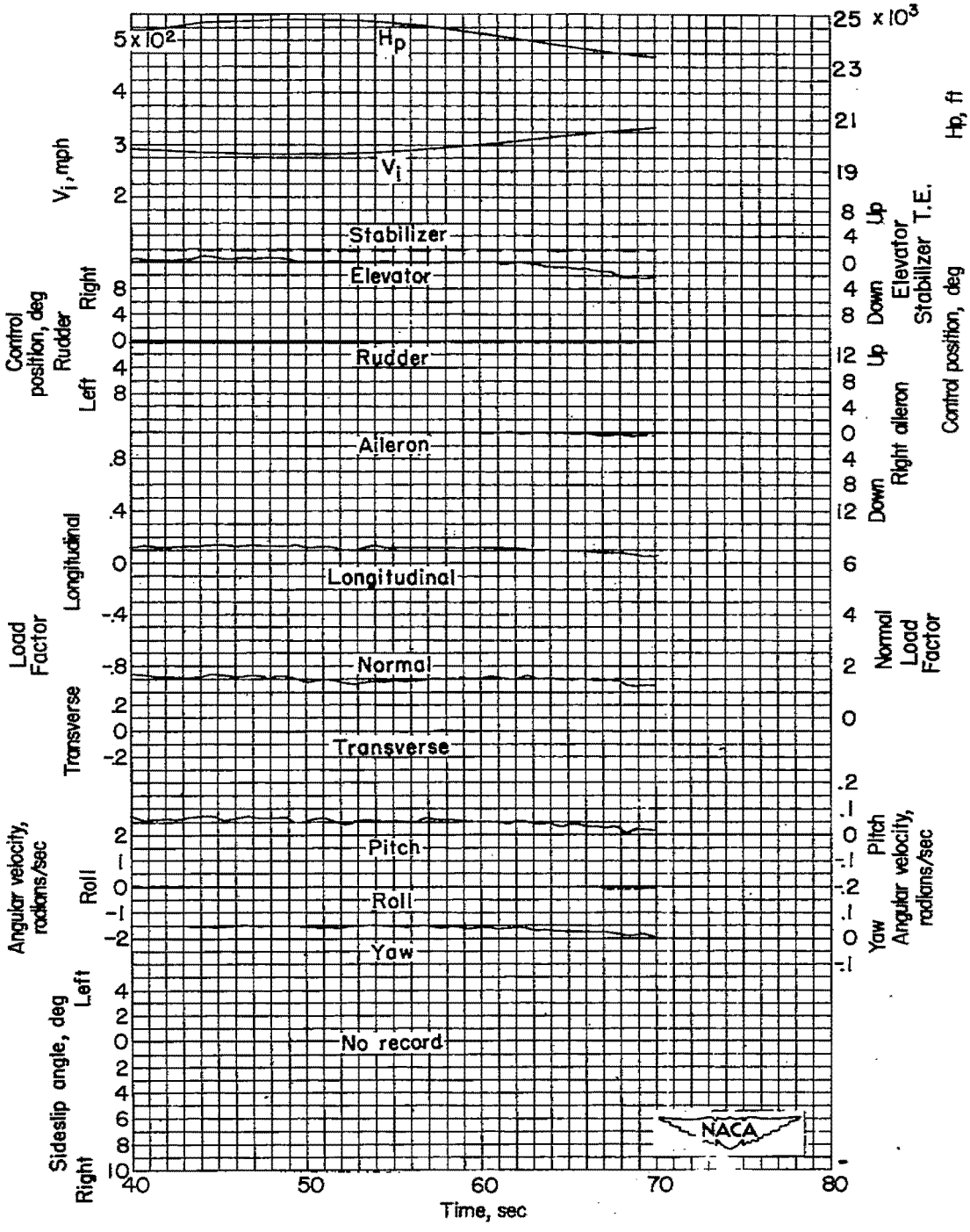


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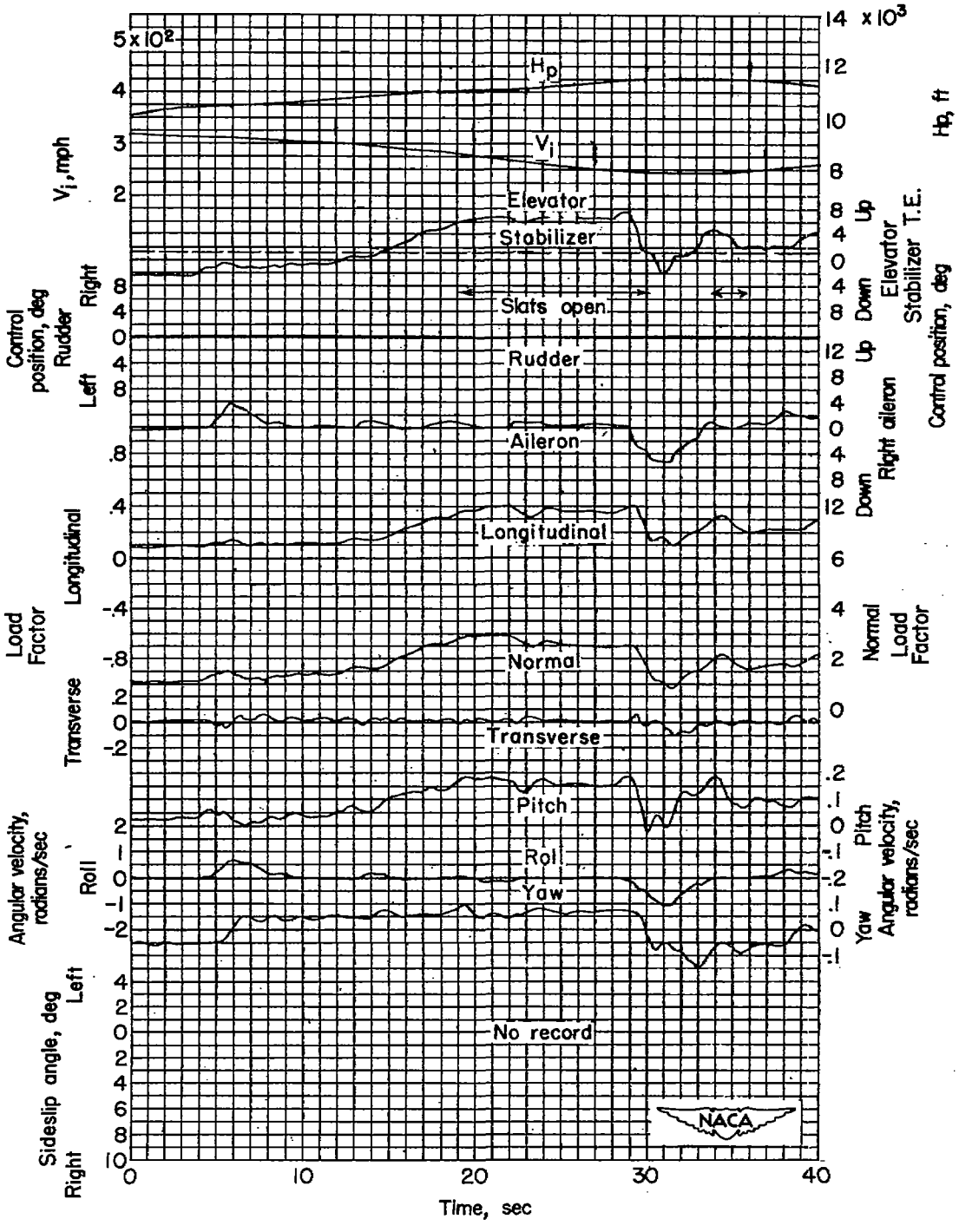


Figure 111.- Right and left turns. Airplane weight, 13,200 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

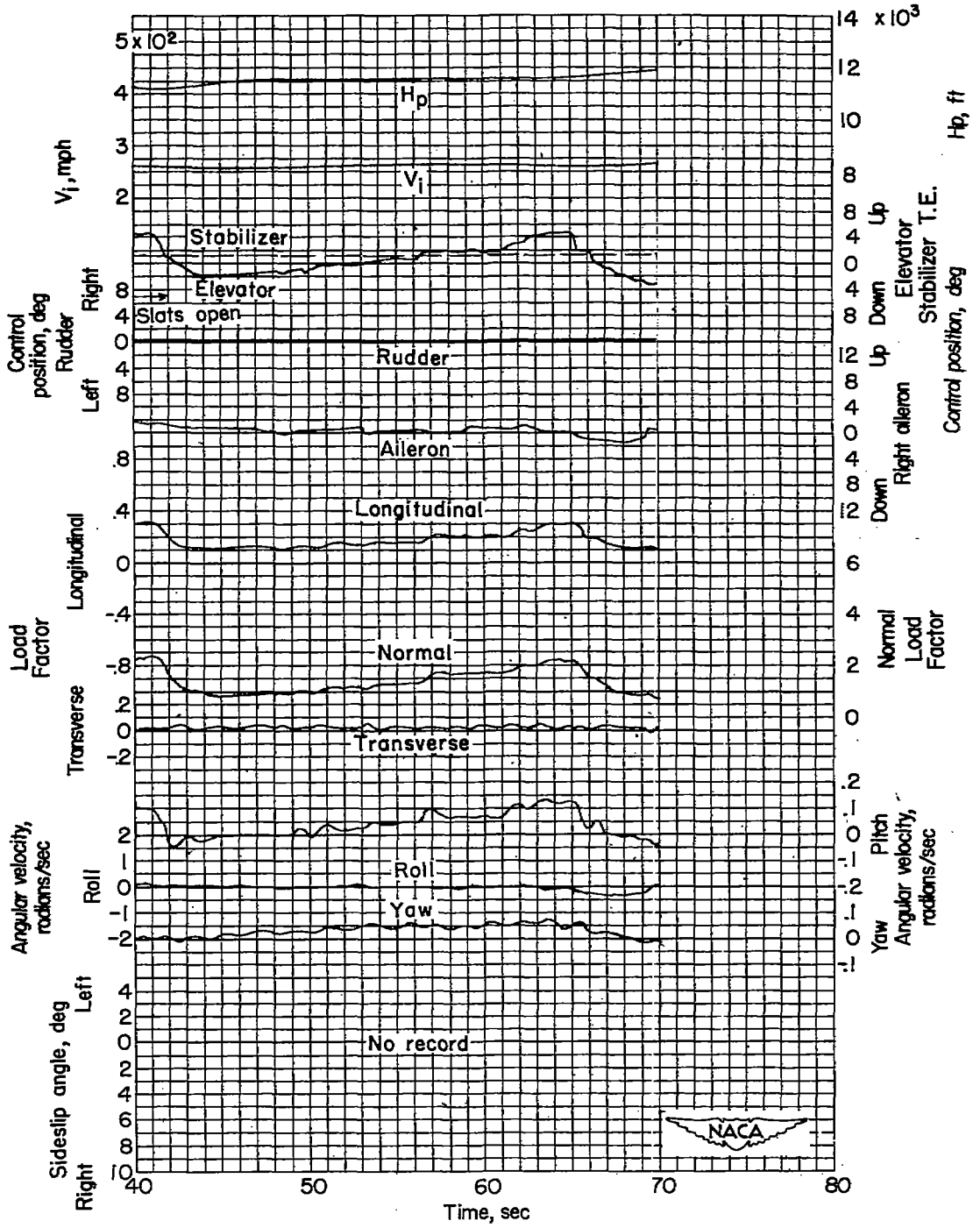


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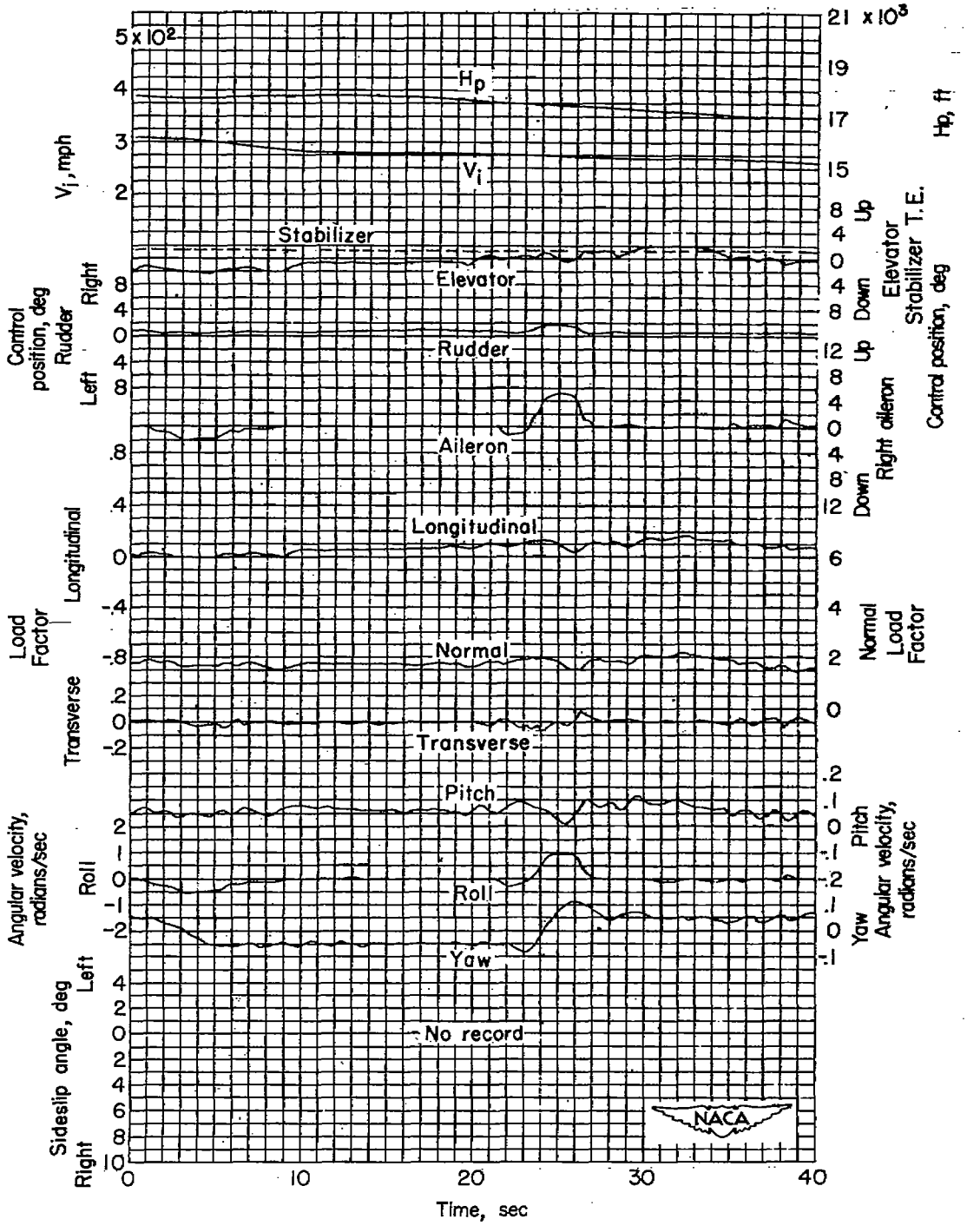


Figure 112.- Left and right turns; airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

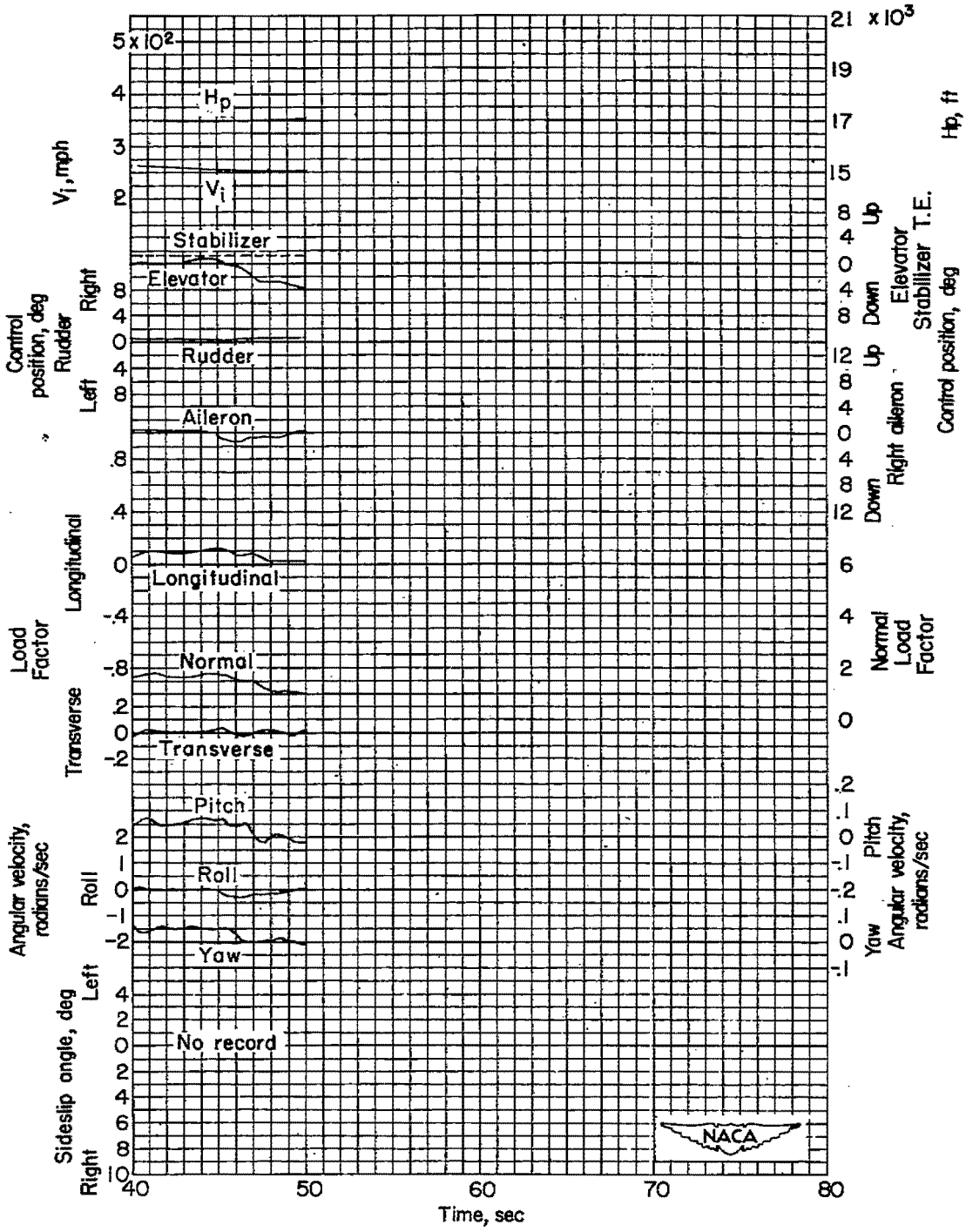


Figure 112.- Concluded.

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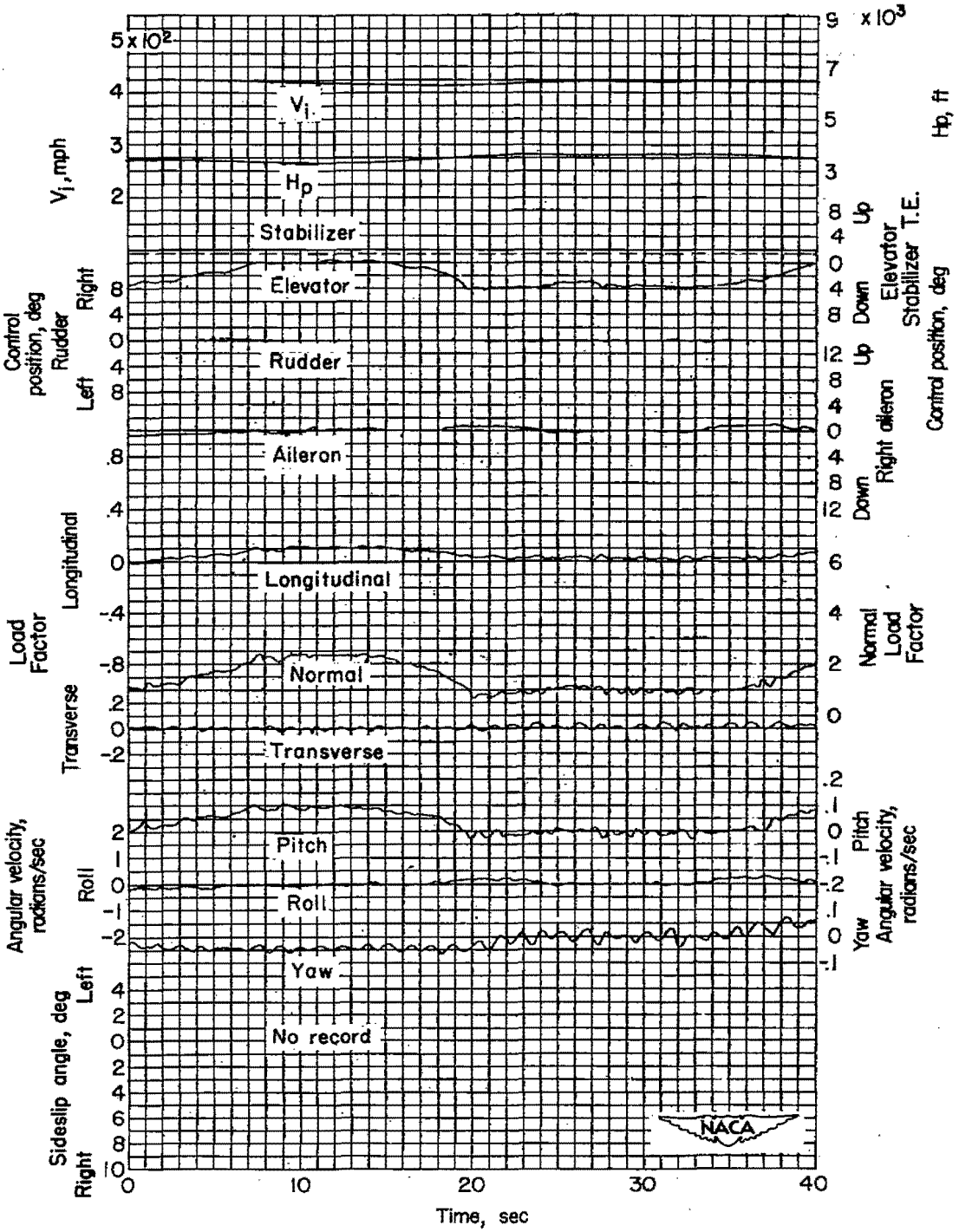


Figure 113.- Left and right turns. Airplane weight, 13,650 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

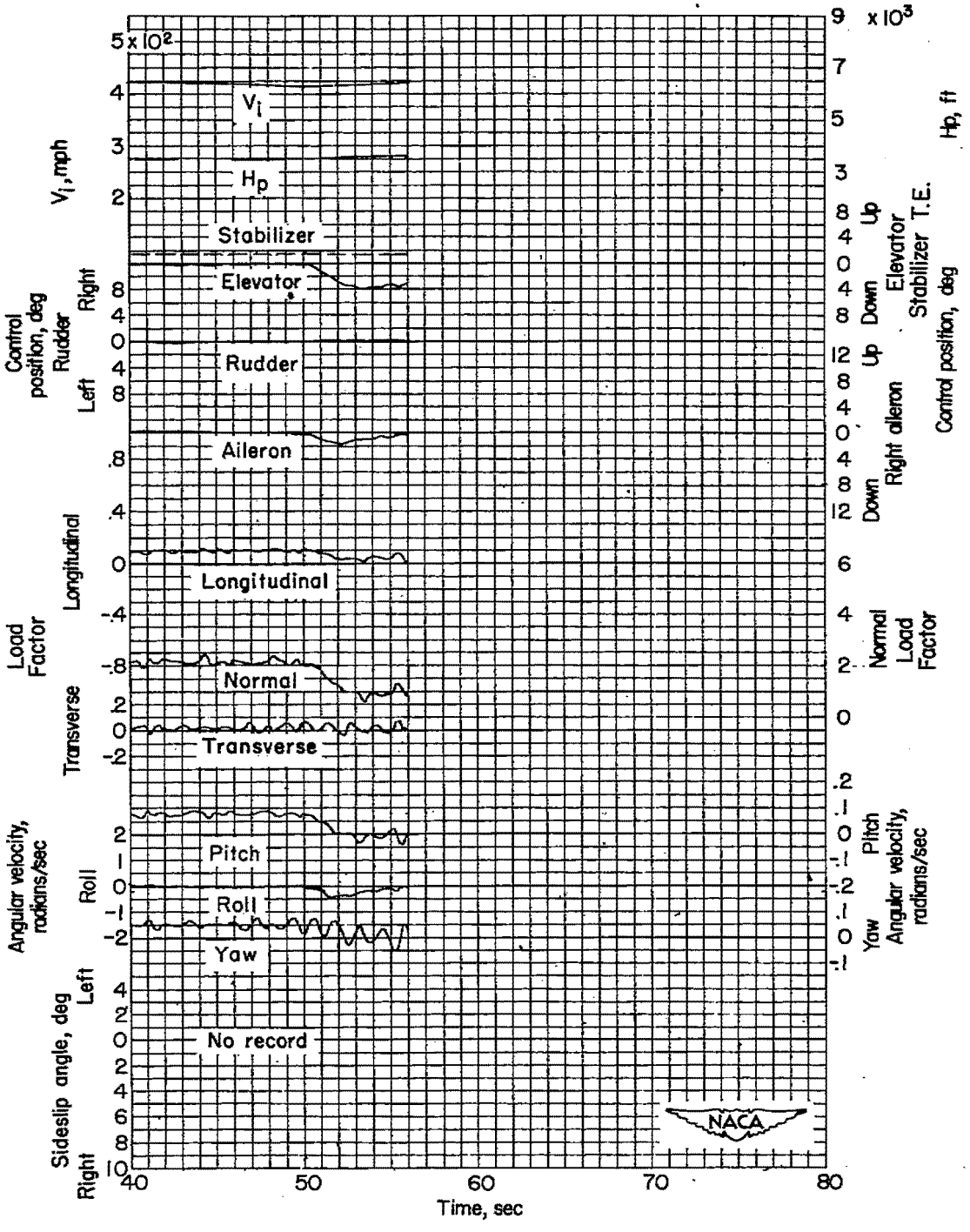


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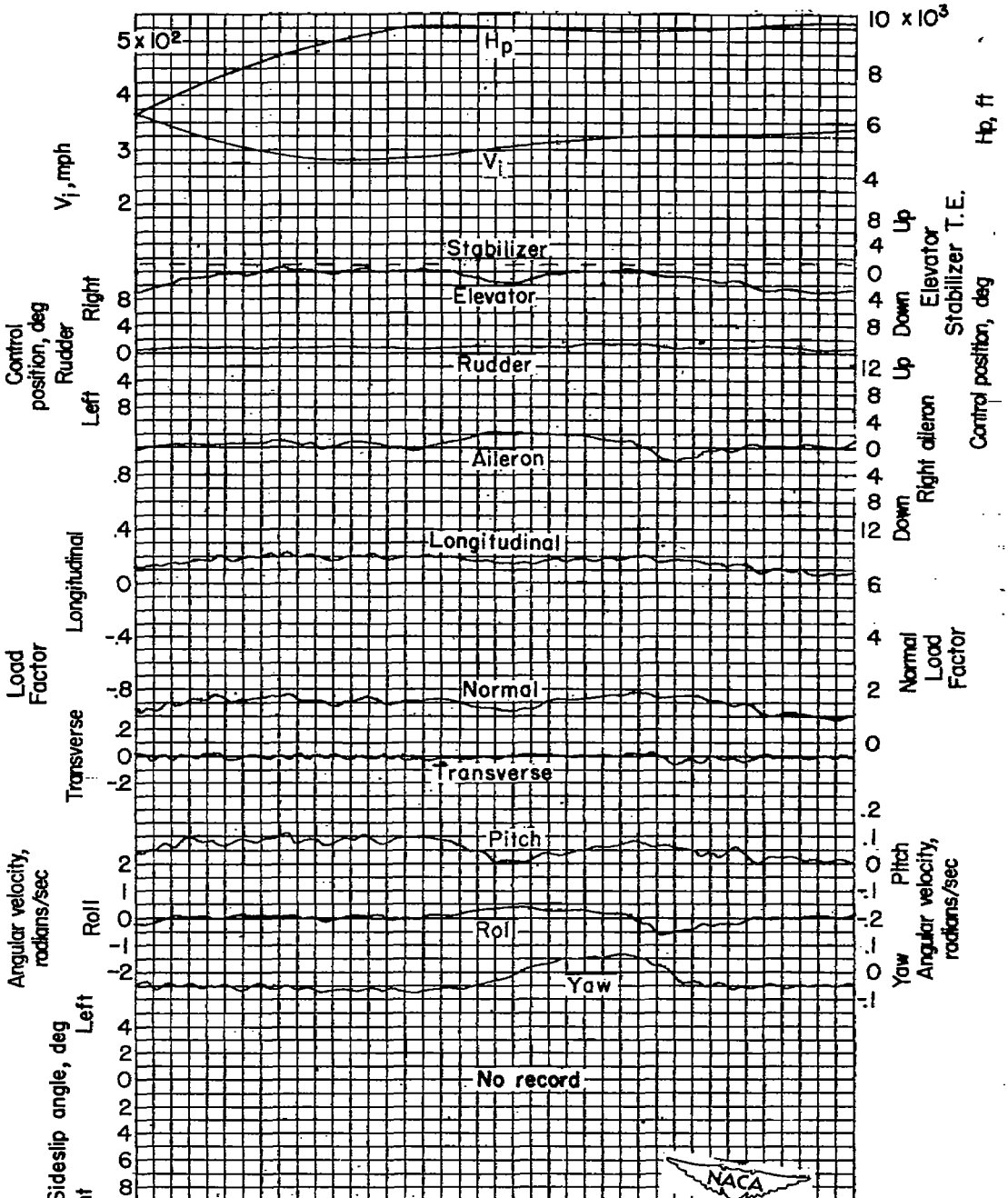


Figure 114.- Climbing left turn followed by a right and left turn. Airplane weight, 12,750 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

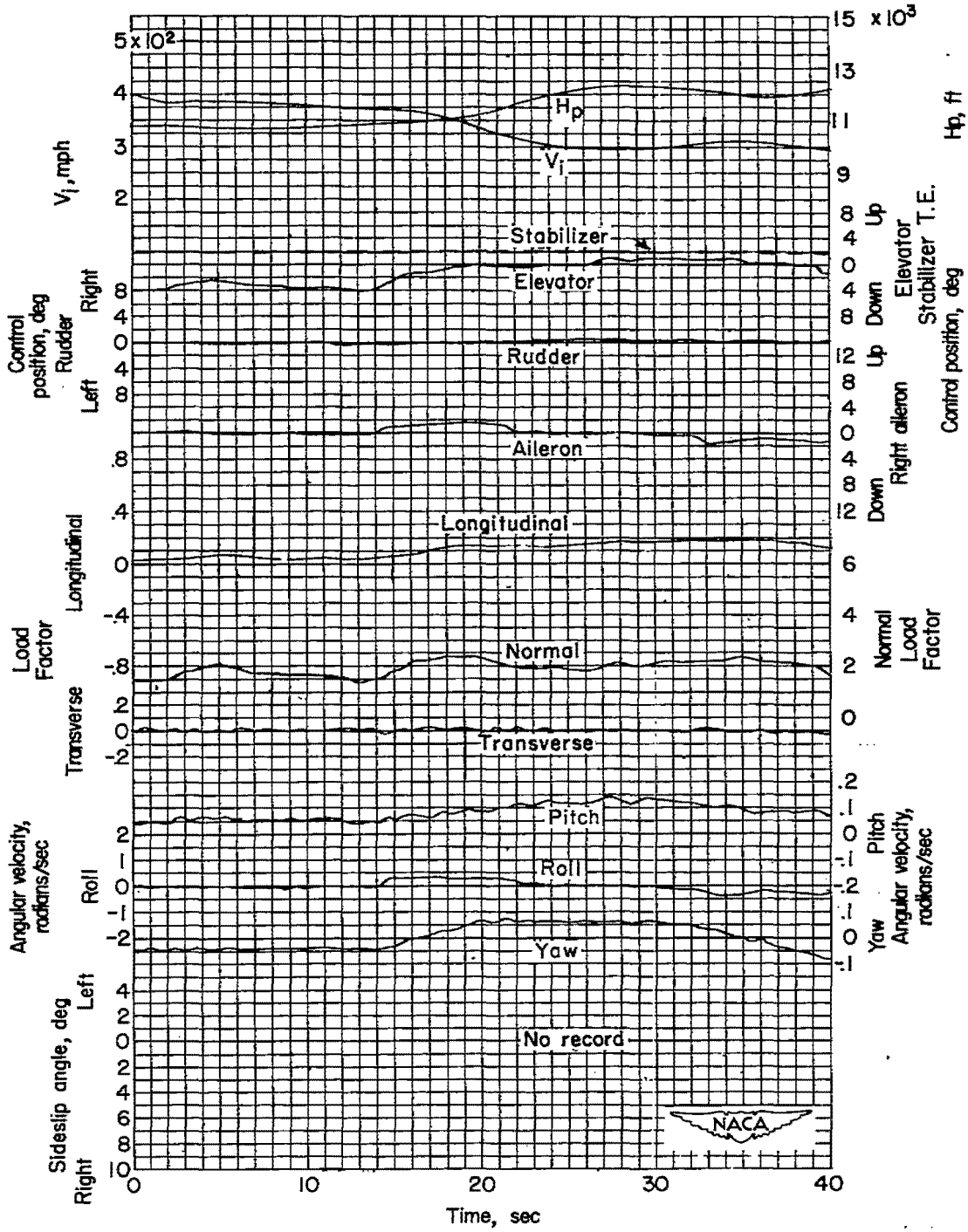


Figure 115.- Left turn, climbing right turn followed by left and right turn. Airplane weight, 11,950 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

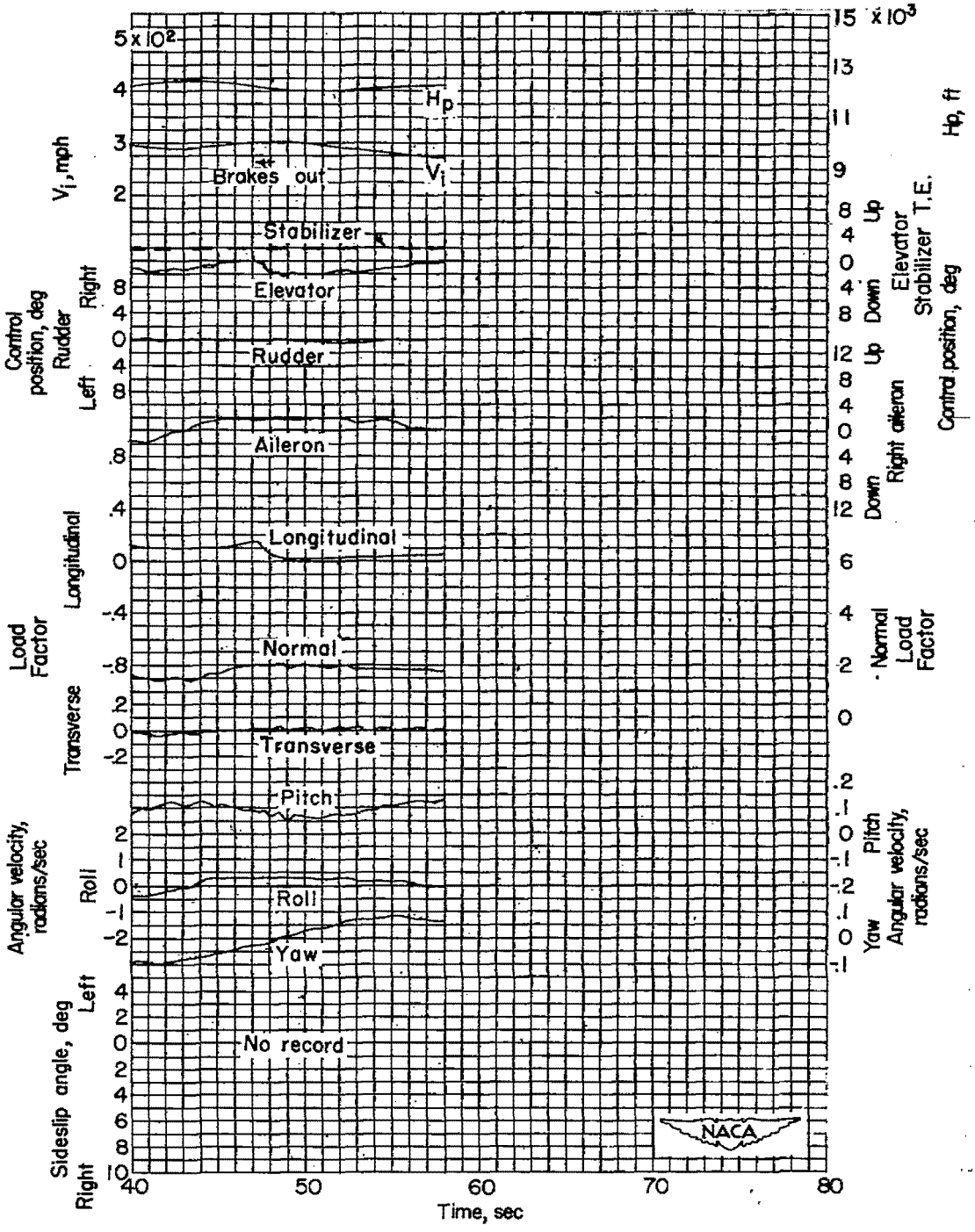


Figure 115.- Concluded.

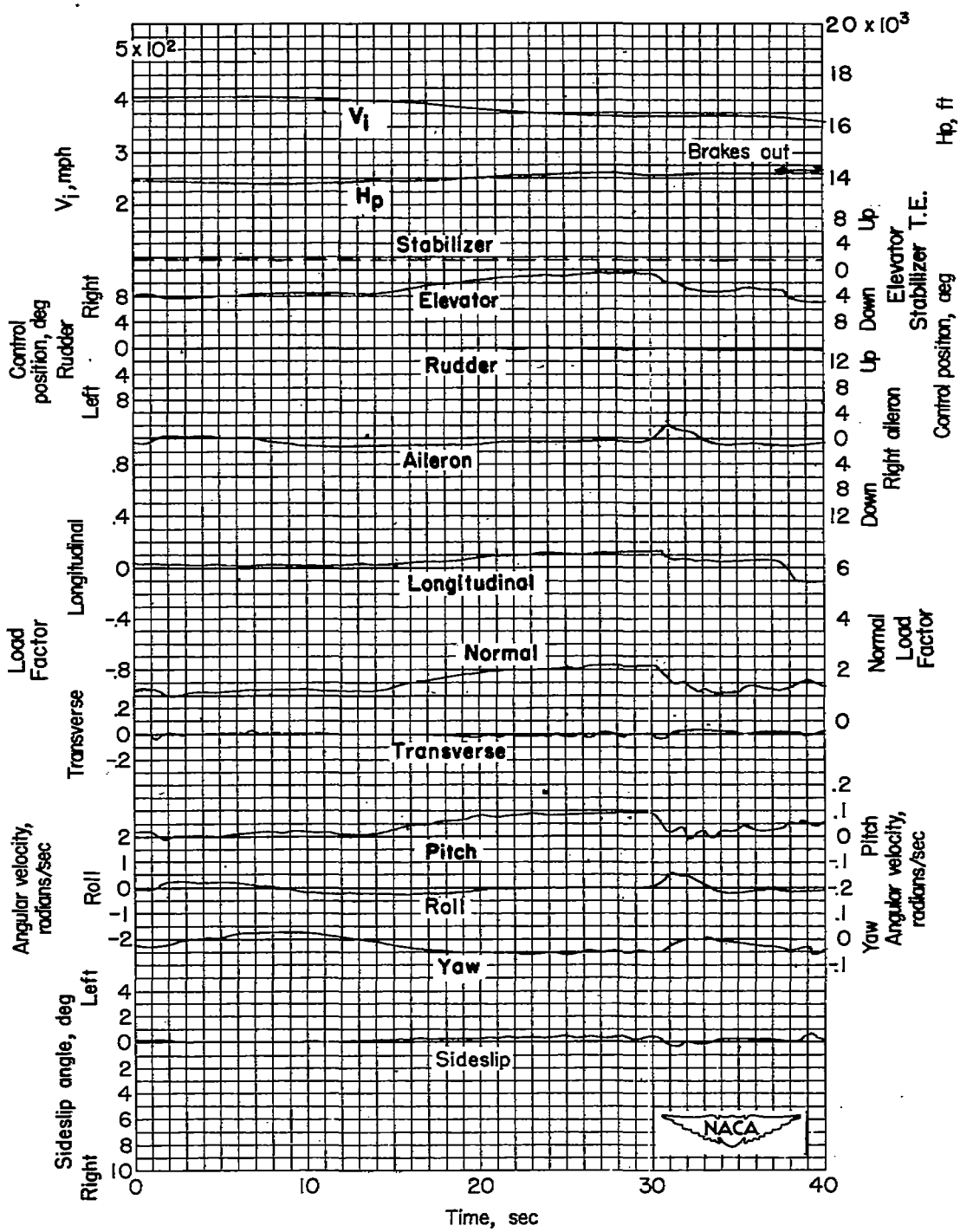


Figure 116.- Right and left turns. Airplane weight, 12,950 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

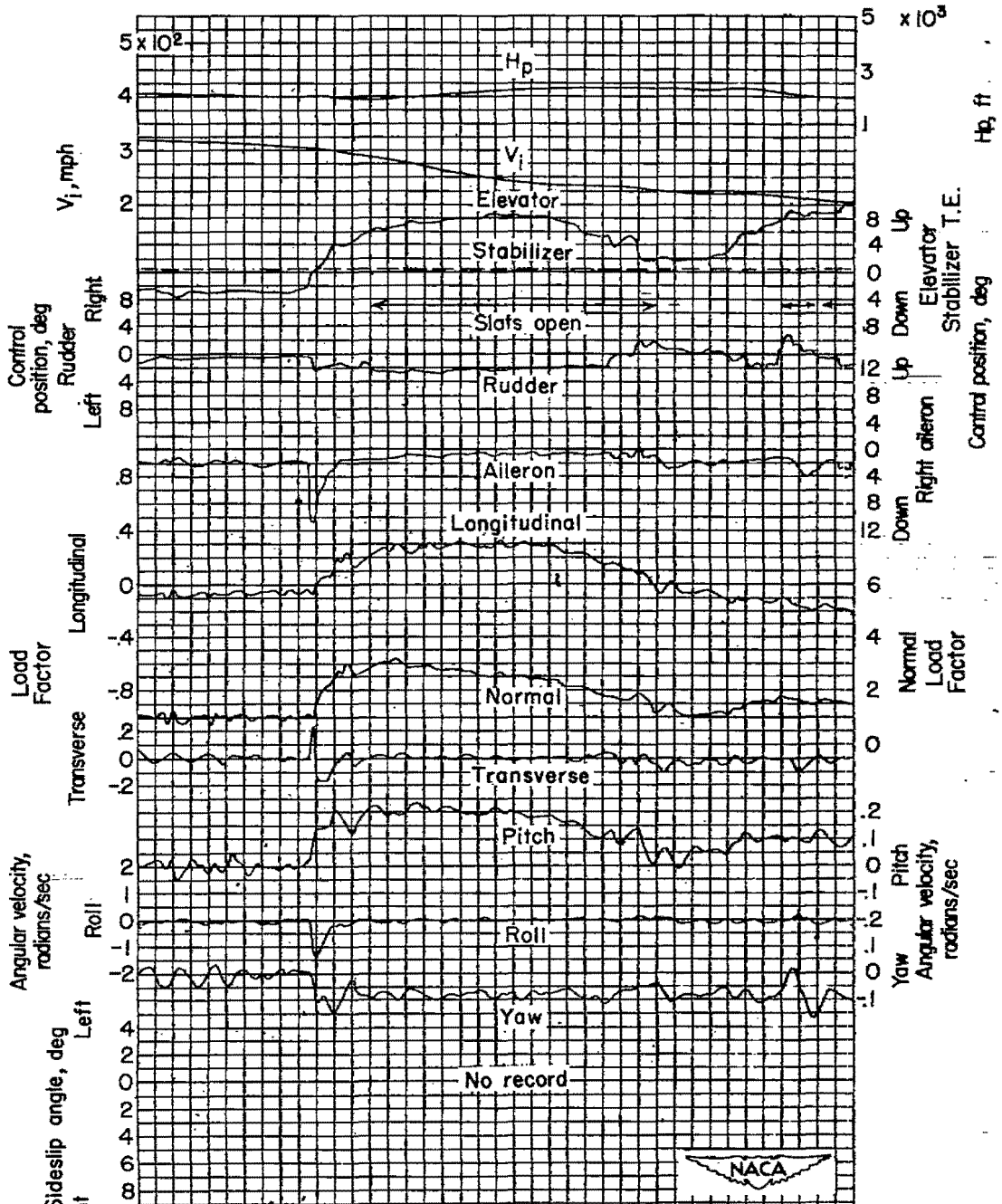


Figure 117.- Sharp left turn. Airplane weight, 11,750 pounds; center-of gravity location, 21.6 percent of the mean aerodynamic chord.

[redacted]

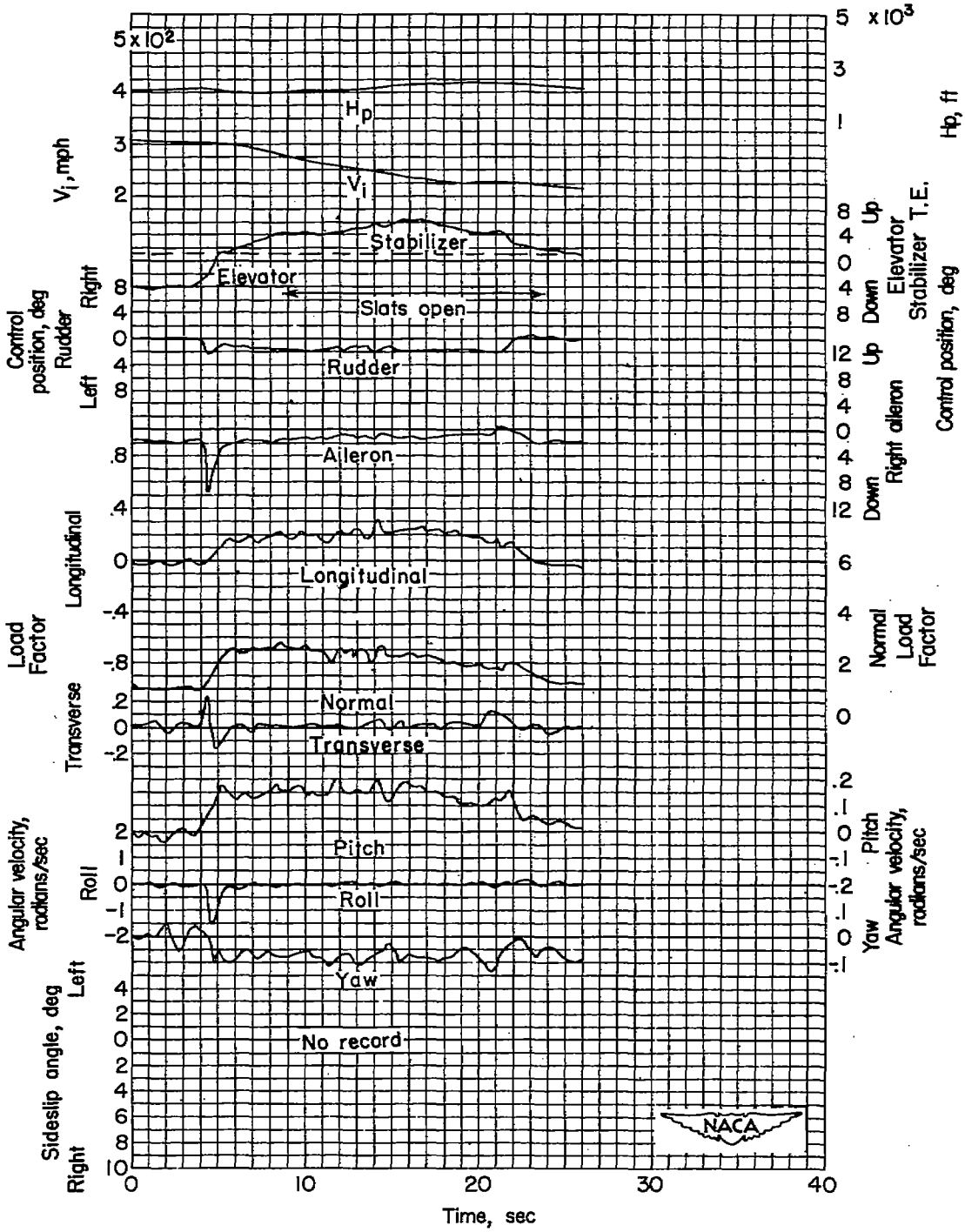


Figure 118.- Sharp left turn. Airplane weight, 11,950 pounds; center-of gravity location, 21.2 percent of the mean aerodynamic chord.

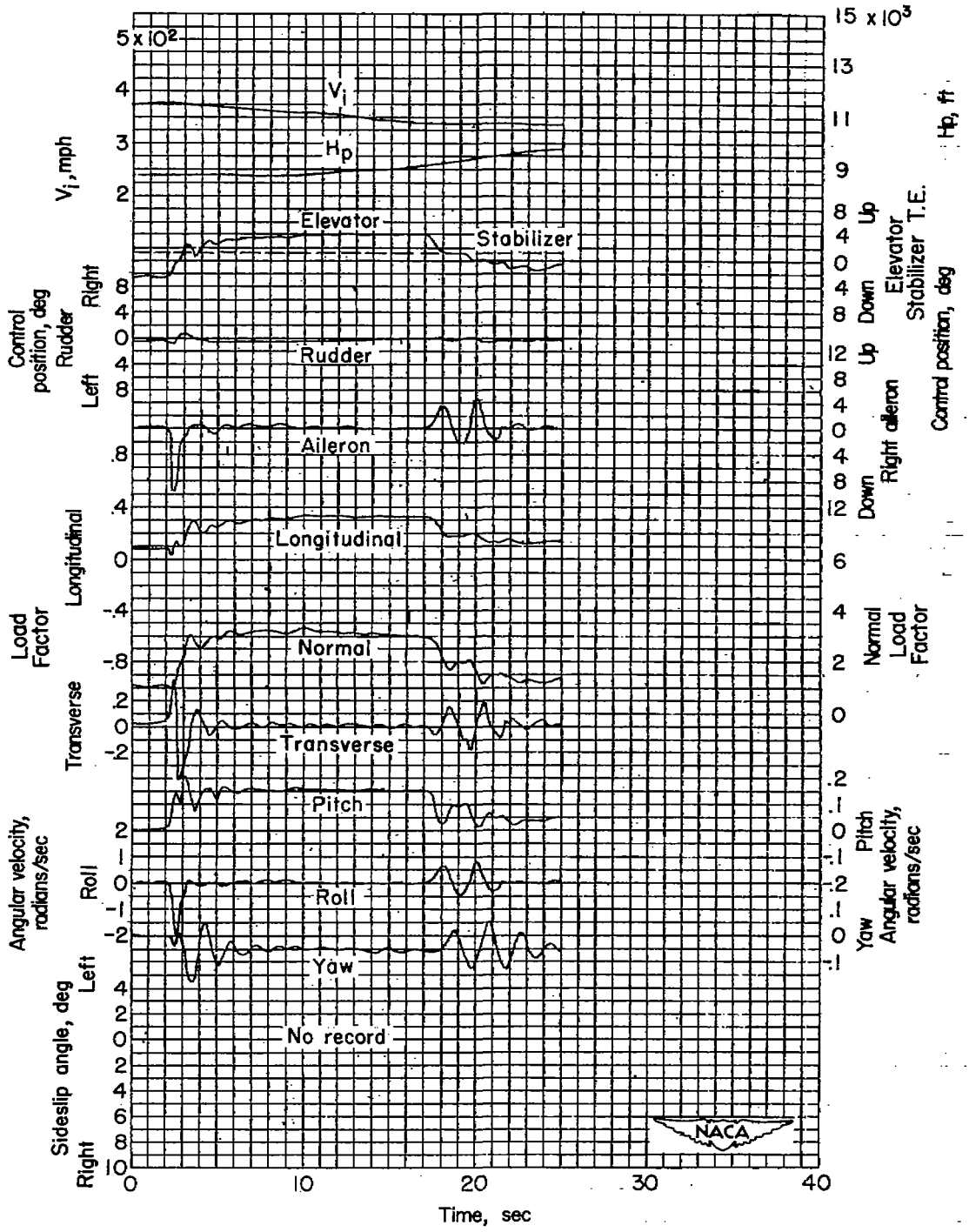


Figure 119.- Sharp left turn. Airplane weight, 13,400 pounds; center-of gravity location, 21.2 percent of the mean aerodynamic chord.

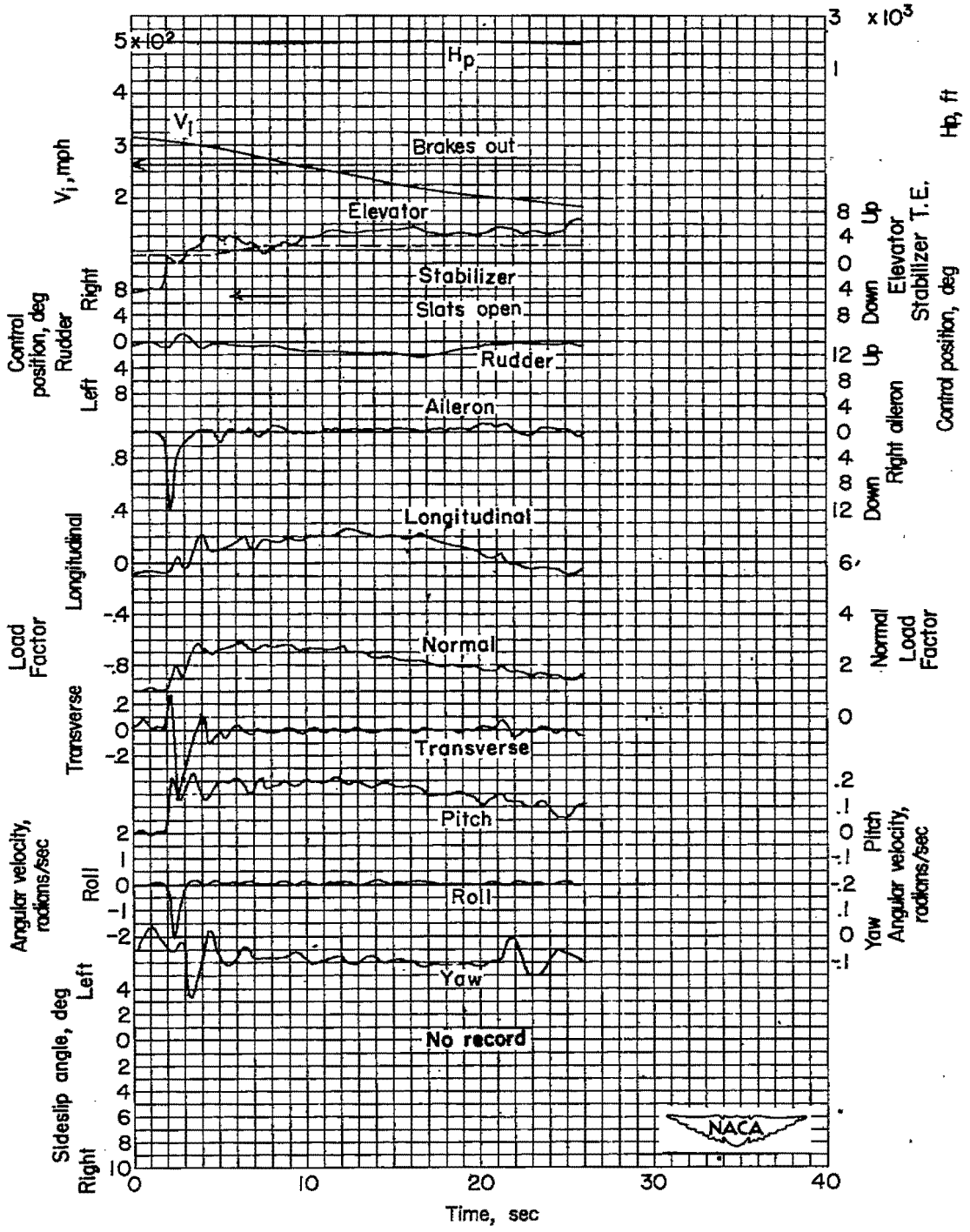


Figure 120.- Sharp left turn. Airplane weight, 12,650 pounds; center-of gravity location, 21.4 percent of the mean aerodynamic chord.

[redacted]

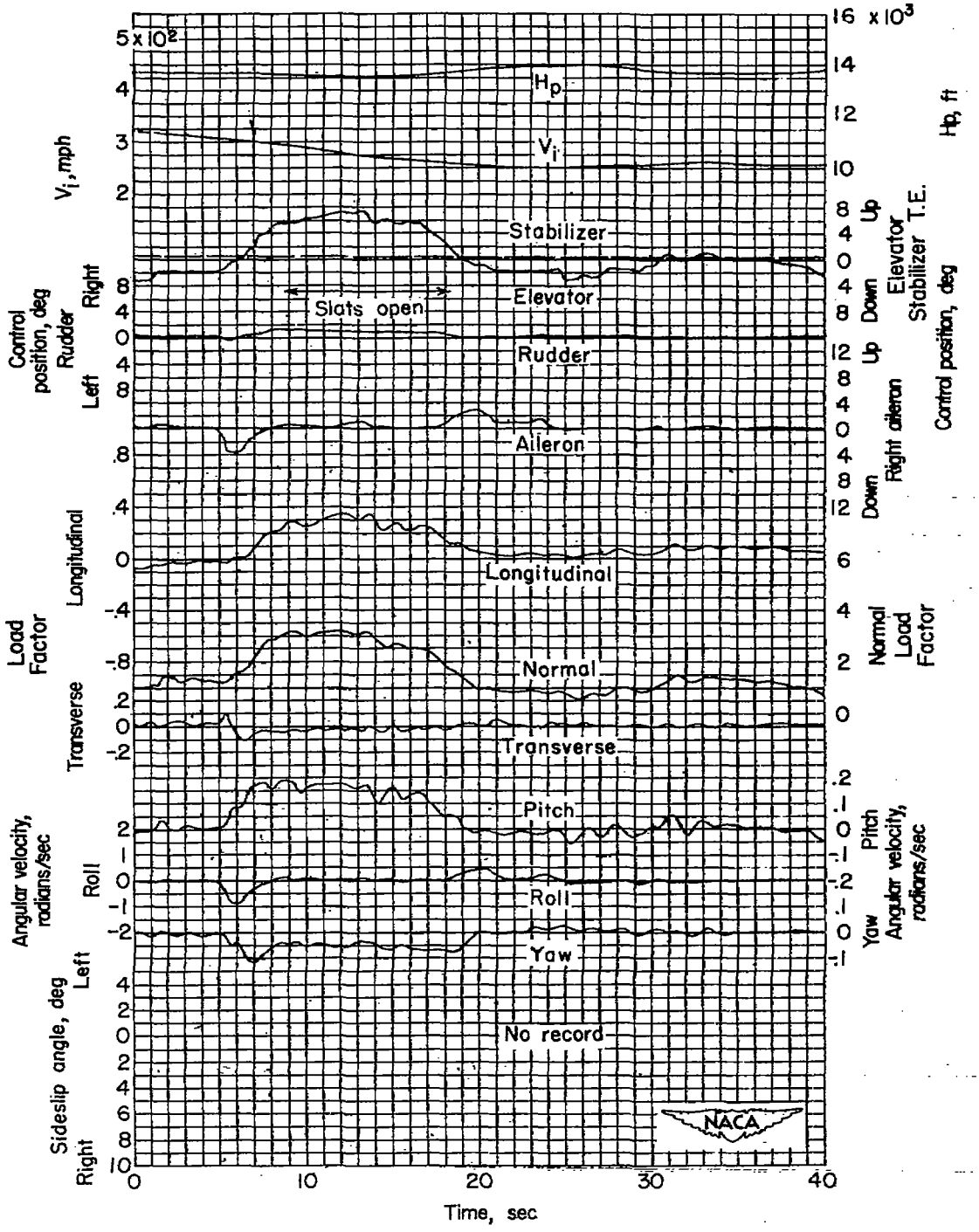


Figure 121.- Sharp left turn. Airplane weight, 12,700 pounds; center-of gravity location, 21.0 percent of the mean aerodynamic chord.

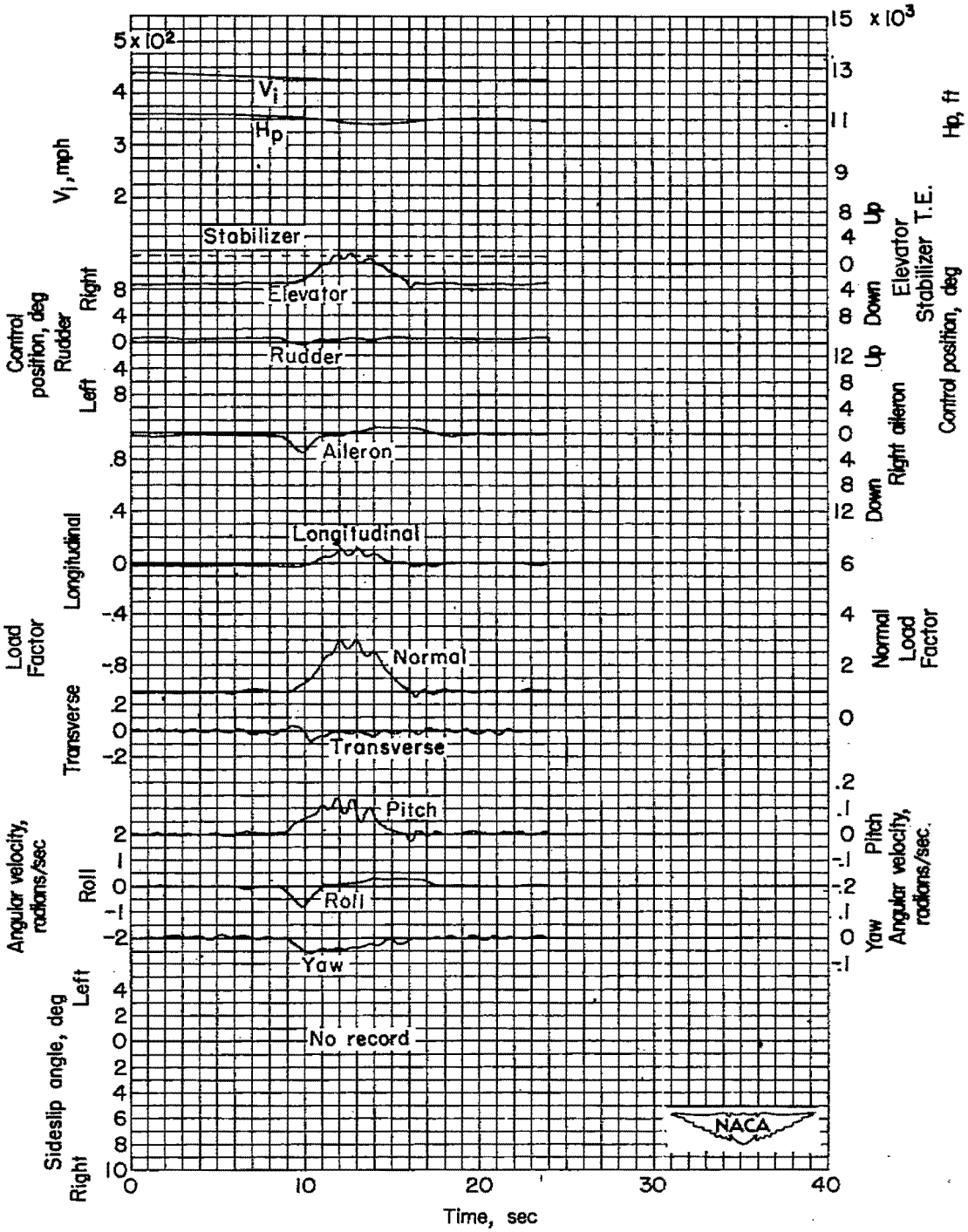


Figure 122.- Sharp left turn. Airplane weight, 12,100 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

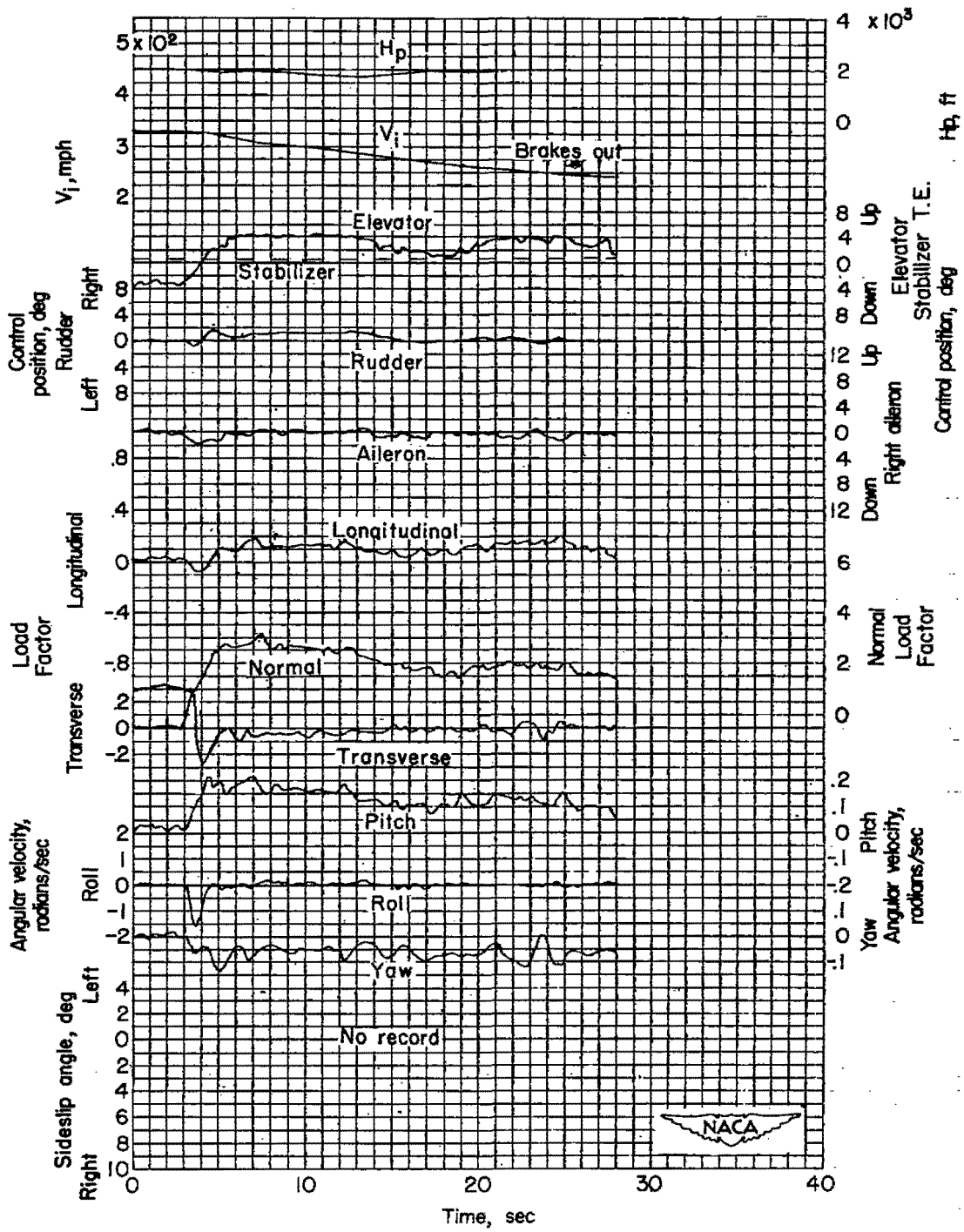


Figure 123.- Sharp left turn. Airplane weight, 12,400 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

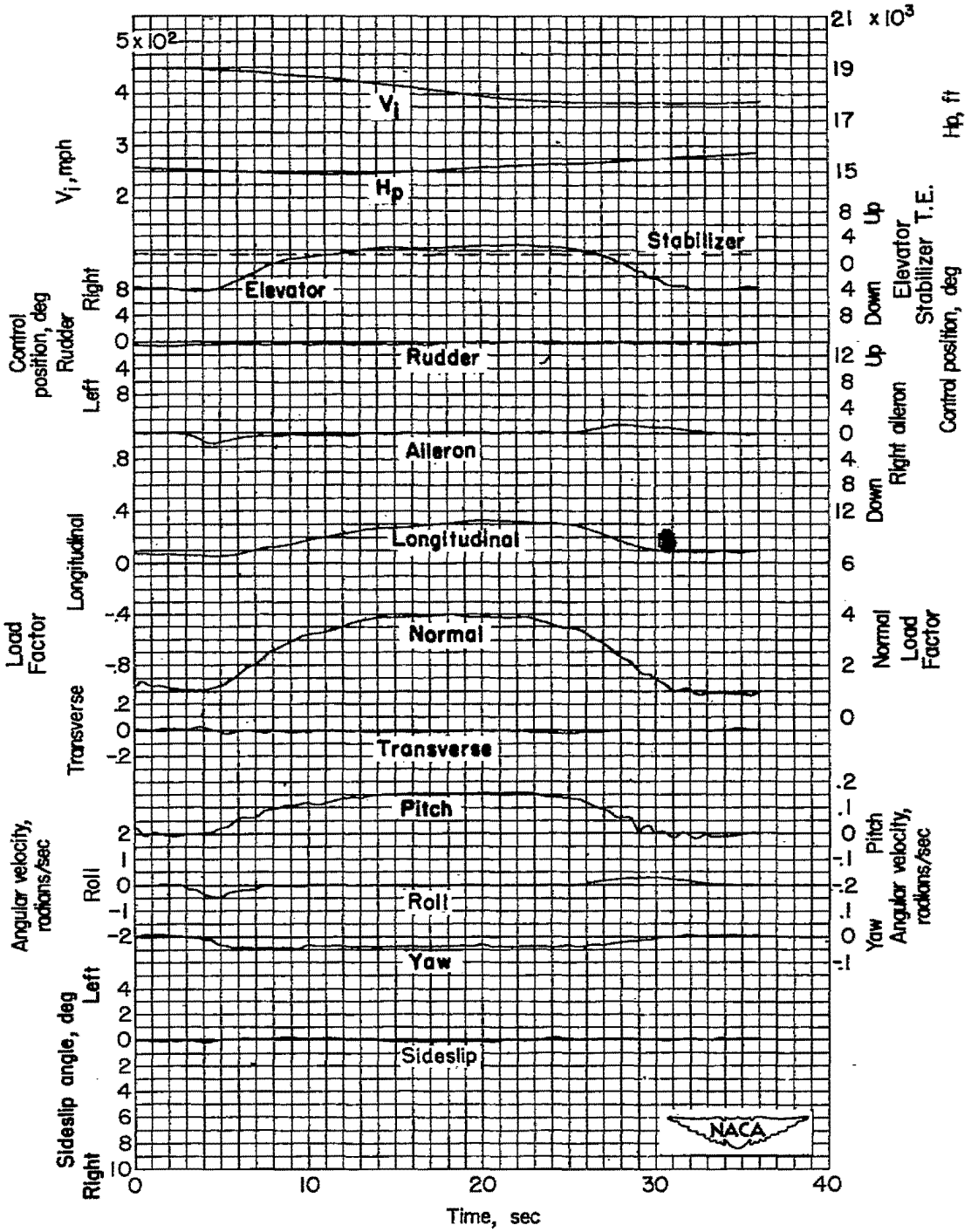


Figure 124.- Sharp left turn. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

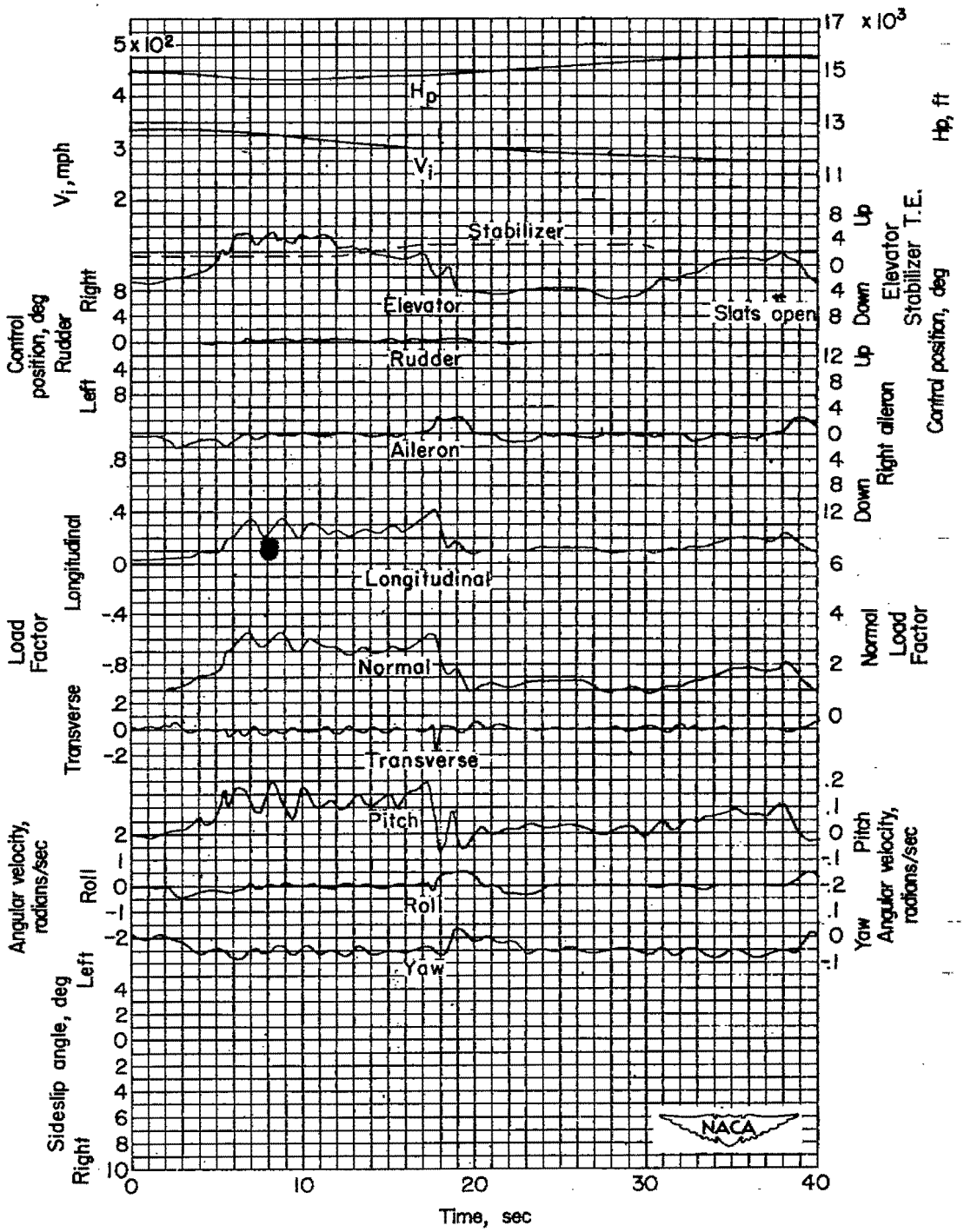


Figure 125.- Sharp left turns. Airplane weight, 13,750 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

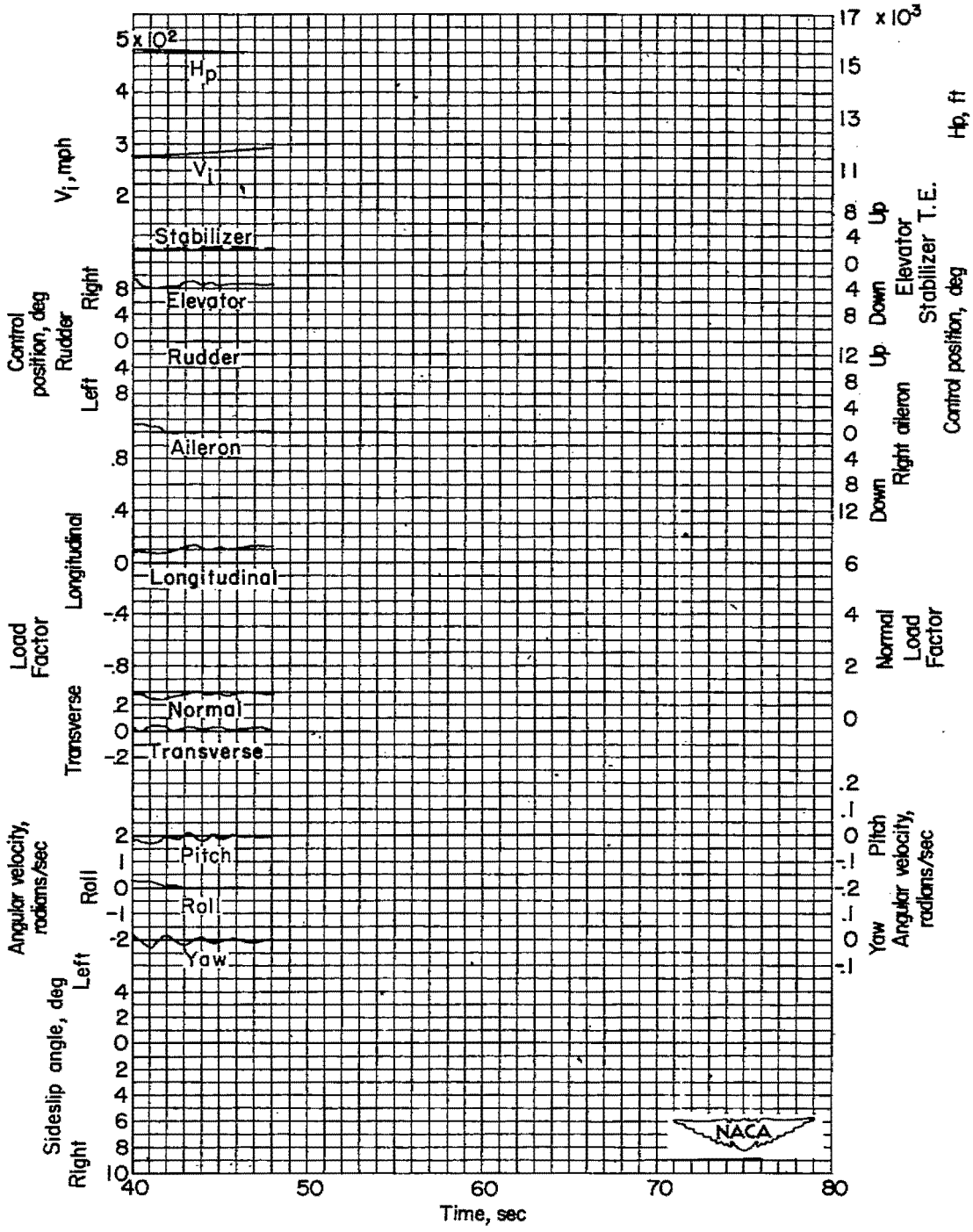


Figure 125.- Concluded.

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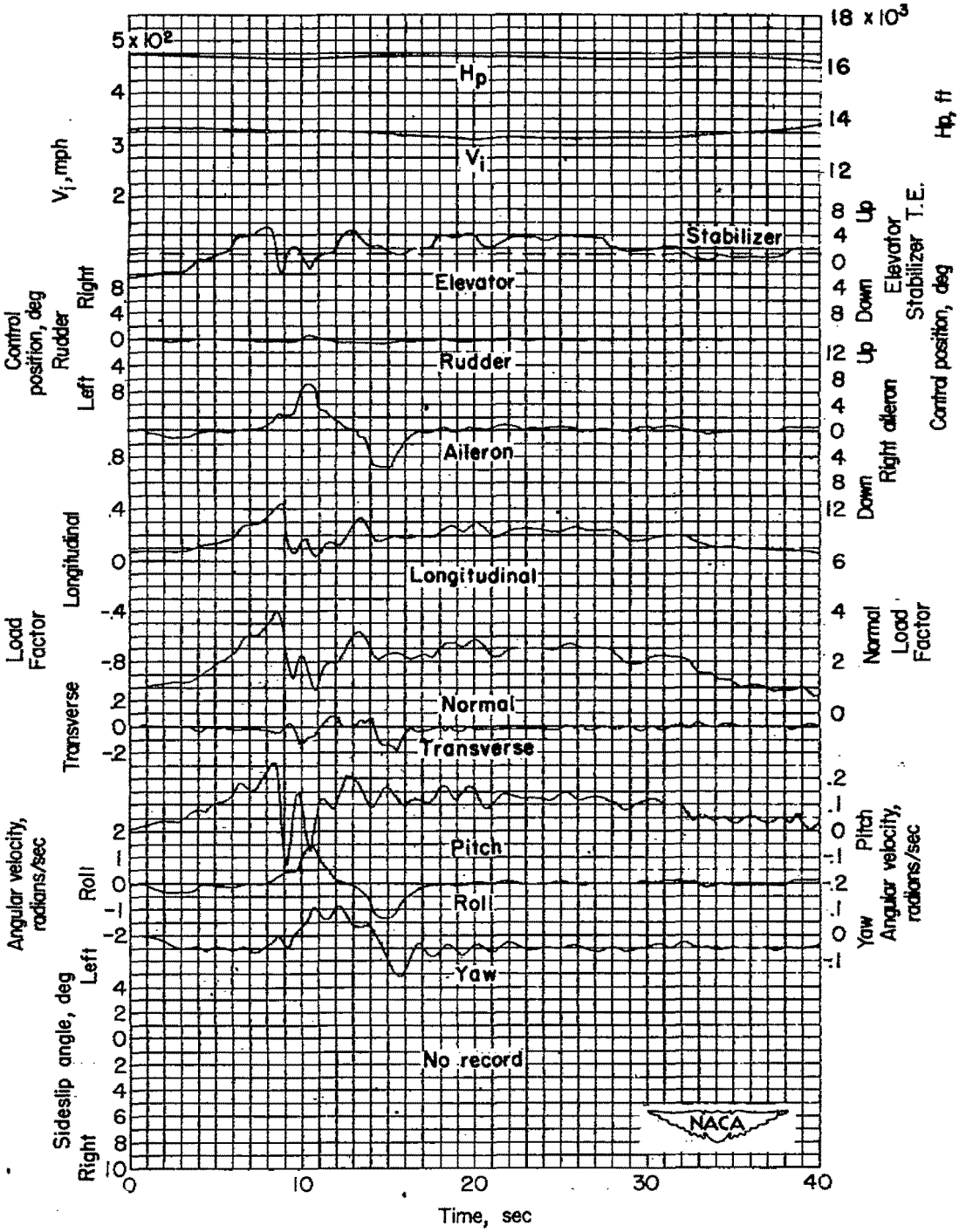


Figure 126.- Sharp left turns. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

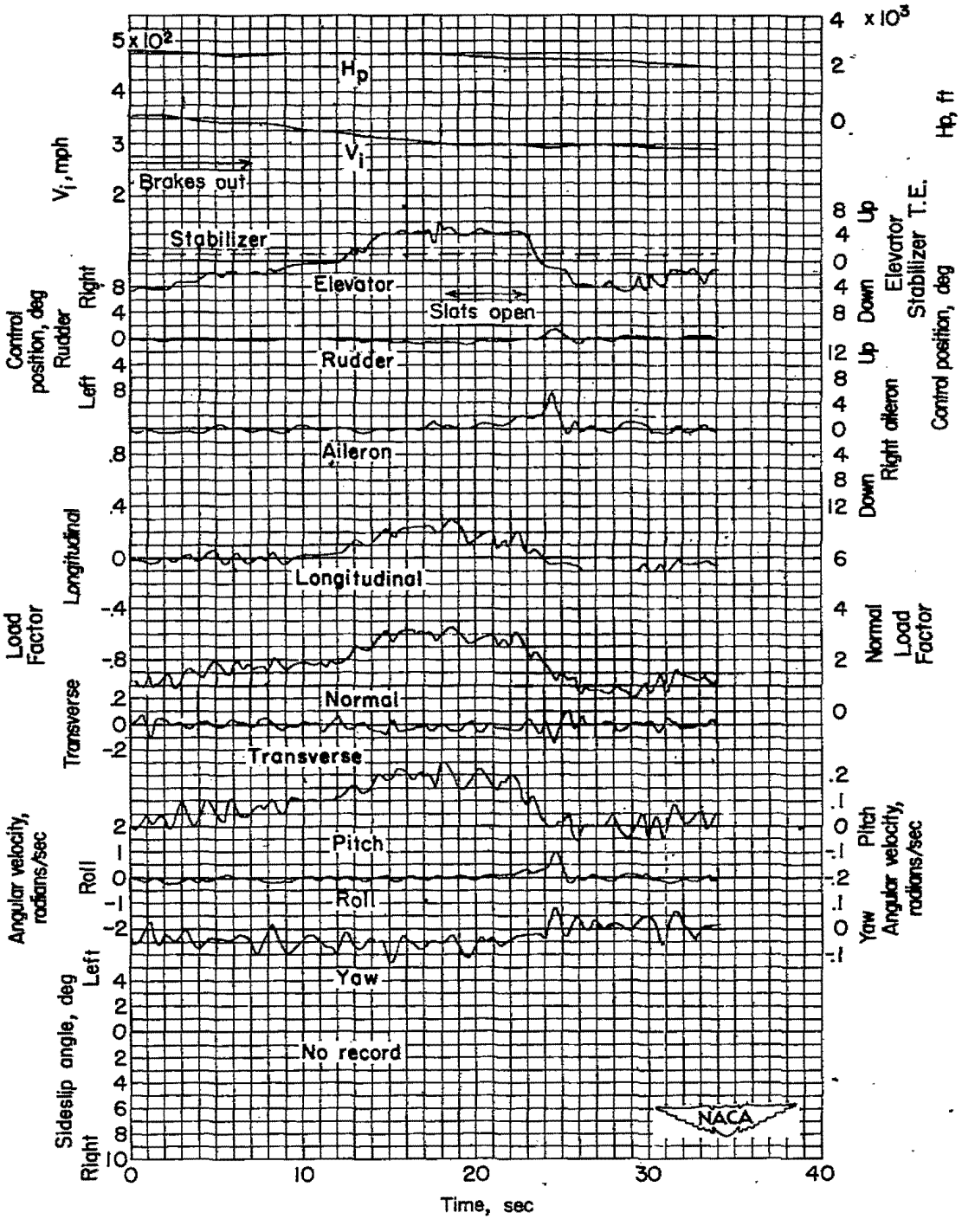


Figure 127.- Sharp left turn. Airplane weight, 12,350 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

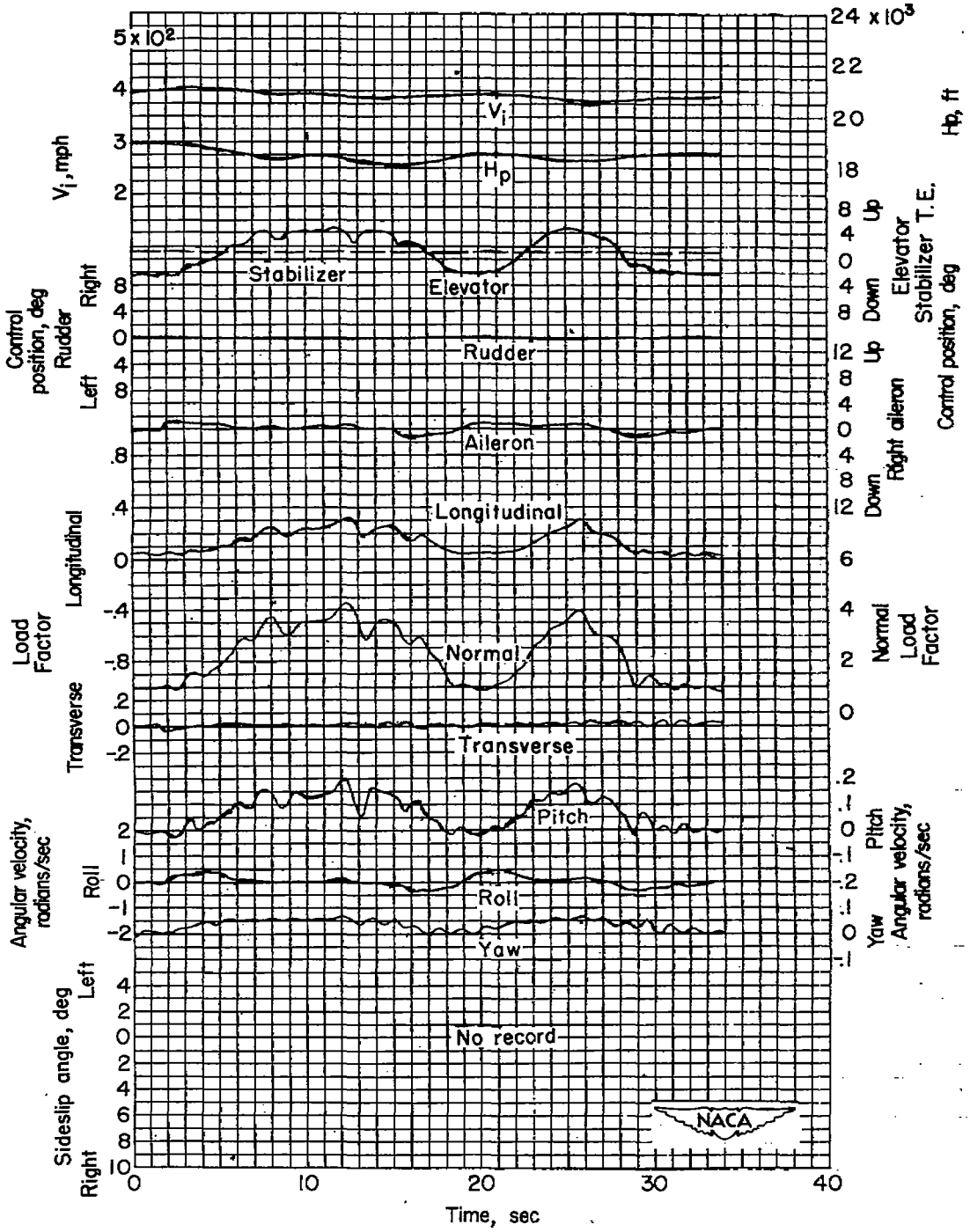
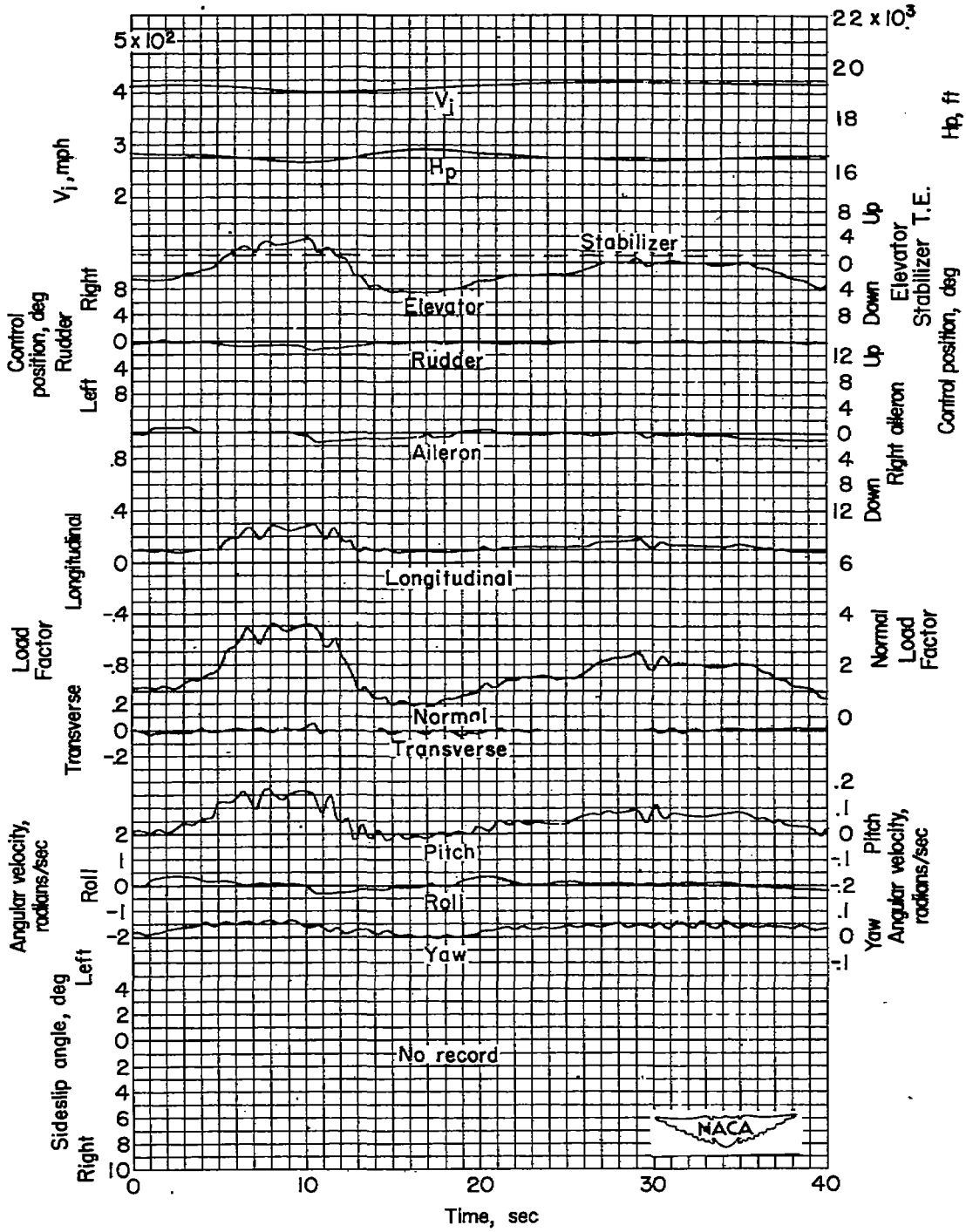


Figure 128.- Sharp right turns. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.



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Figure 129.- Sharp right turns. Airplane weight, ~~13,540~~ pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

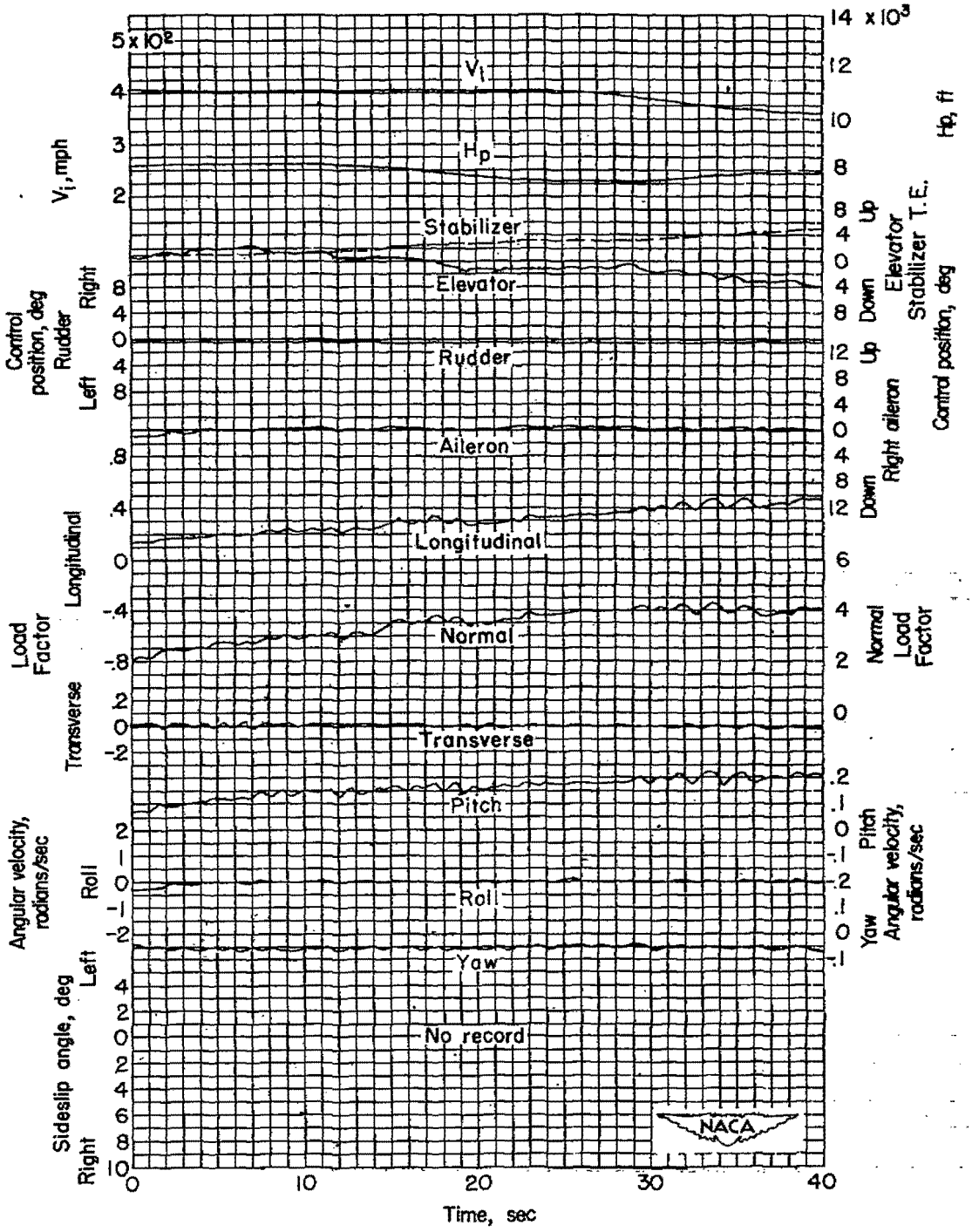


Figure 130.- Sharp left and right turns. Airplane weight, 13,150 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

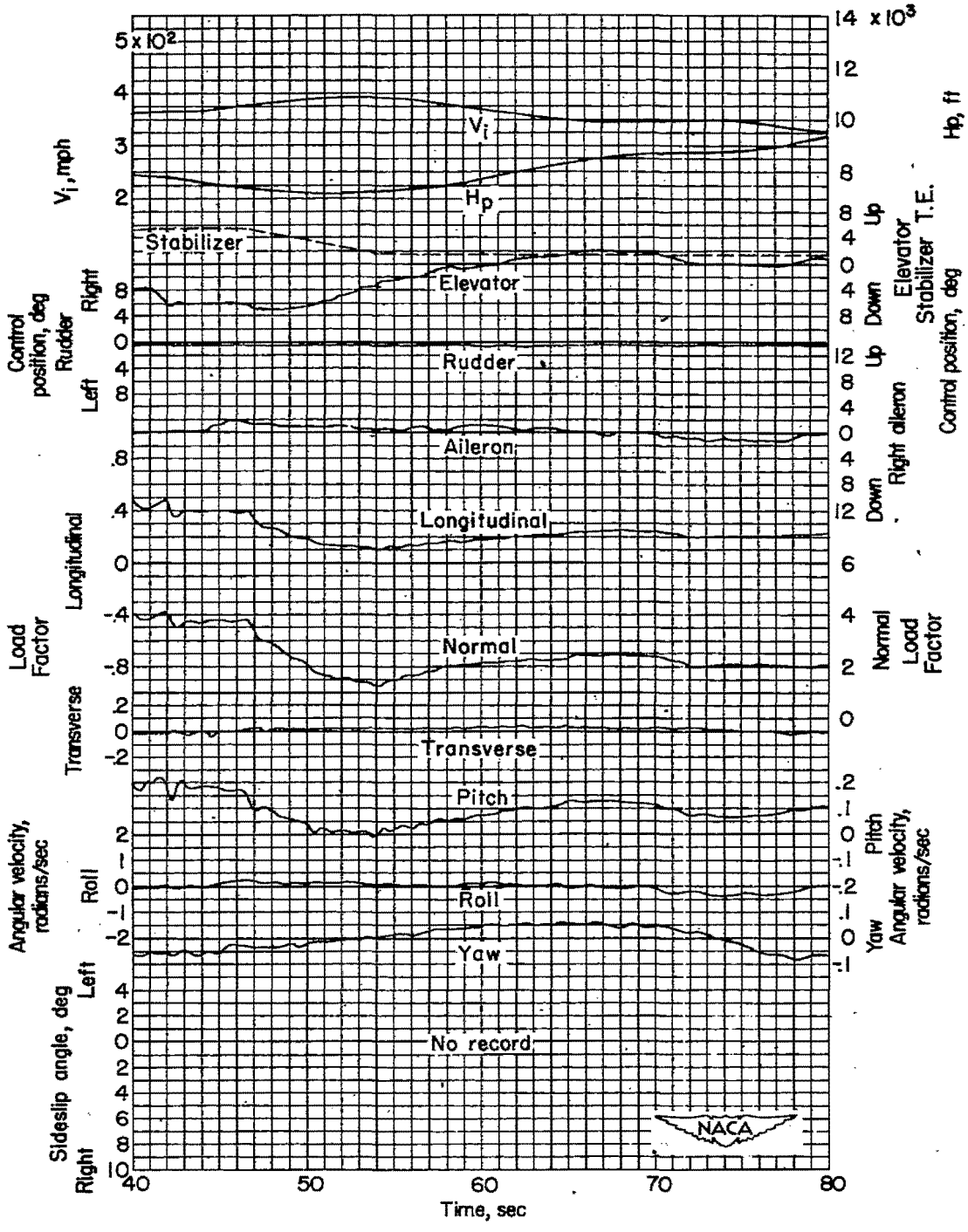


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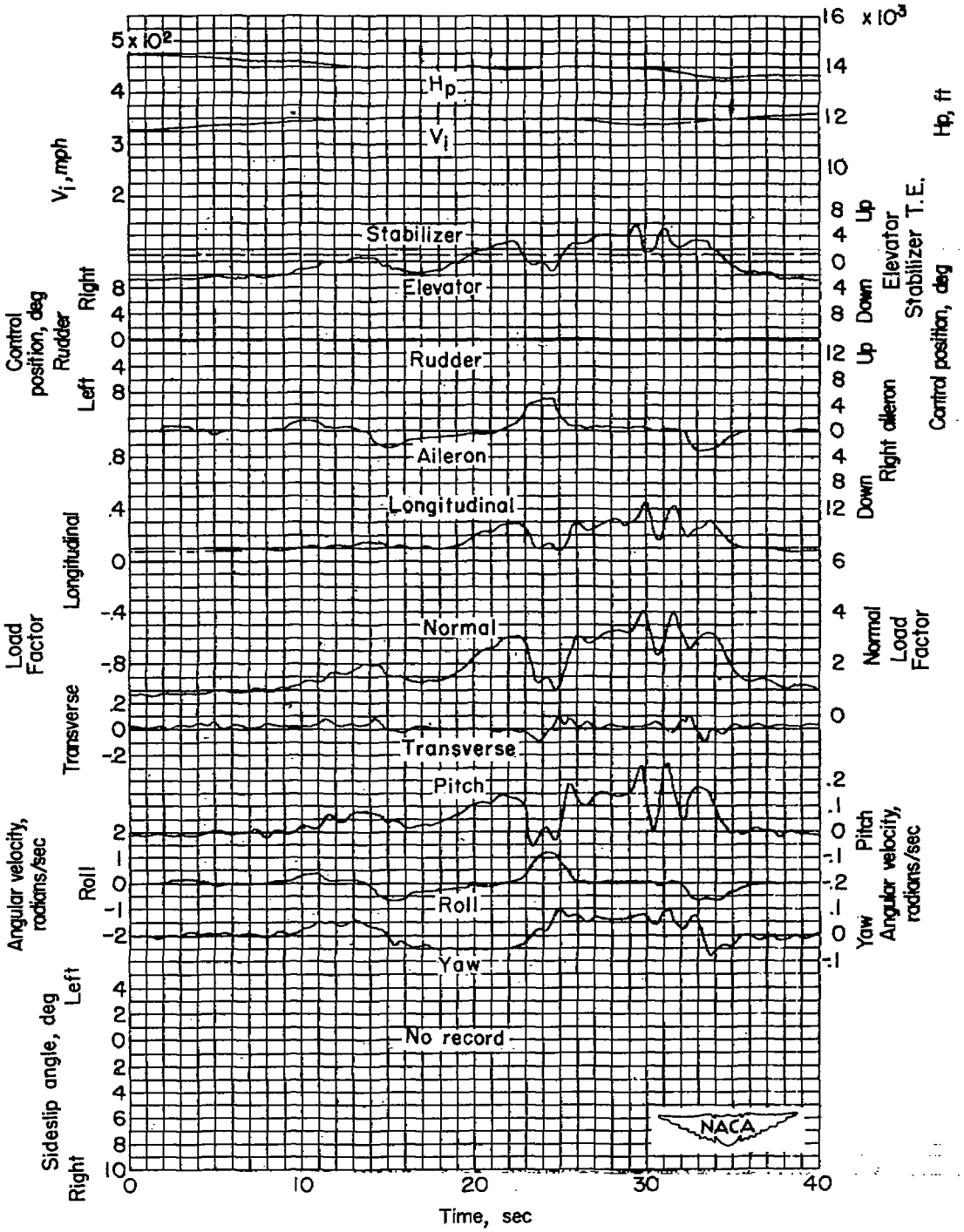


Figure 131.- Sharp right and left turns. Airplane weight, 12,700 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

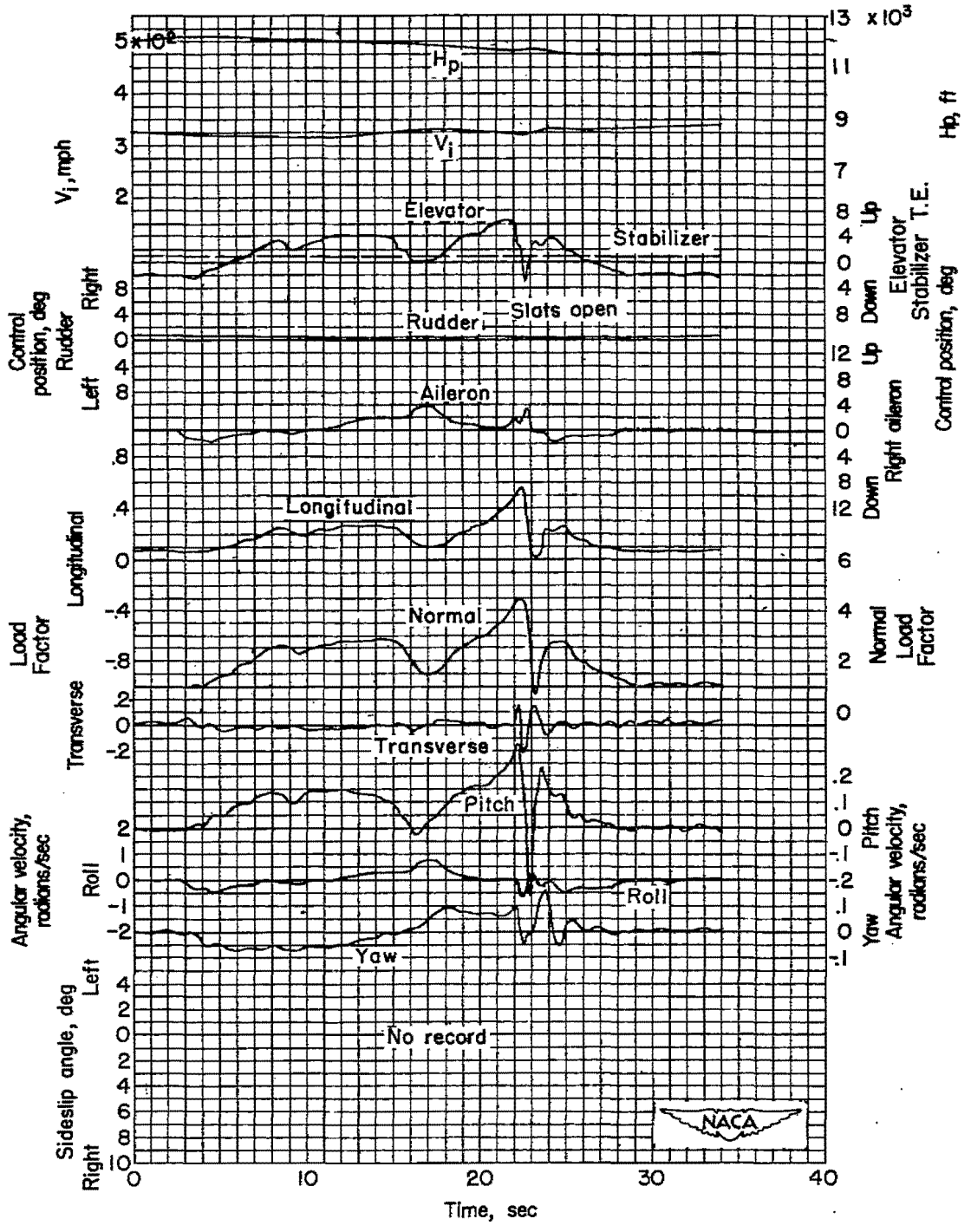


Figure 132.- Sharp left and right turns. Airplane weight, 12,500 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

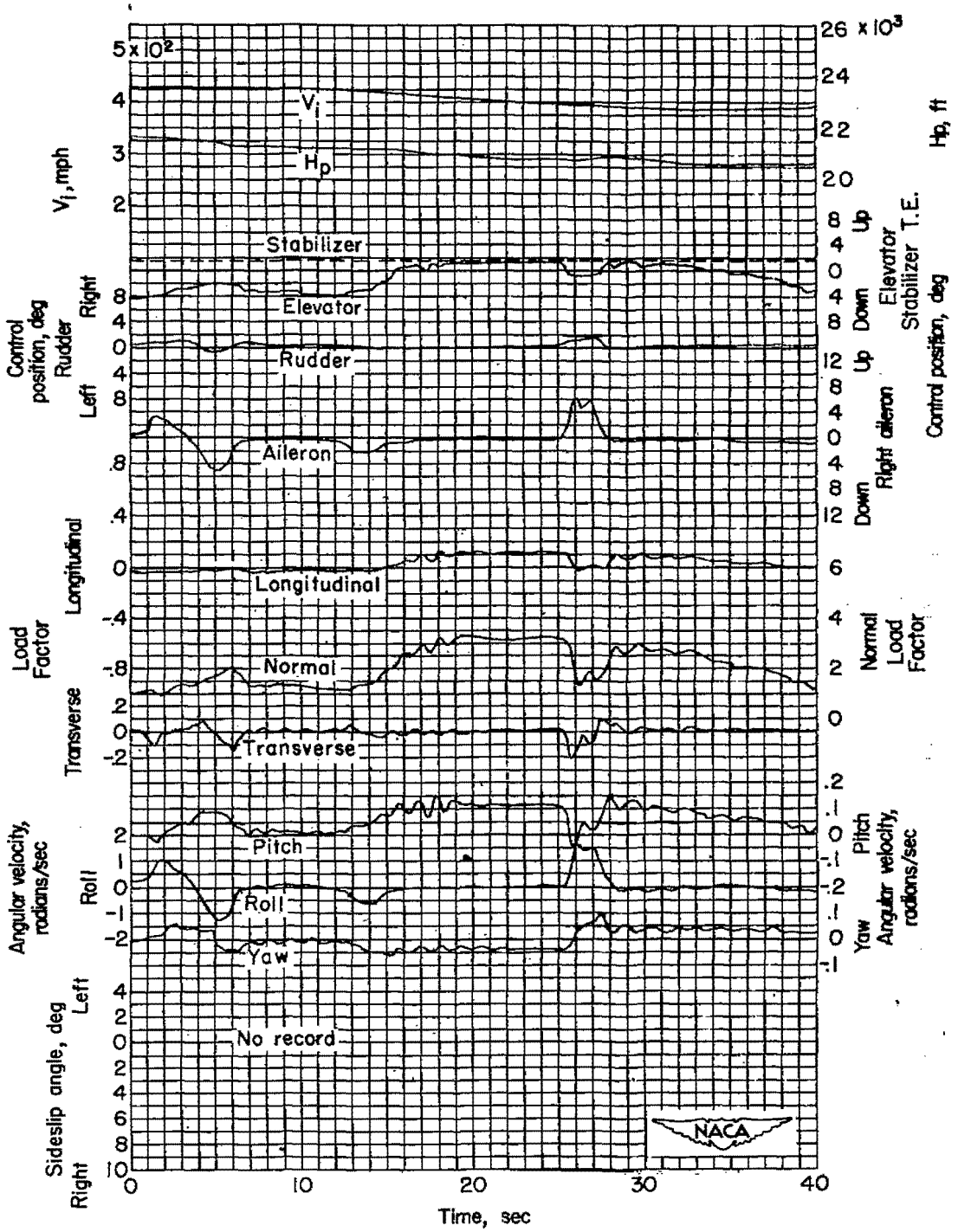


Figure 133.- Left and right half-rolls and sharp turns. Airplane weight, 12,950 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

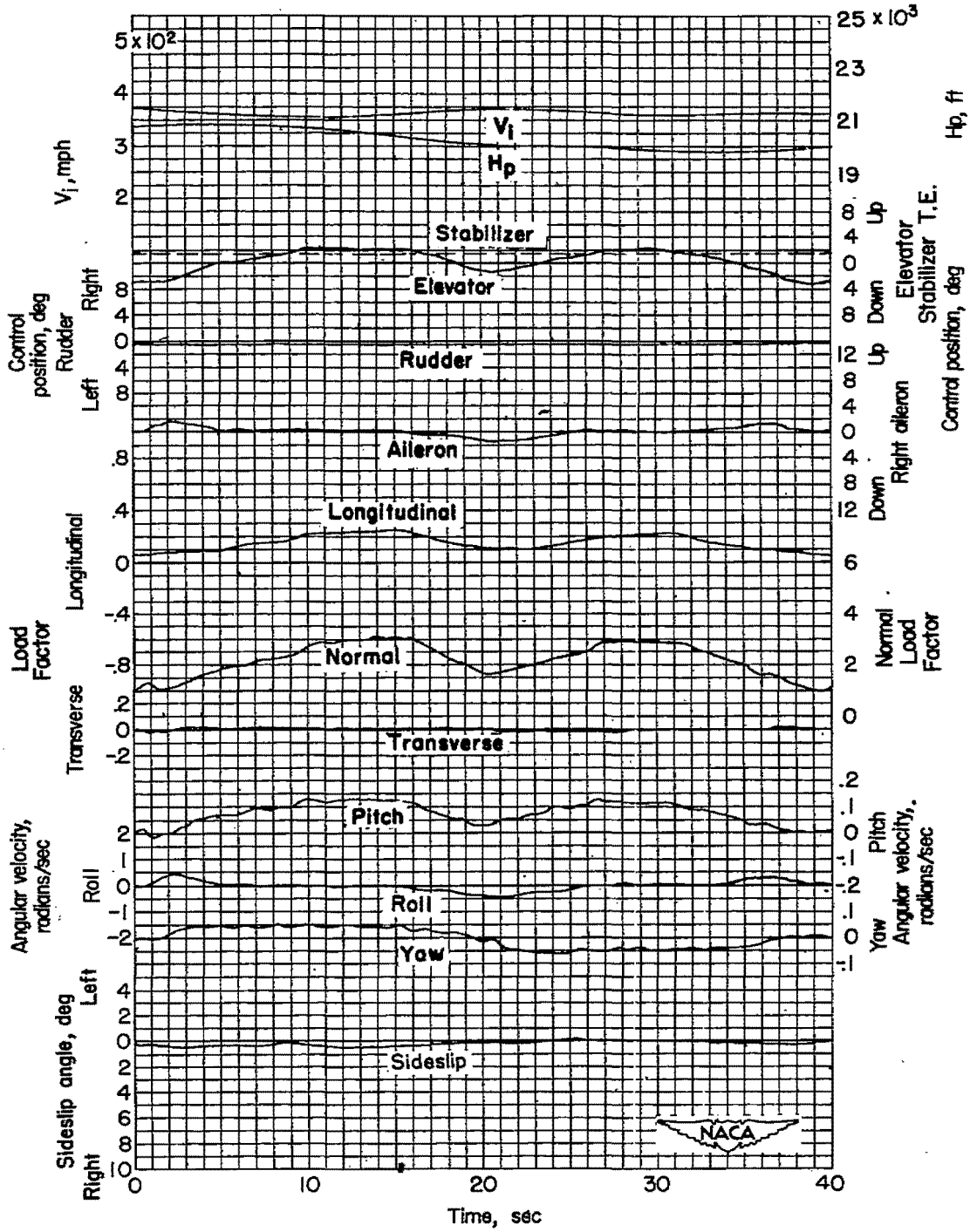


Figure 134.- Sharp right and left turns. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

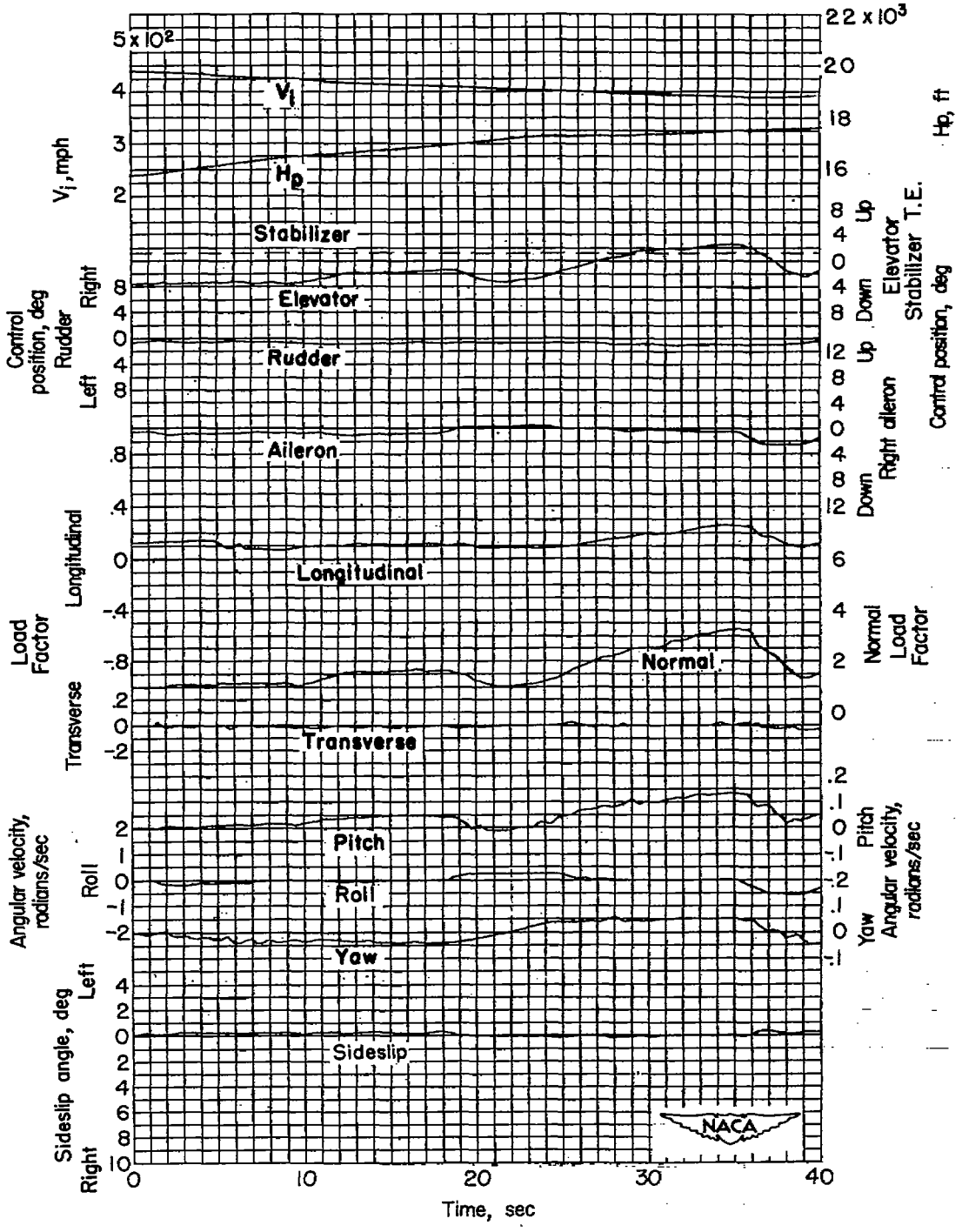


Figure 135.- Gentle left climbing turn followed by sharp right and left turns. Airplane weight, 13,850 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

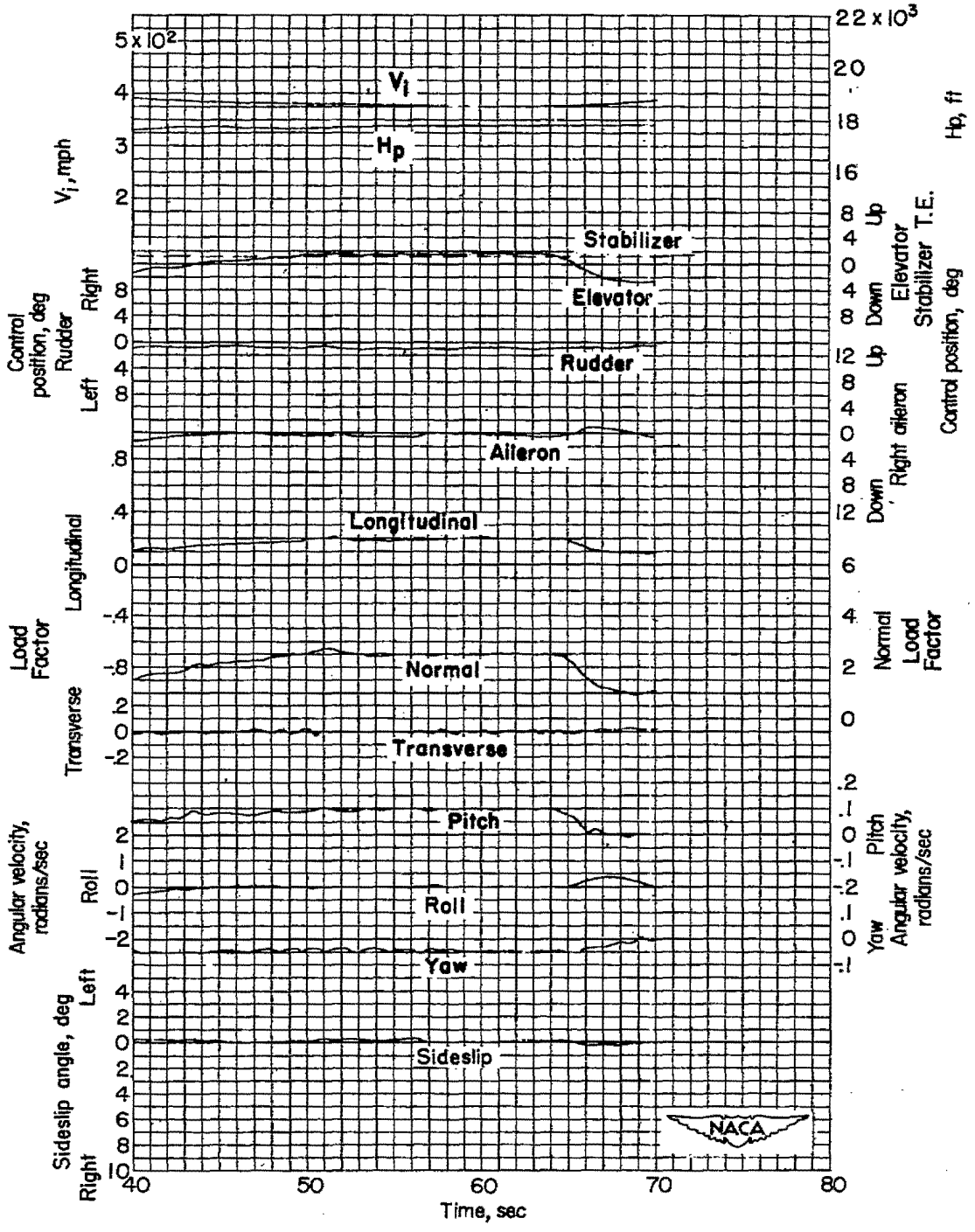


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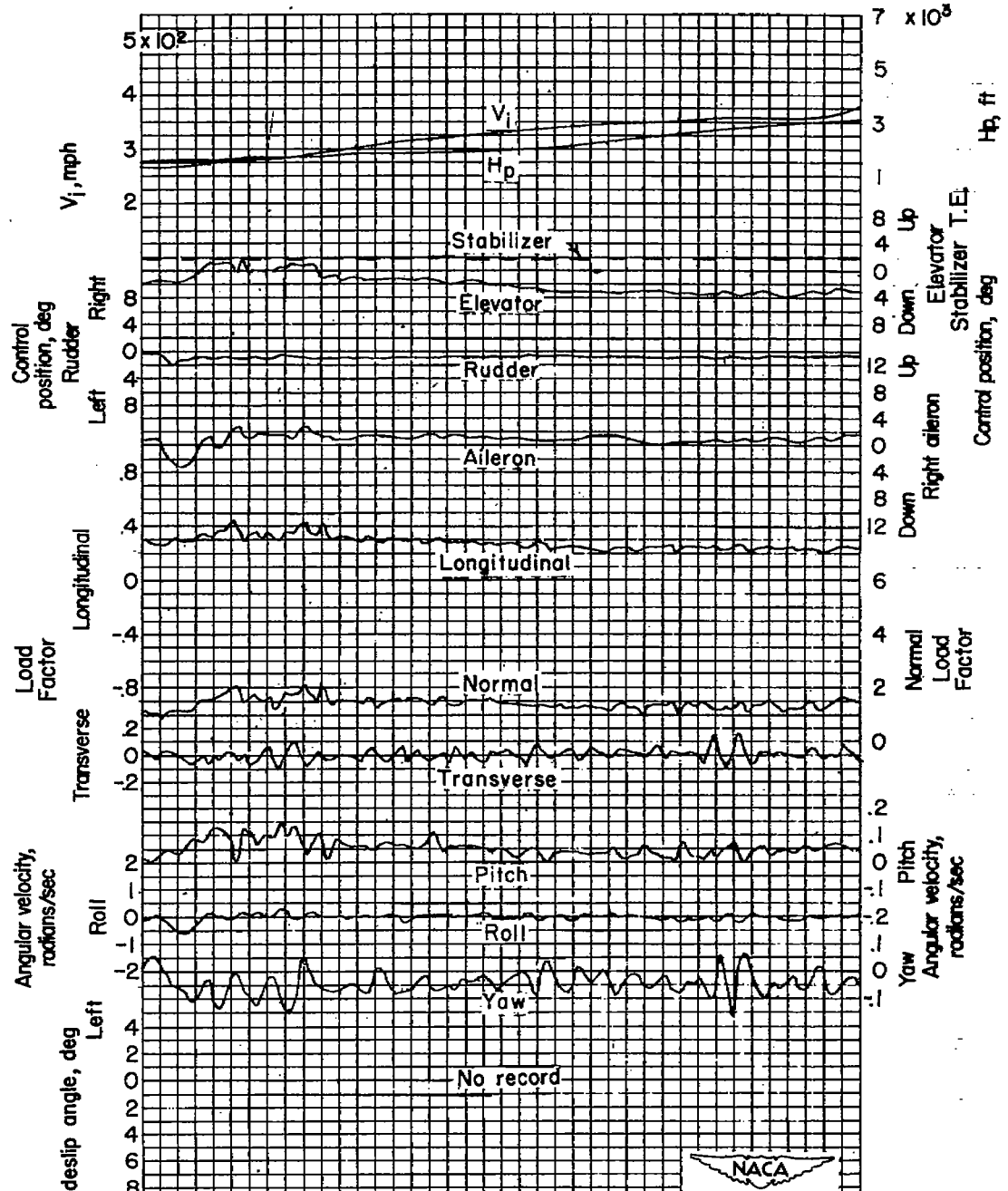


Figure 136.- Gentle left climbing turn. Airplane weight, 14,100 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

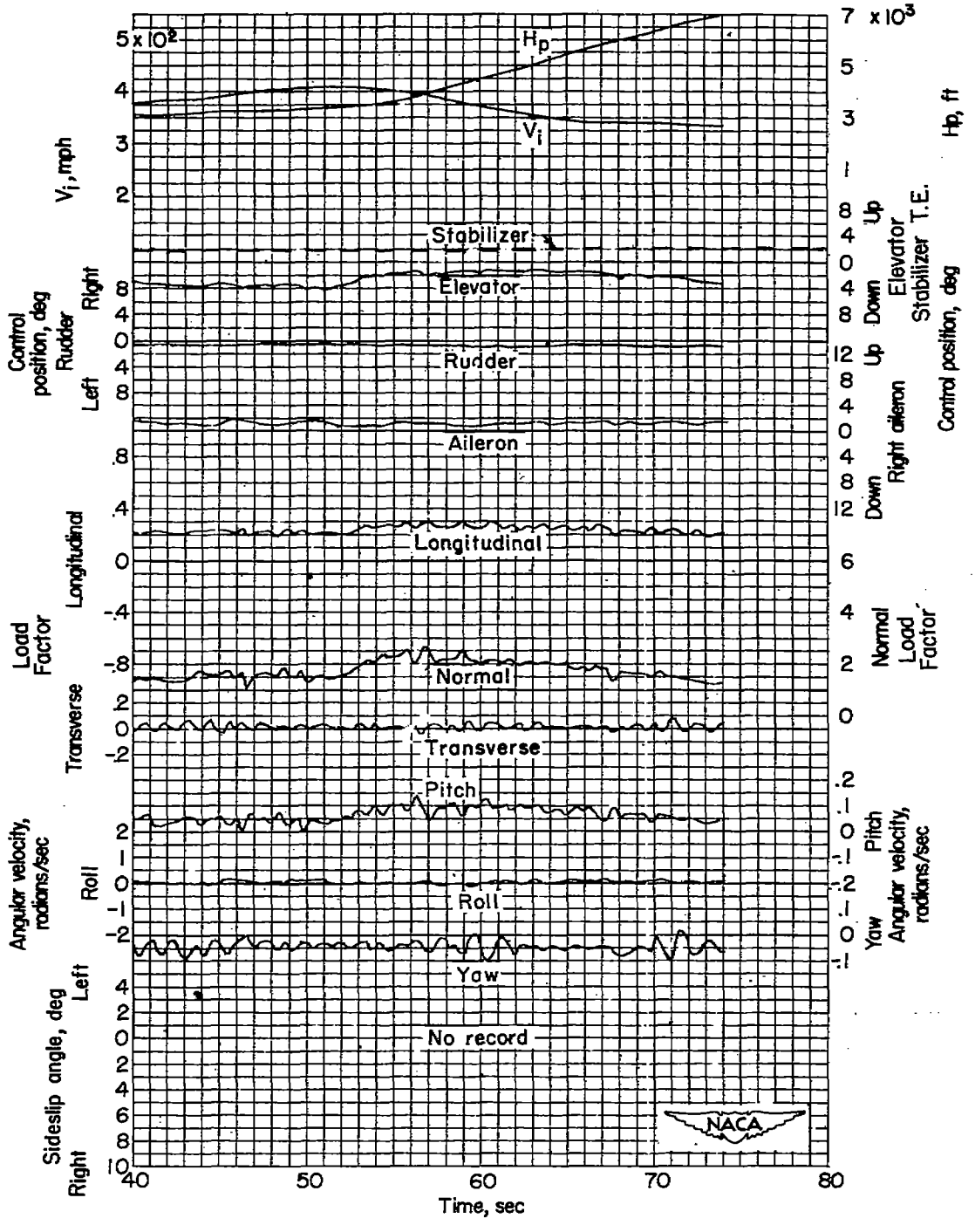


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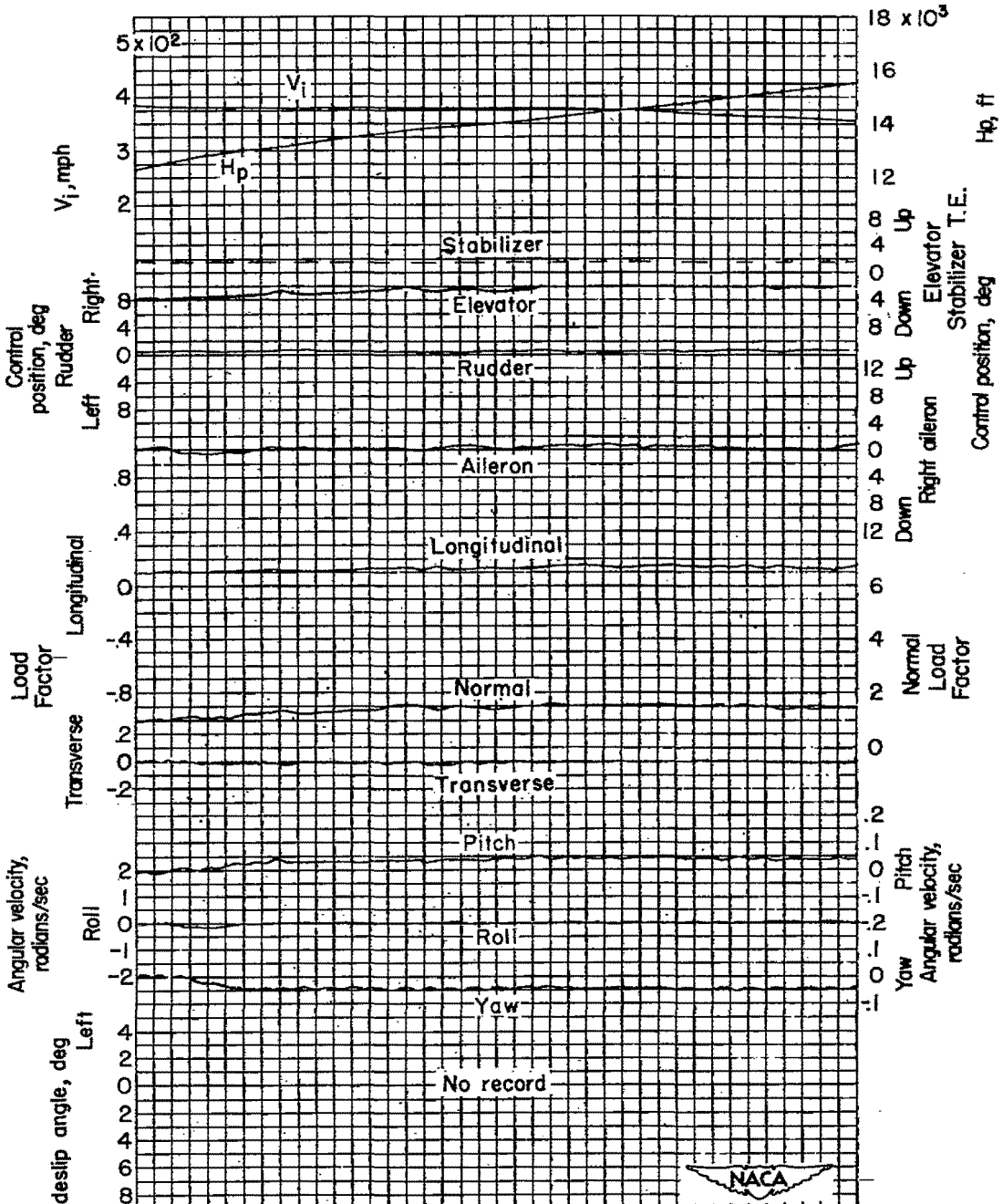


Figure 137.- Gentle left climbing turn. Airplane weight, 14,000 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

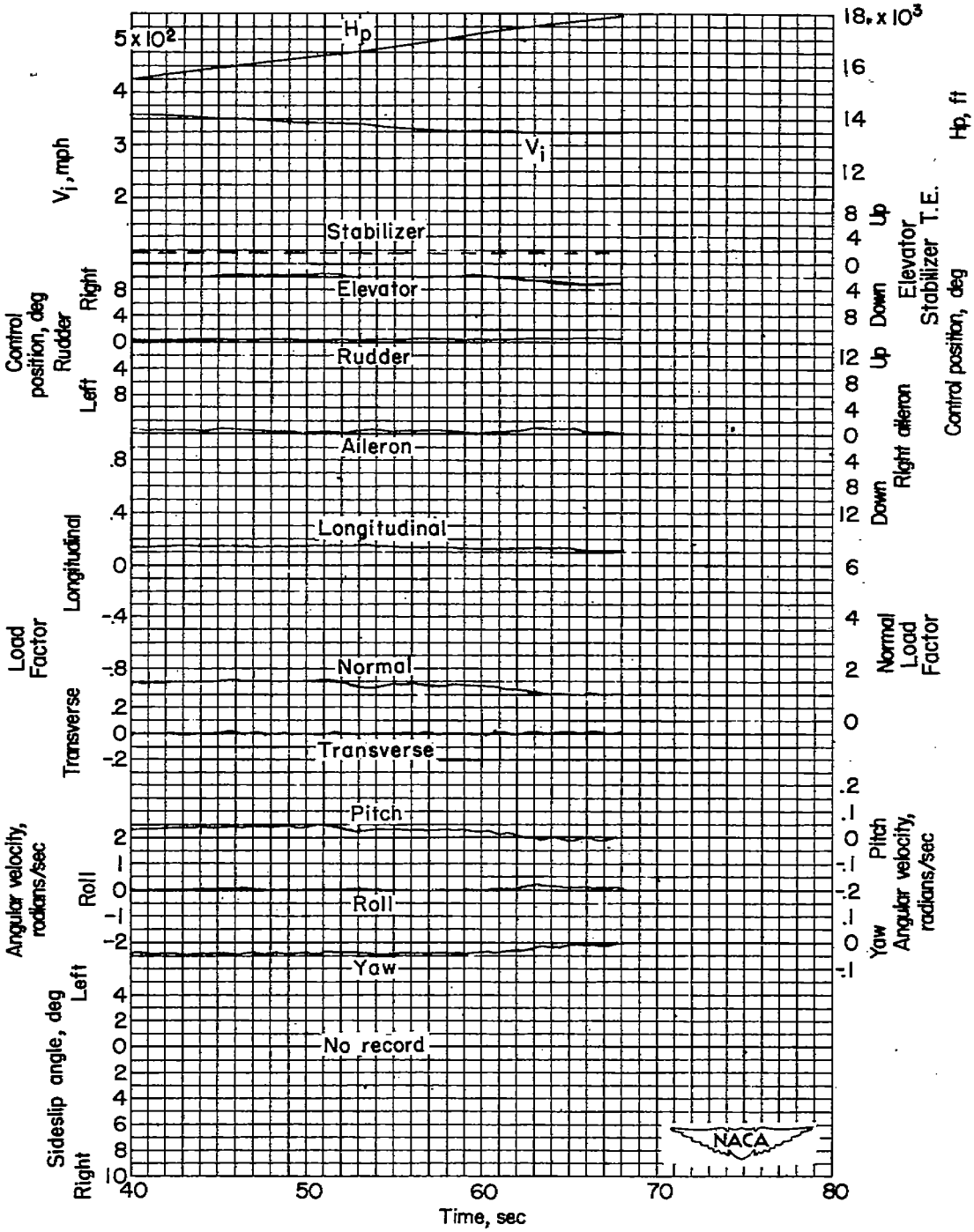


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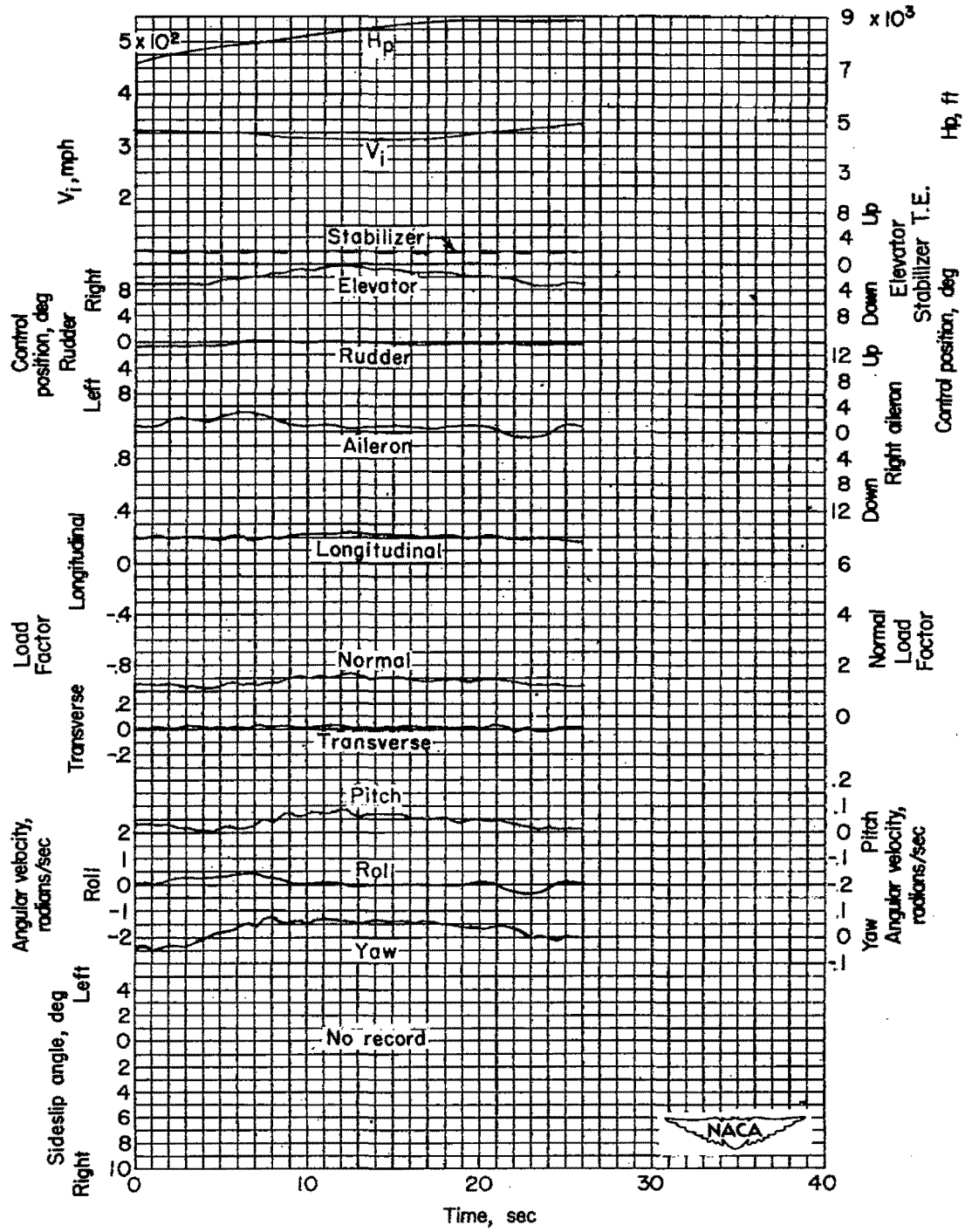


Figure 138.- Gentle right climbing turn. Airplane weight, 14,050 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

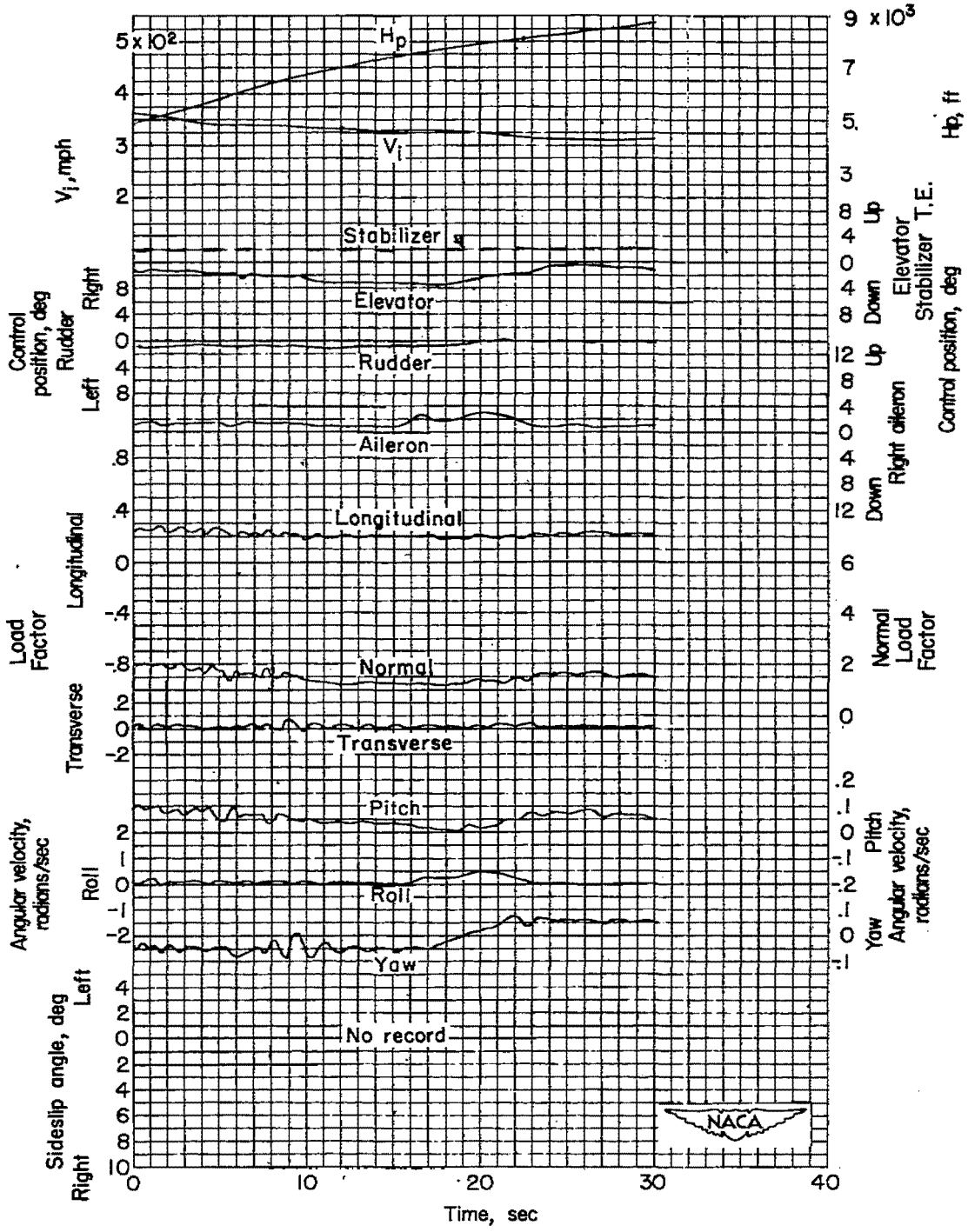


Figure 139.- Gentle left and right climbing turns. Airplane weight 14,050 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

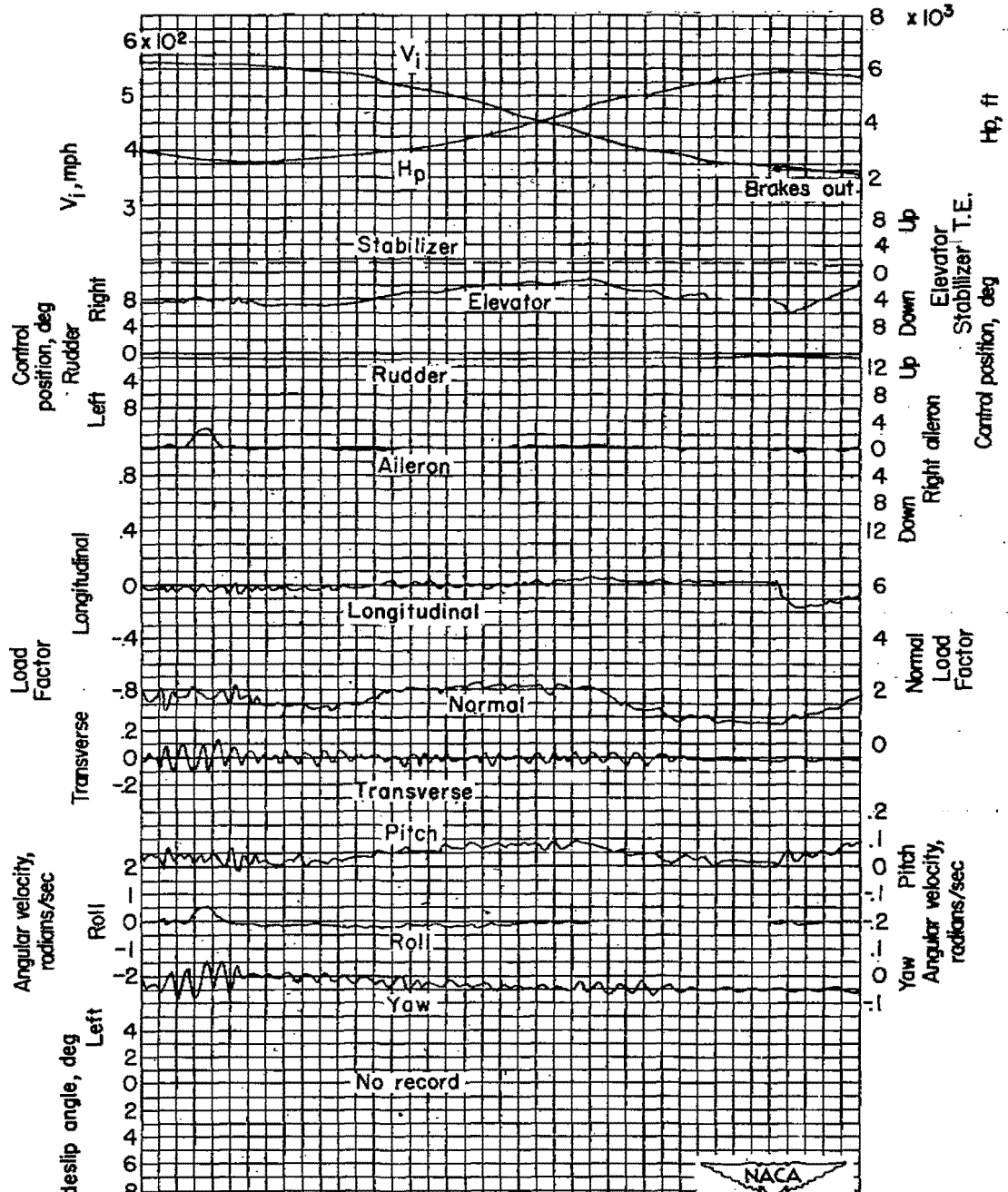


Figure 140.- Left climbing turn. Airplane weight, 13,050 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

[redacted]

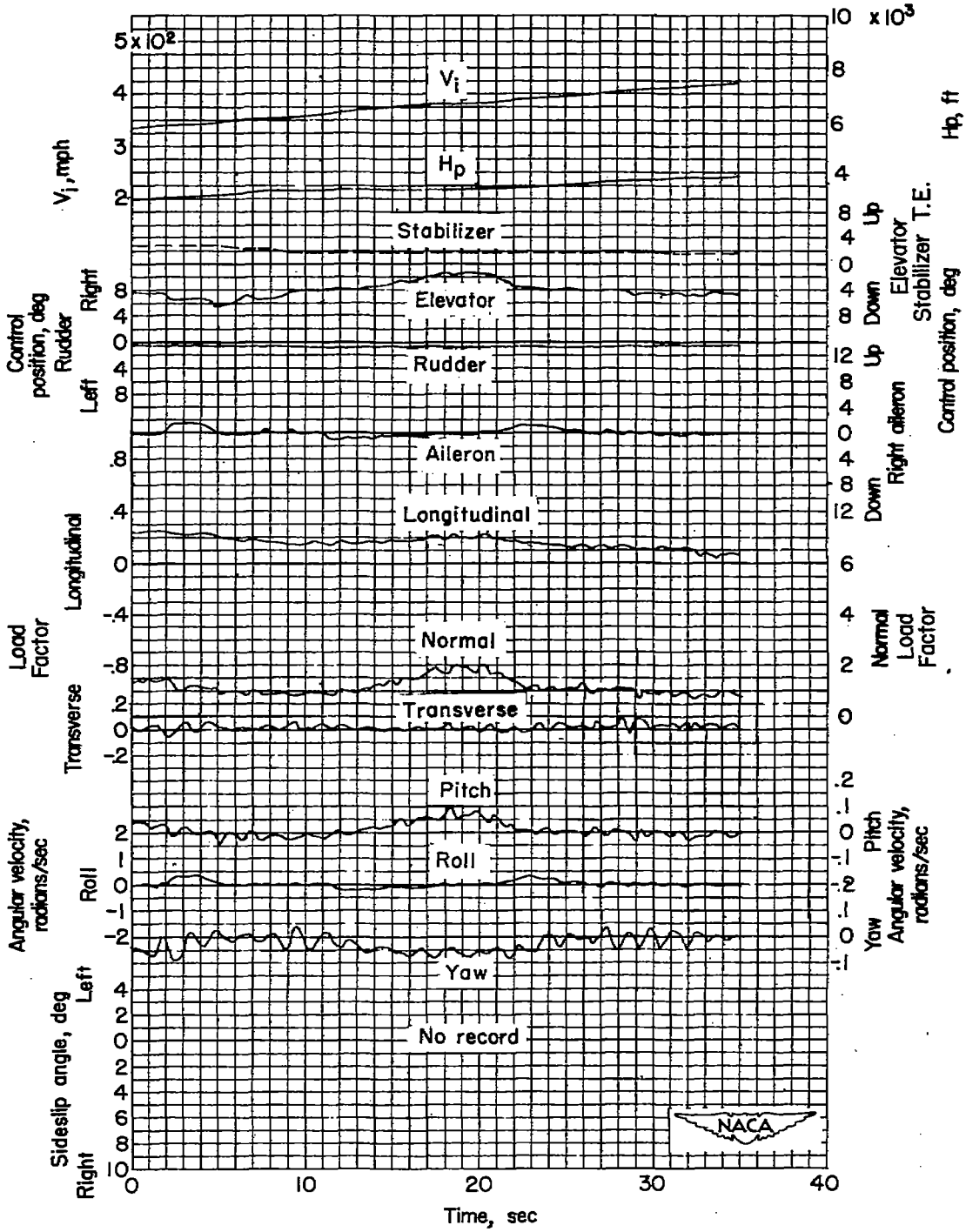


Figure 141.- Left climbing turn. Airplane weight, 14,050 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

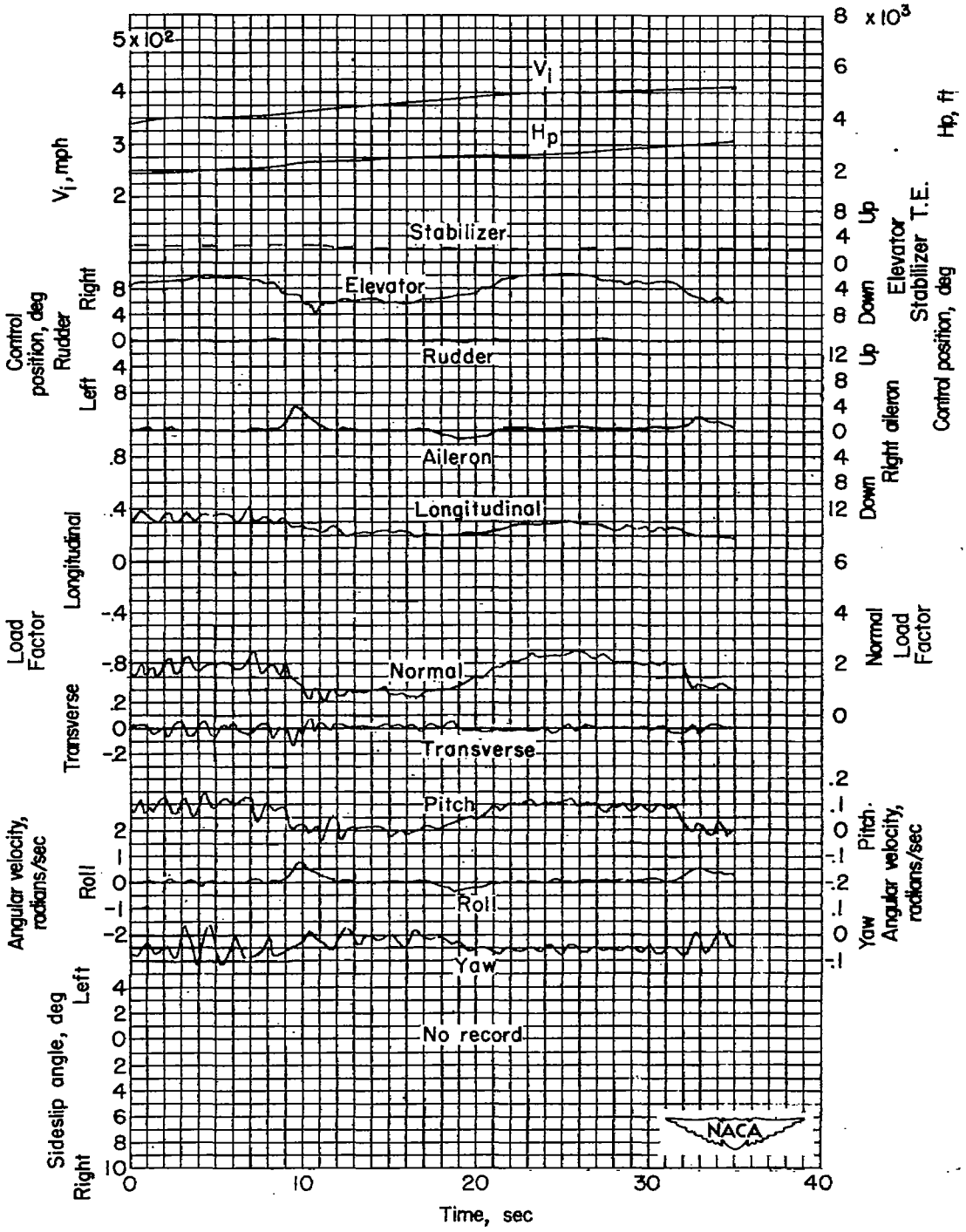


Figure 142.- Left climbing turn. Airplane weight, 14,100 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]

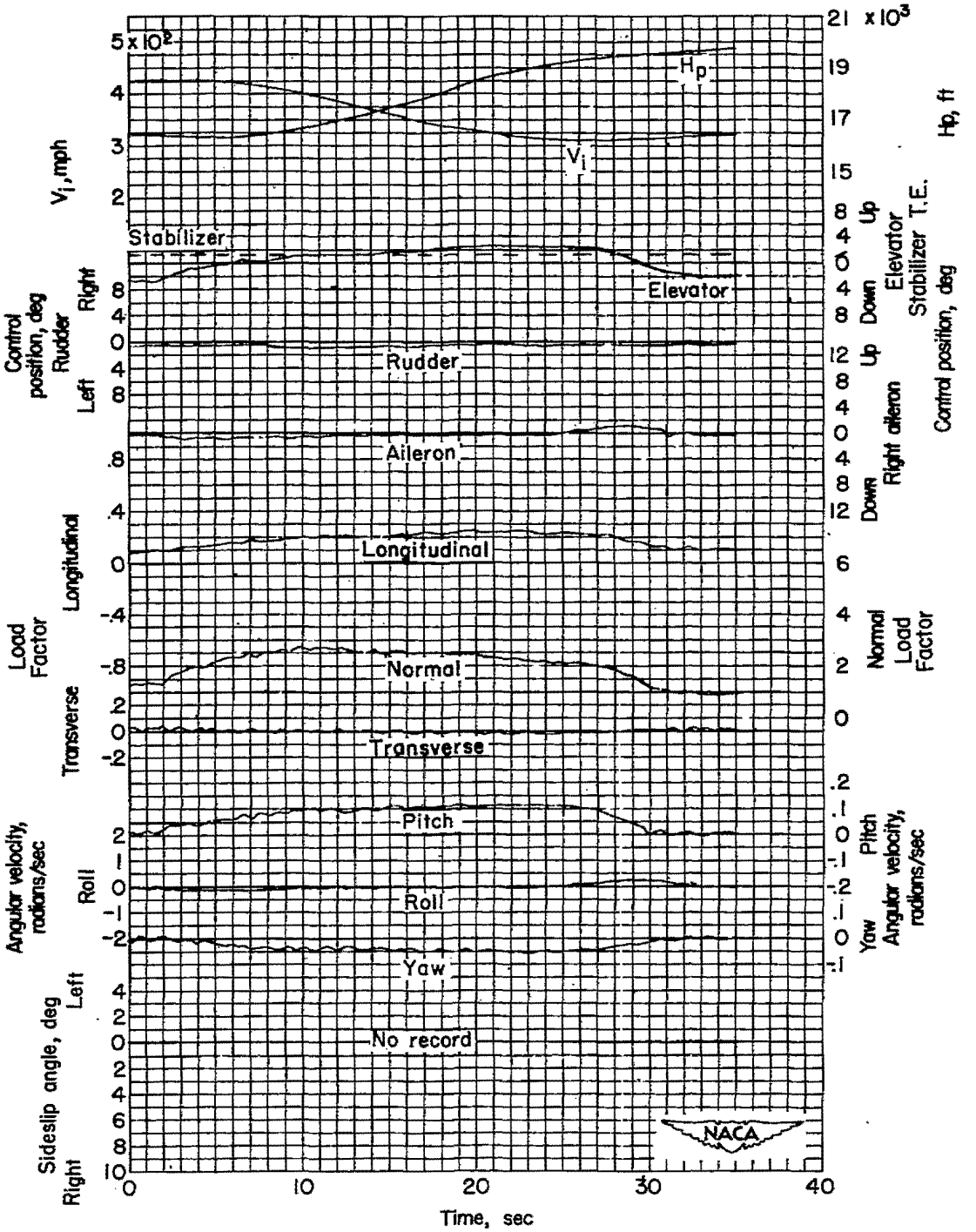


Figure 143.- Left climbing turn. Airplane weight, 13,850 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

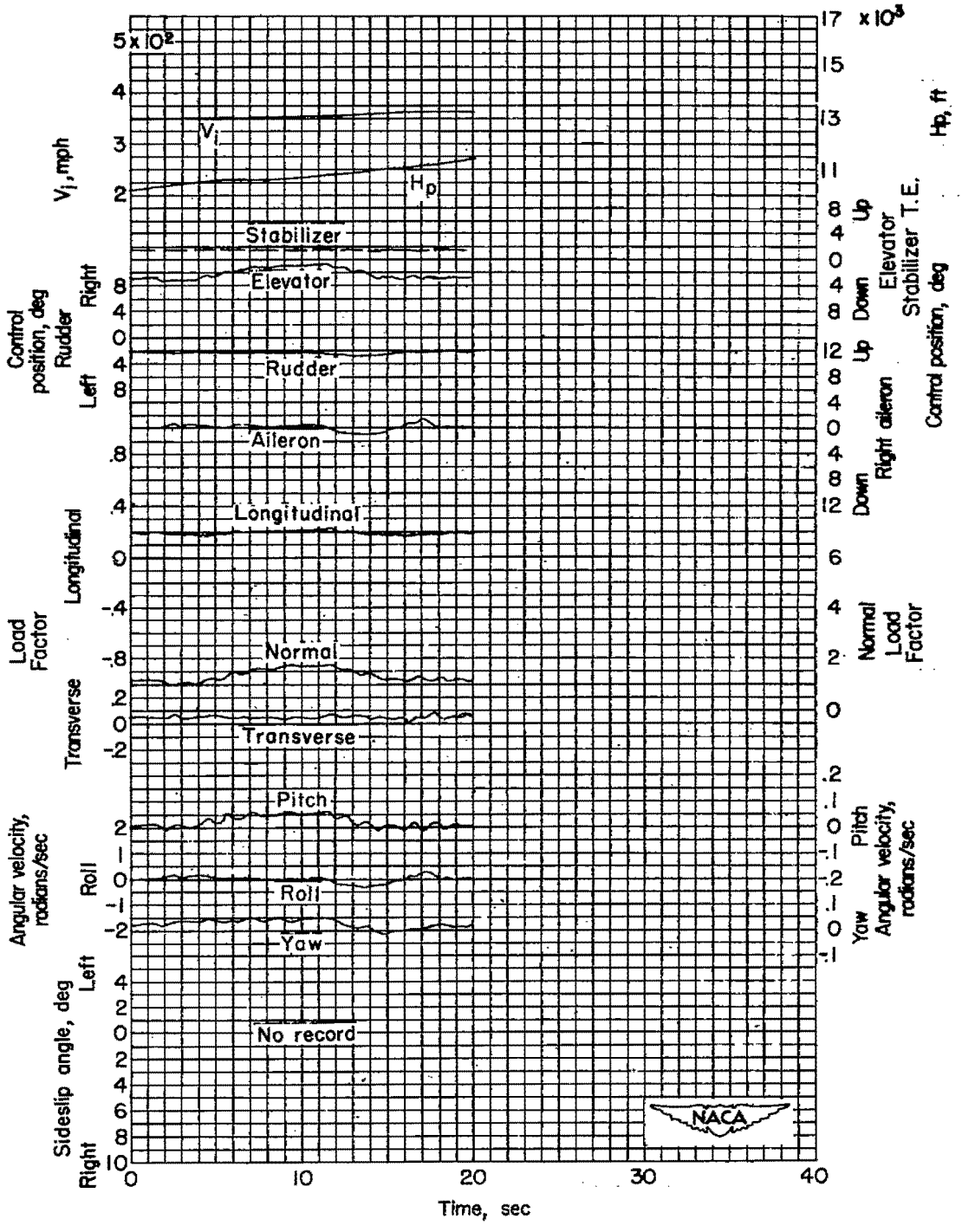
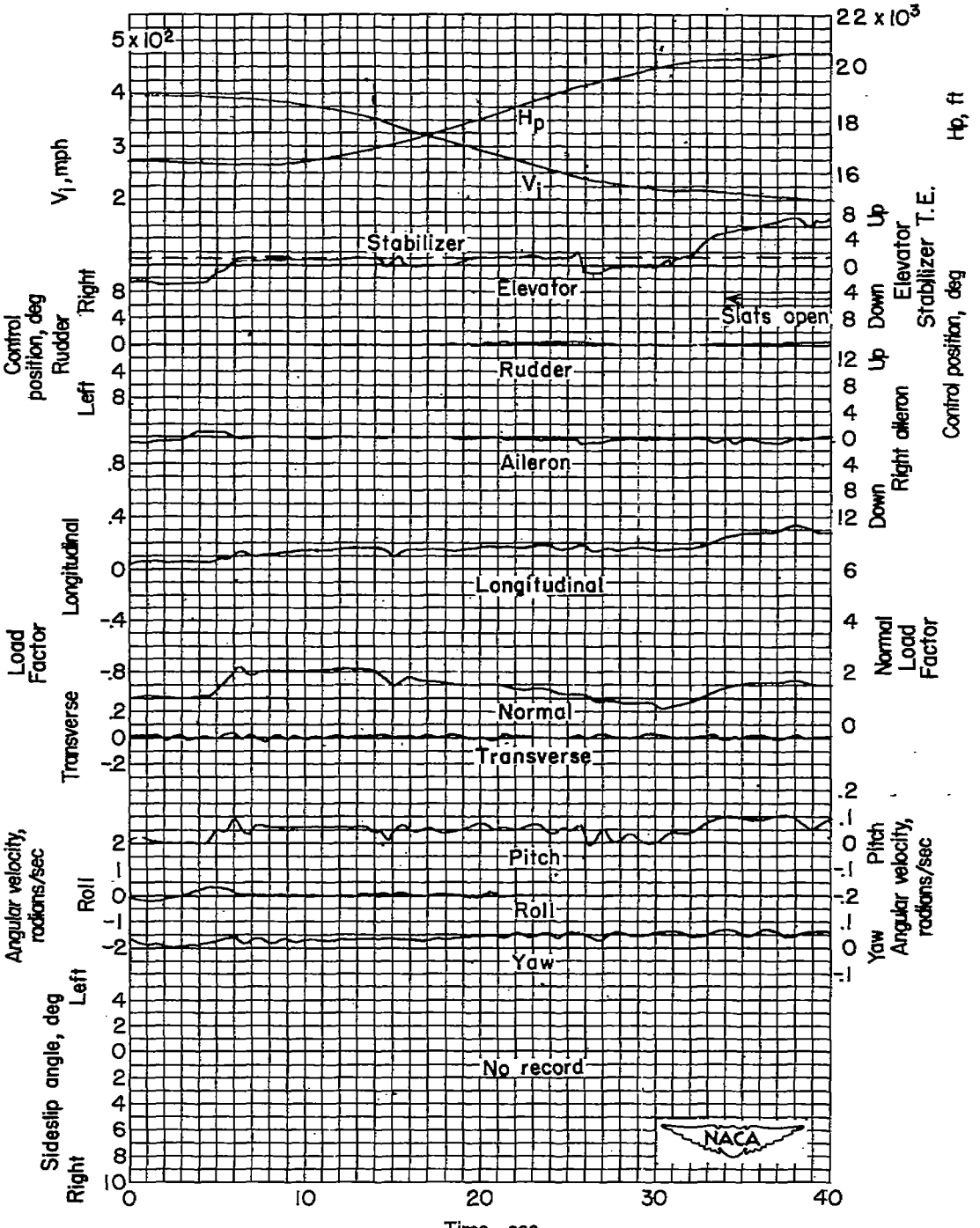


Figure 144.- Right climbing turn. Airplane weight, 14,000 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

[redacted]



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Figure 145.- Right climbing turn. Airplane weight, ~~13,250~~ pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

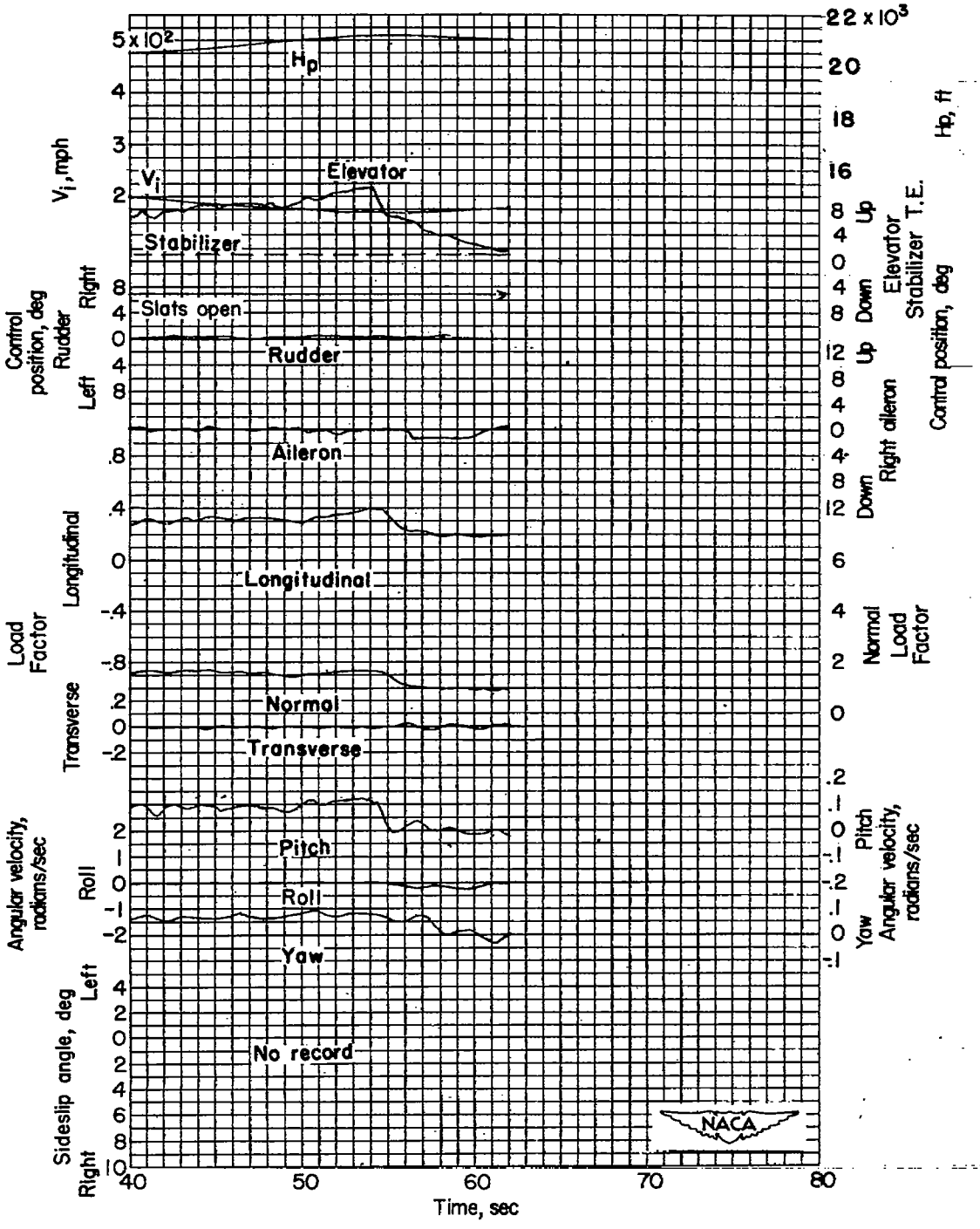


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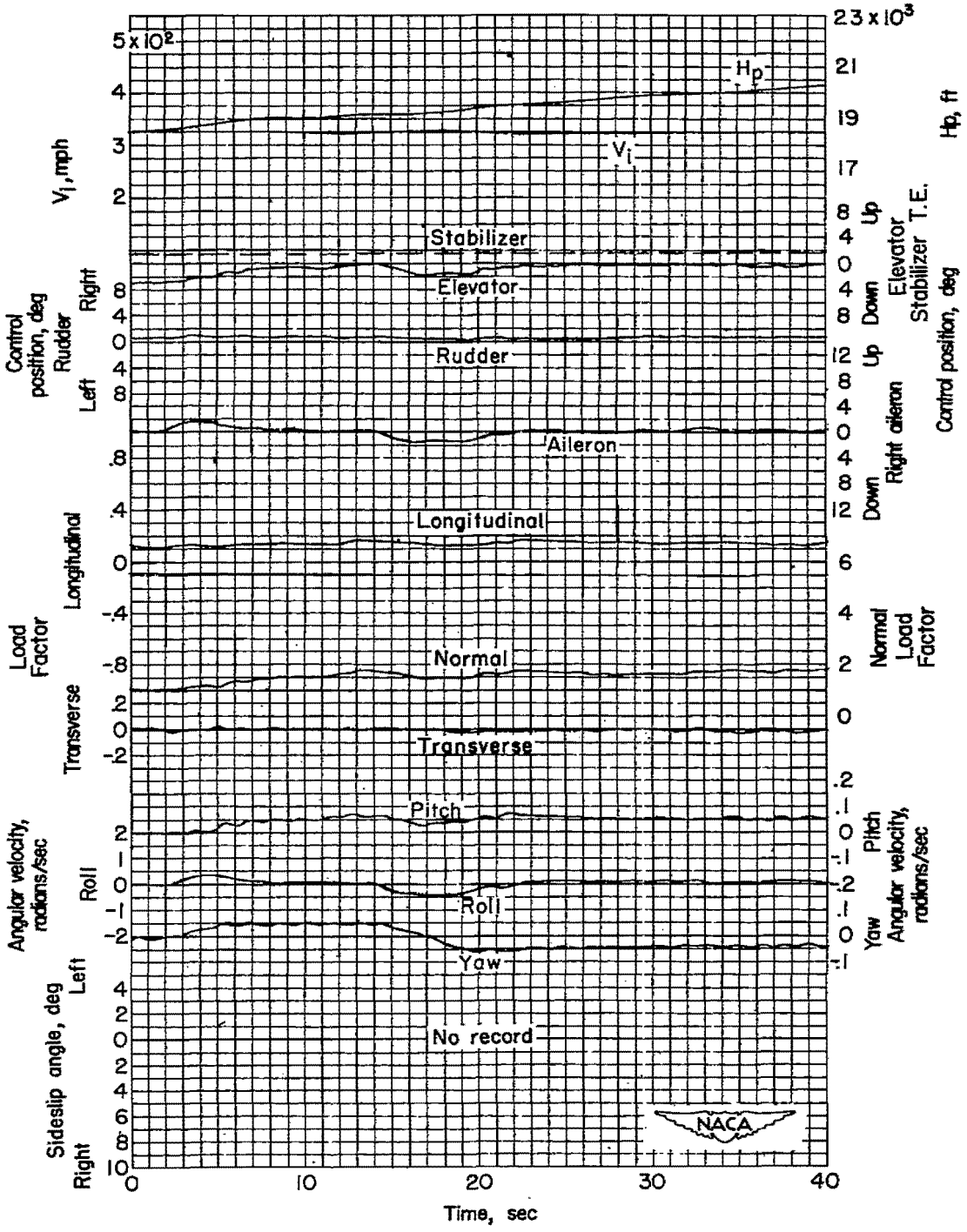


Figure 146.- Right and left climbing turns. Airplane weight, 13,950 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

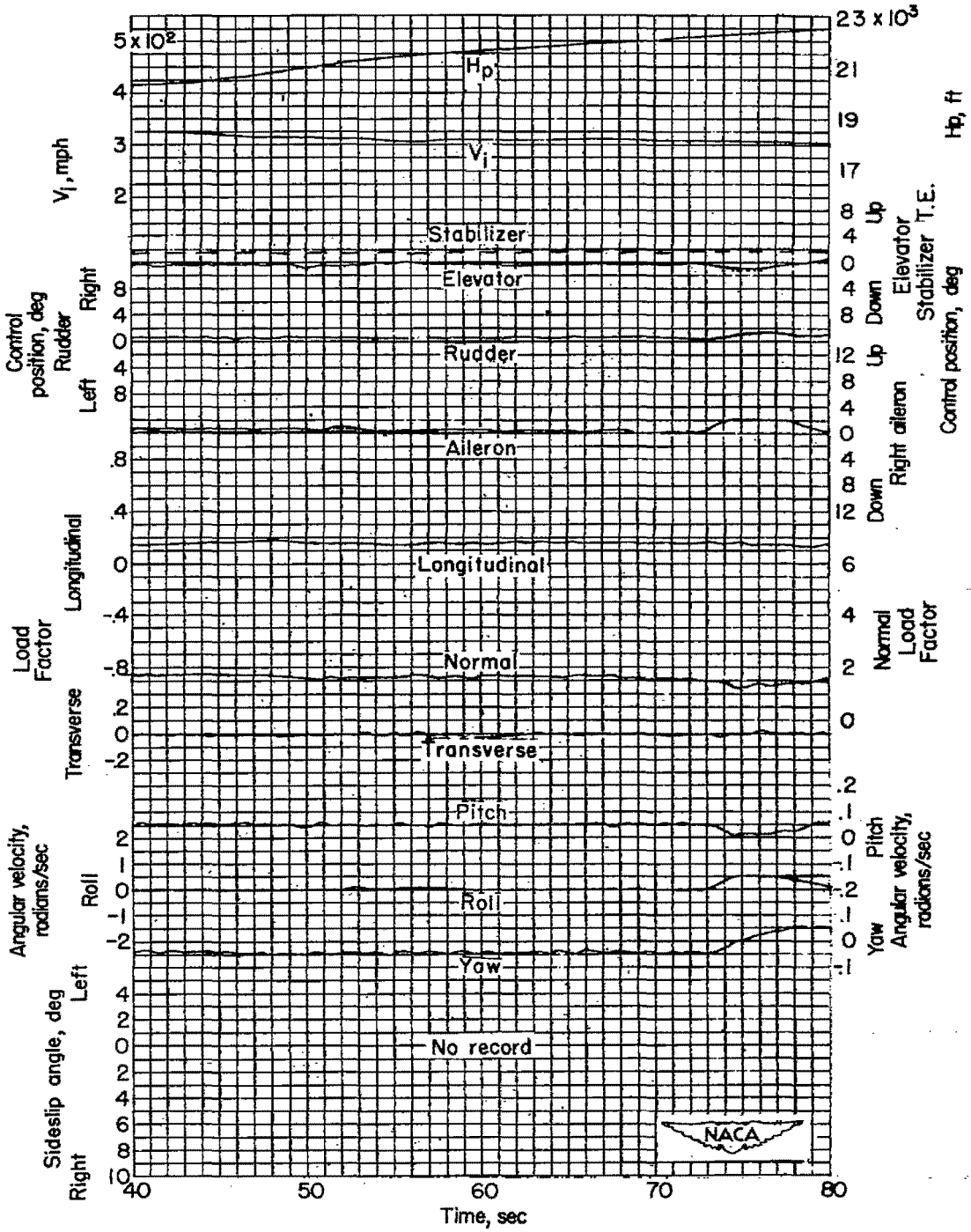


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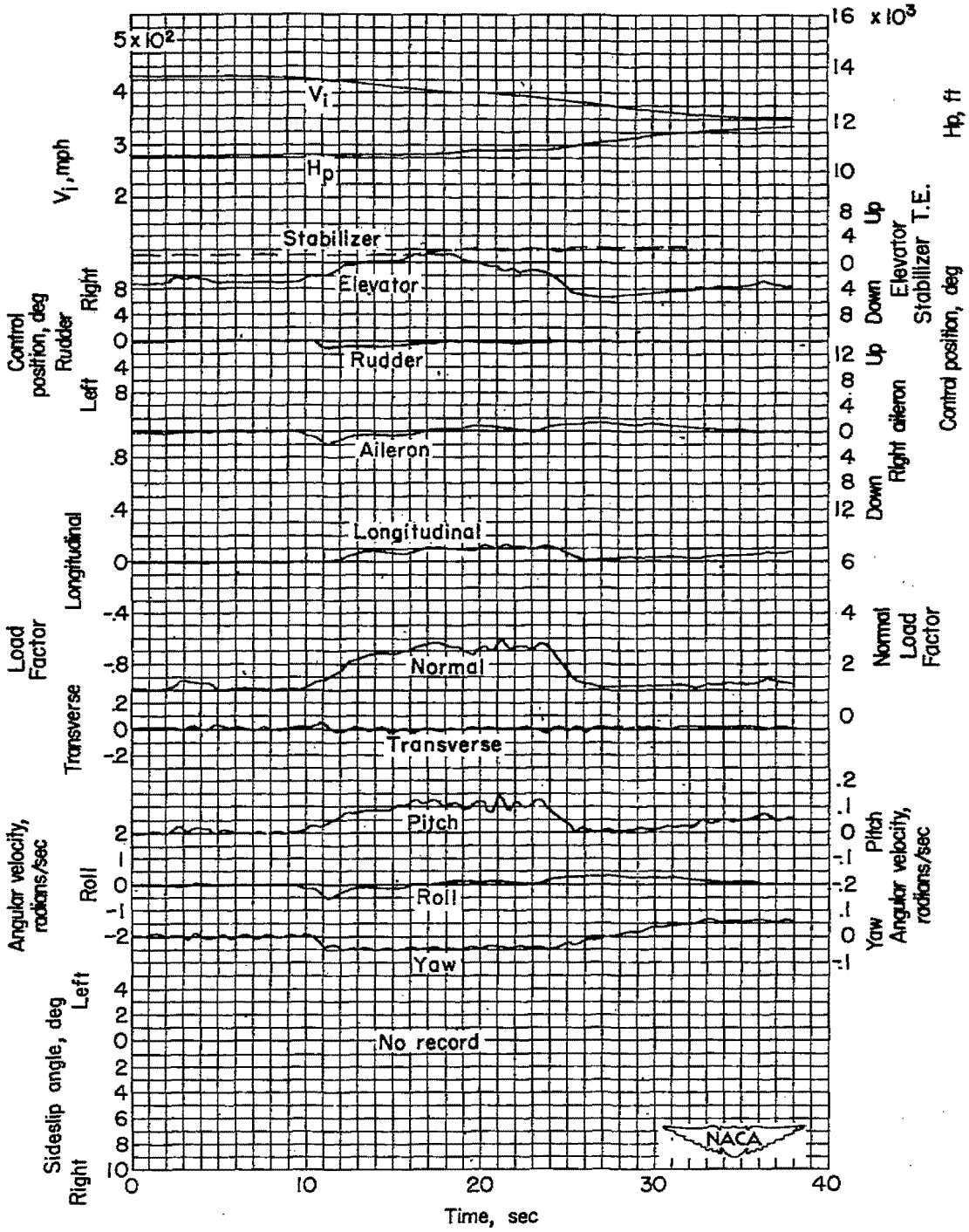


Figure 147.- Left and right climbing turns. Airplane weight, 12,050 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

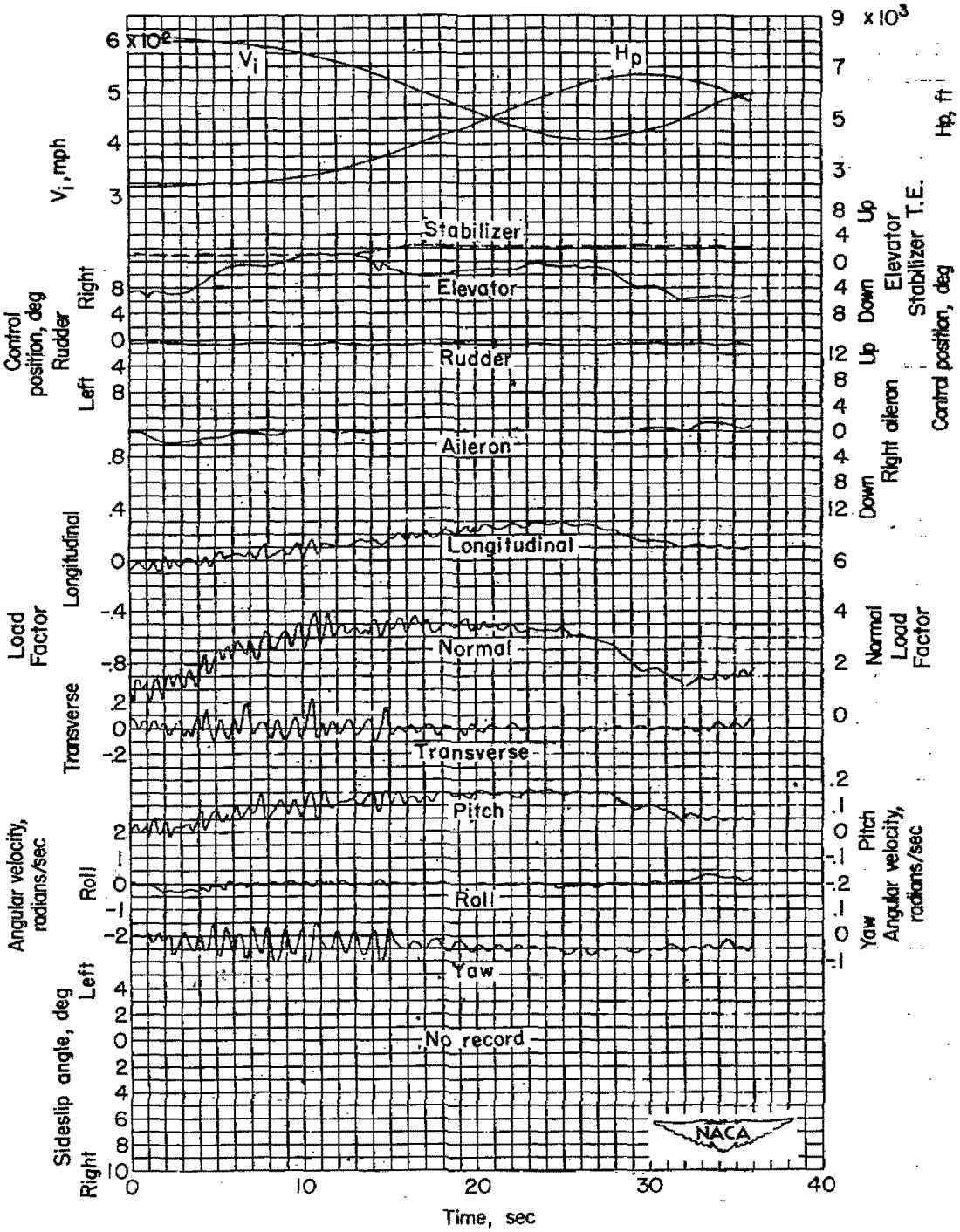


Figure 148.- Sharp left climbing turn. Airplane weight, 14,050 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

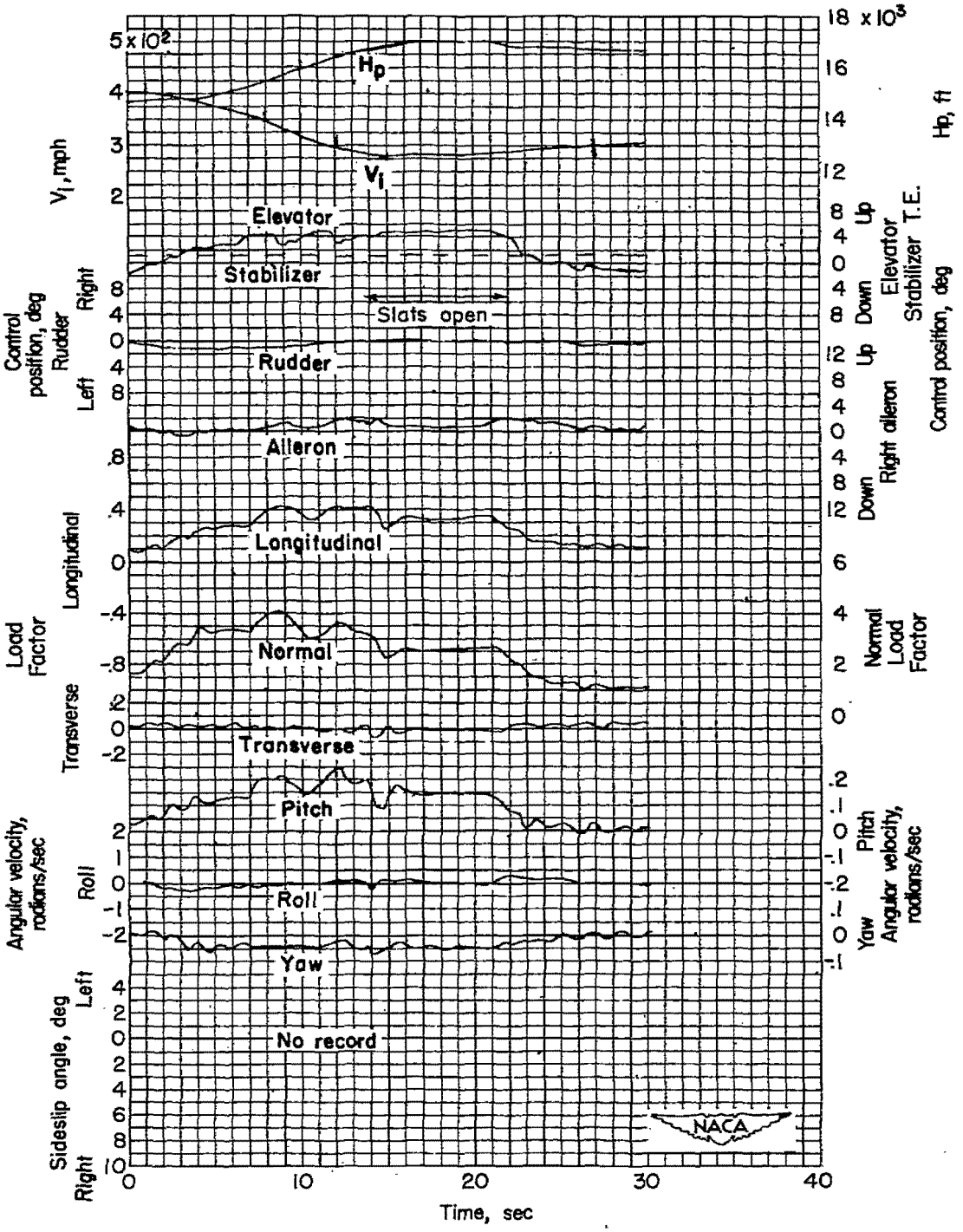


Figure 149.- Sharp left climbing turn. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

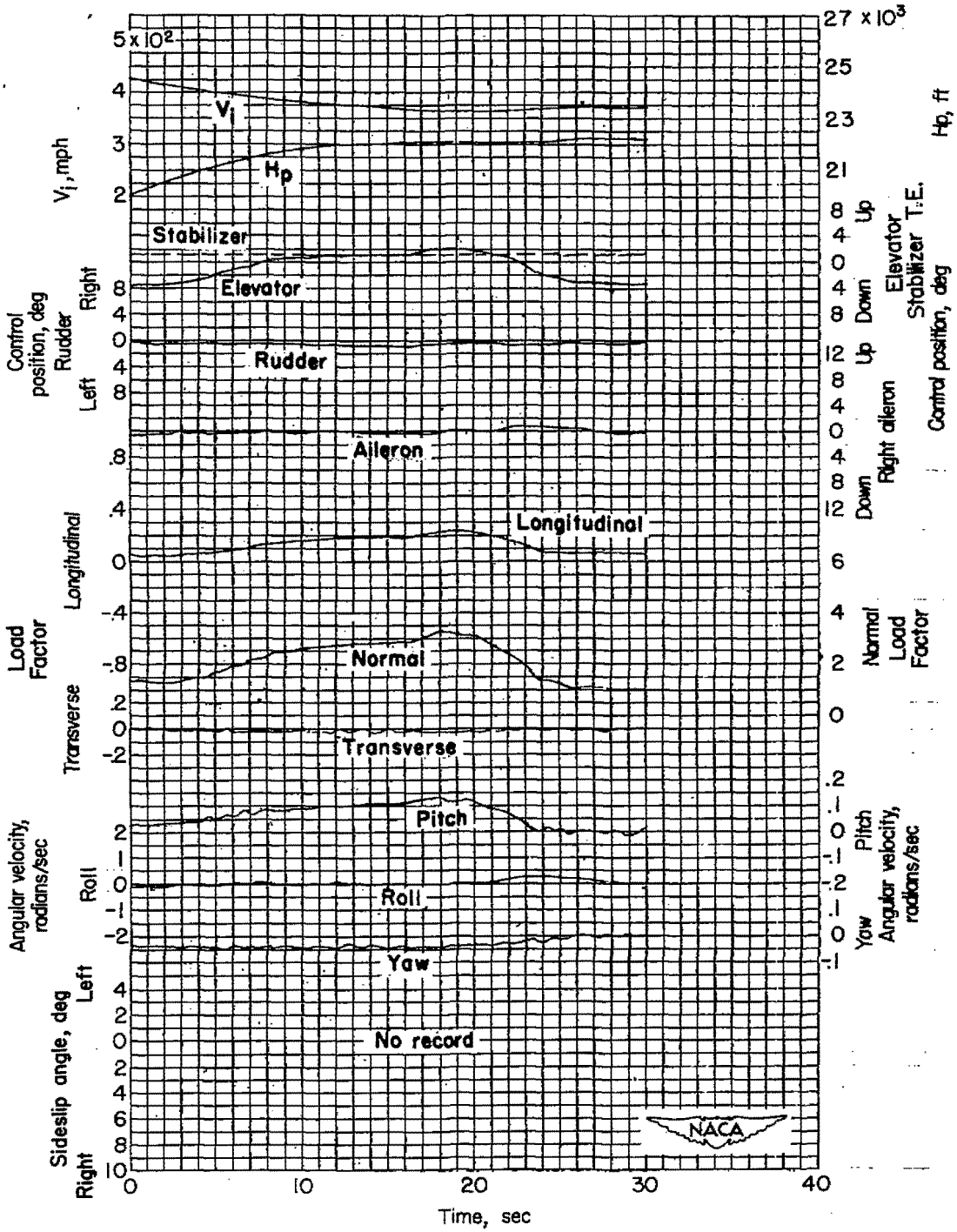


Figure 150.- Sharp left climbing turn. Airplane weight, 13,000 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

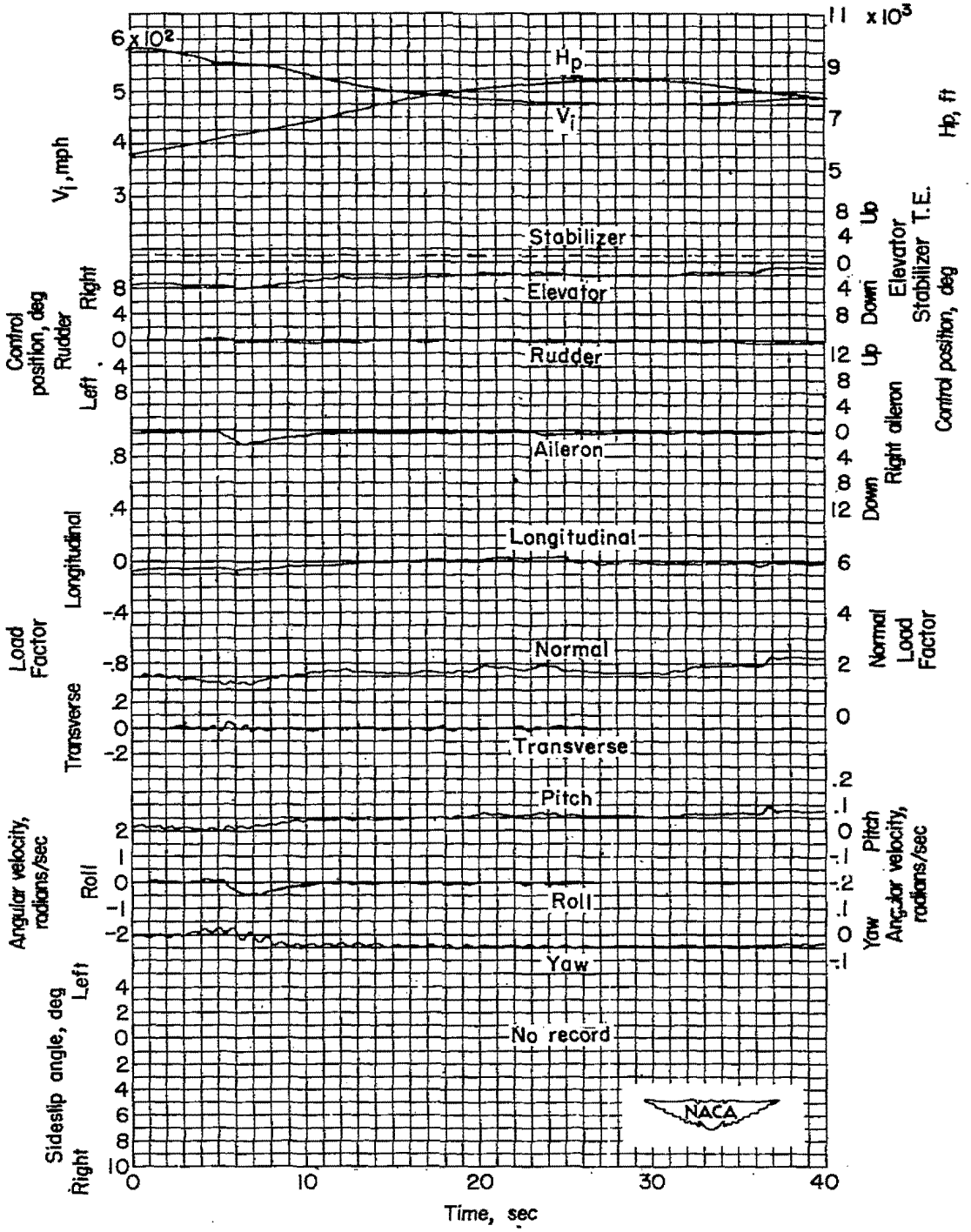


Figure 151.- Left climbing and diving turn. Airplane weight, 11,850 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

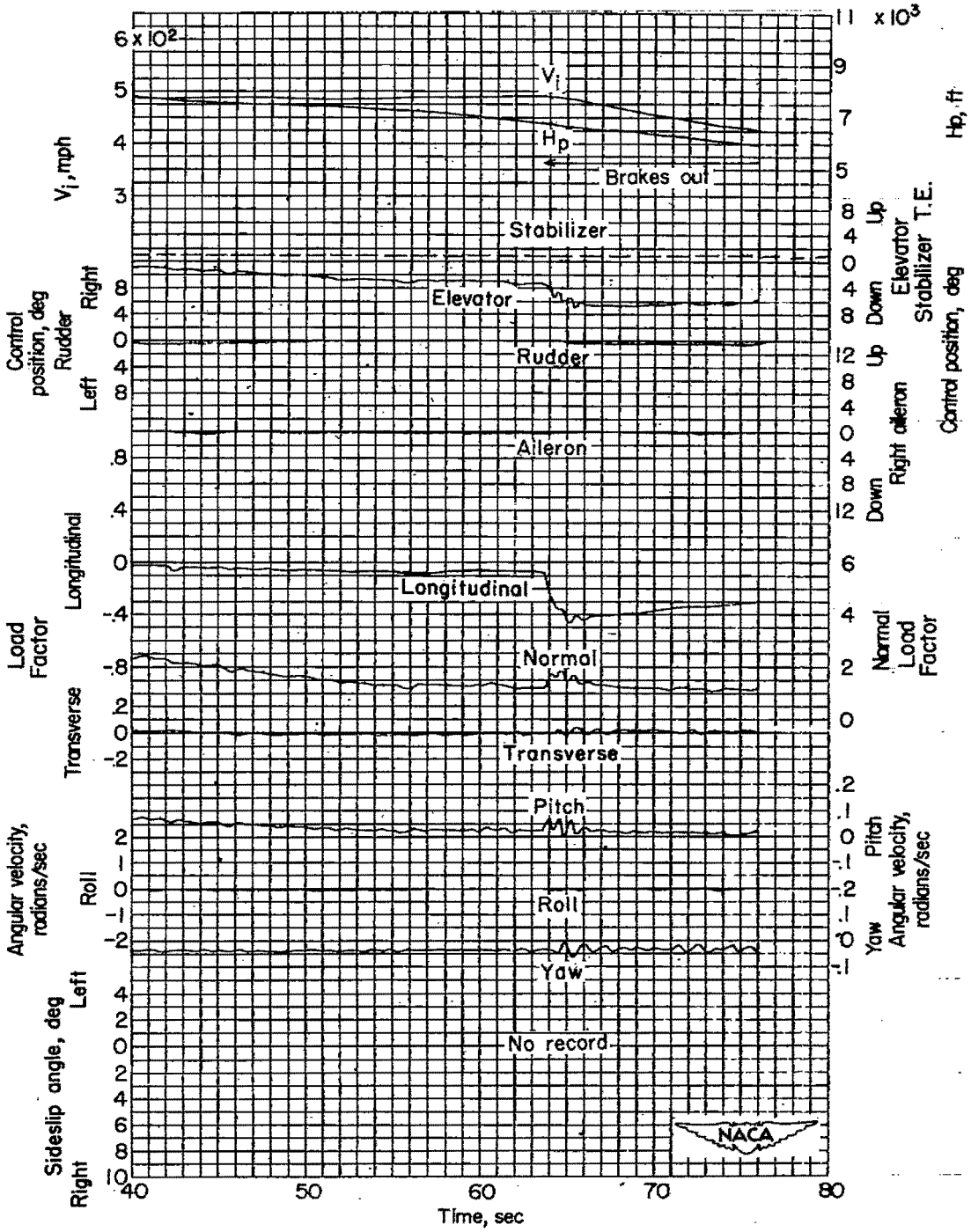


Figure 151.- Concluded.

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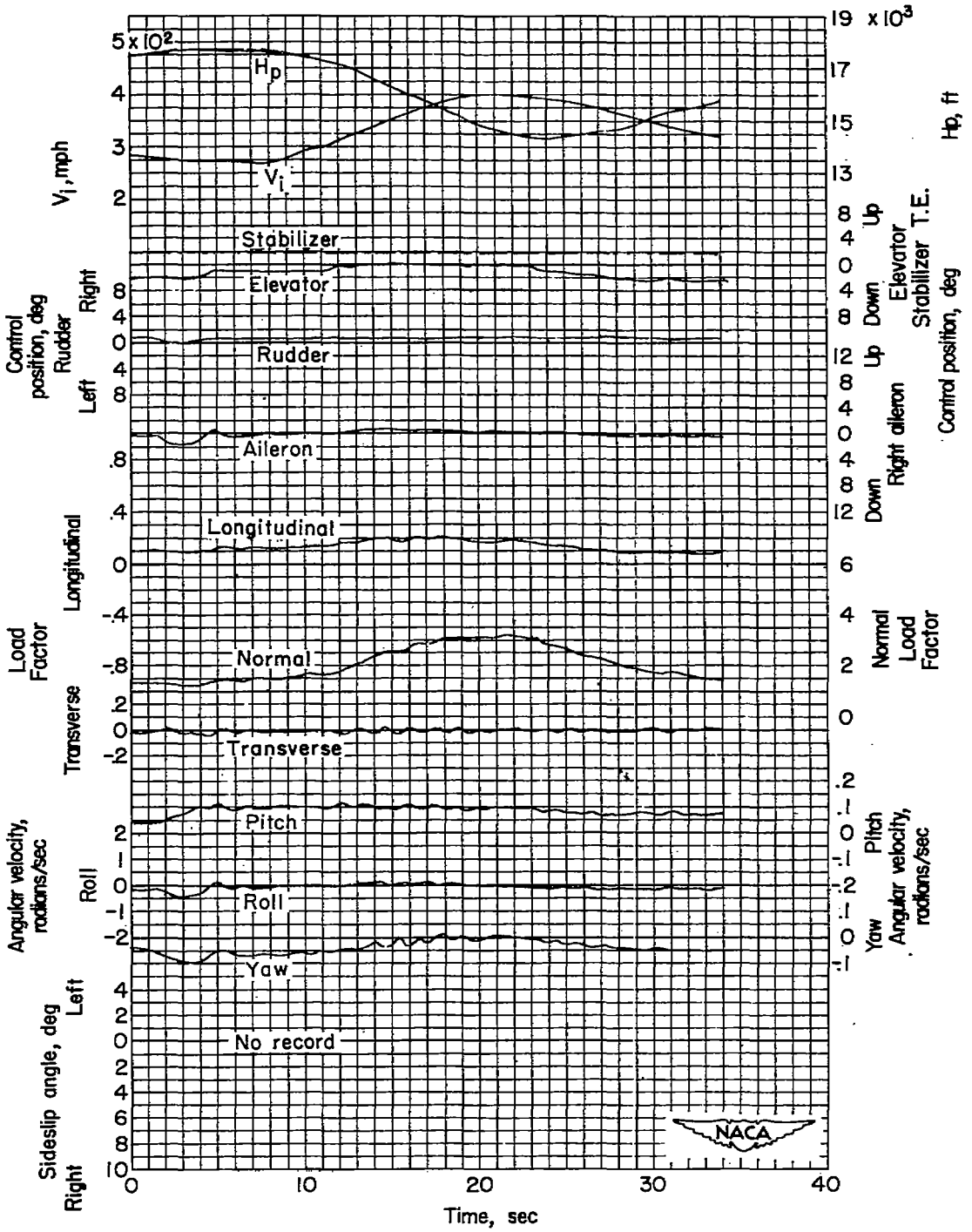


Figure 152.- Left diving and climbing turns. Airplane weight, 12,650 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

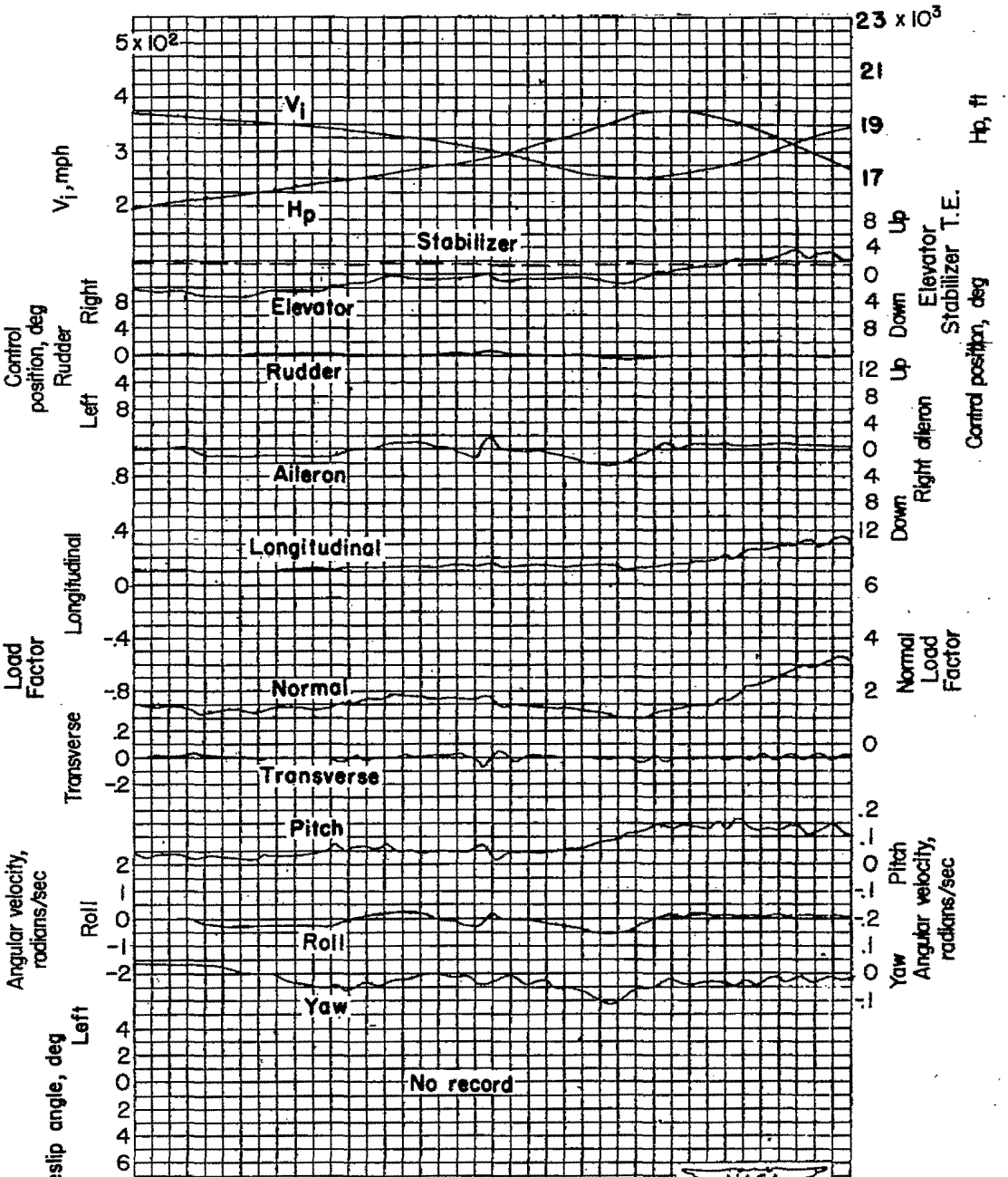


Figure 153.- Left climbing and diving turns. Airplane weight, 12,400 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

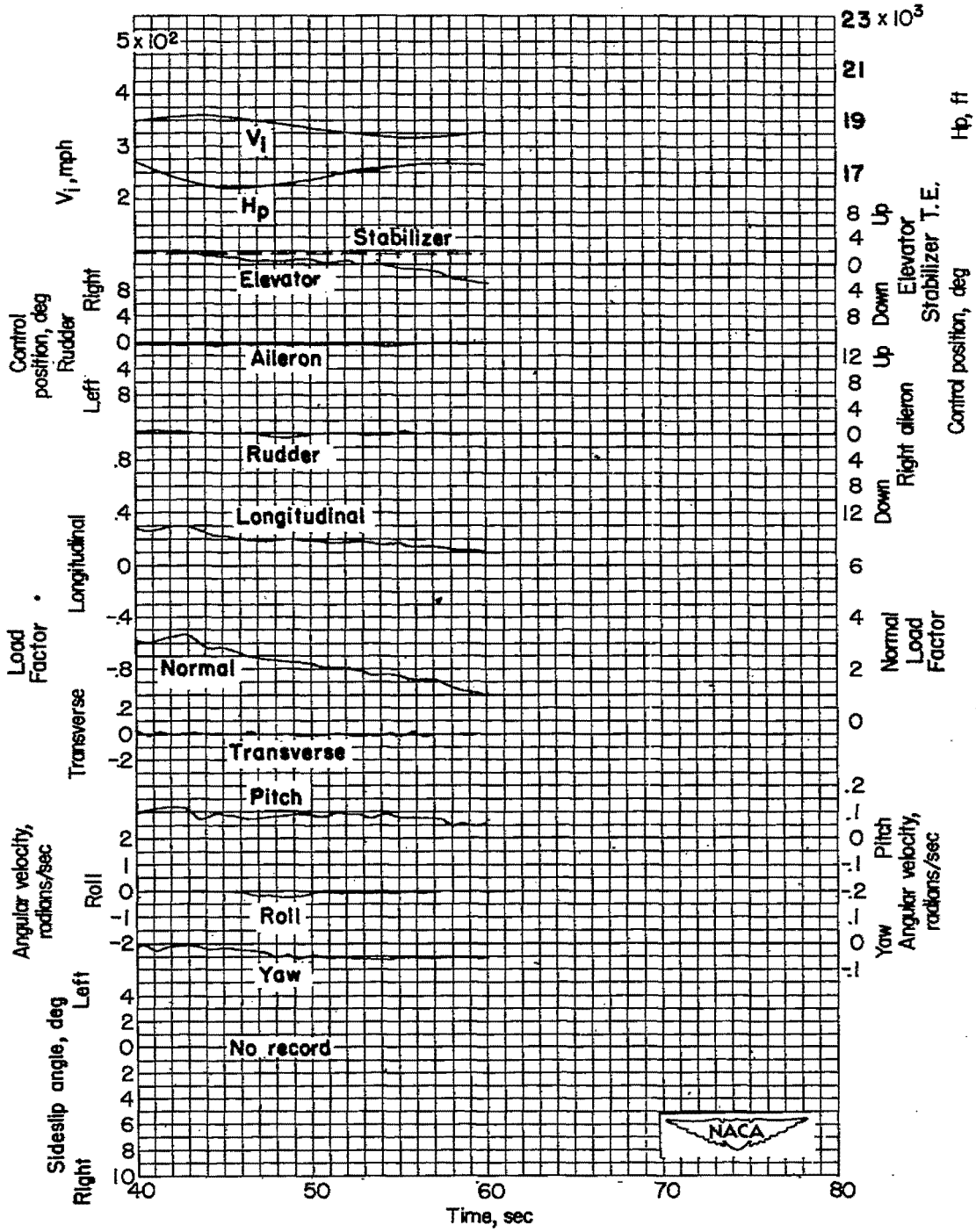


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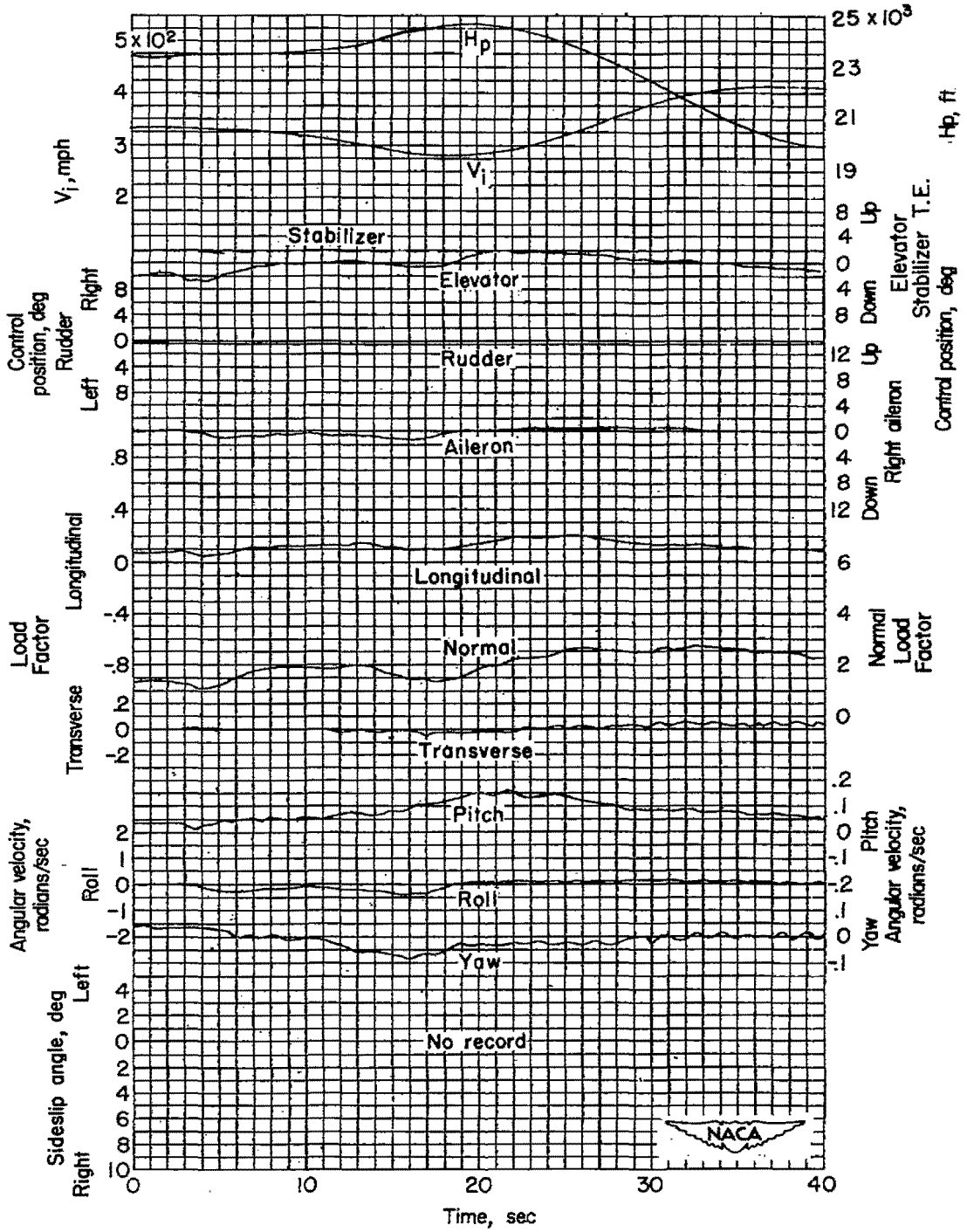


Figure 154.- Left climbing and diving turns. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

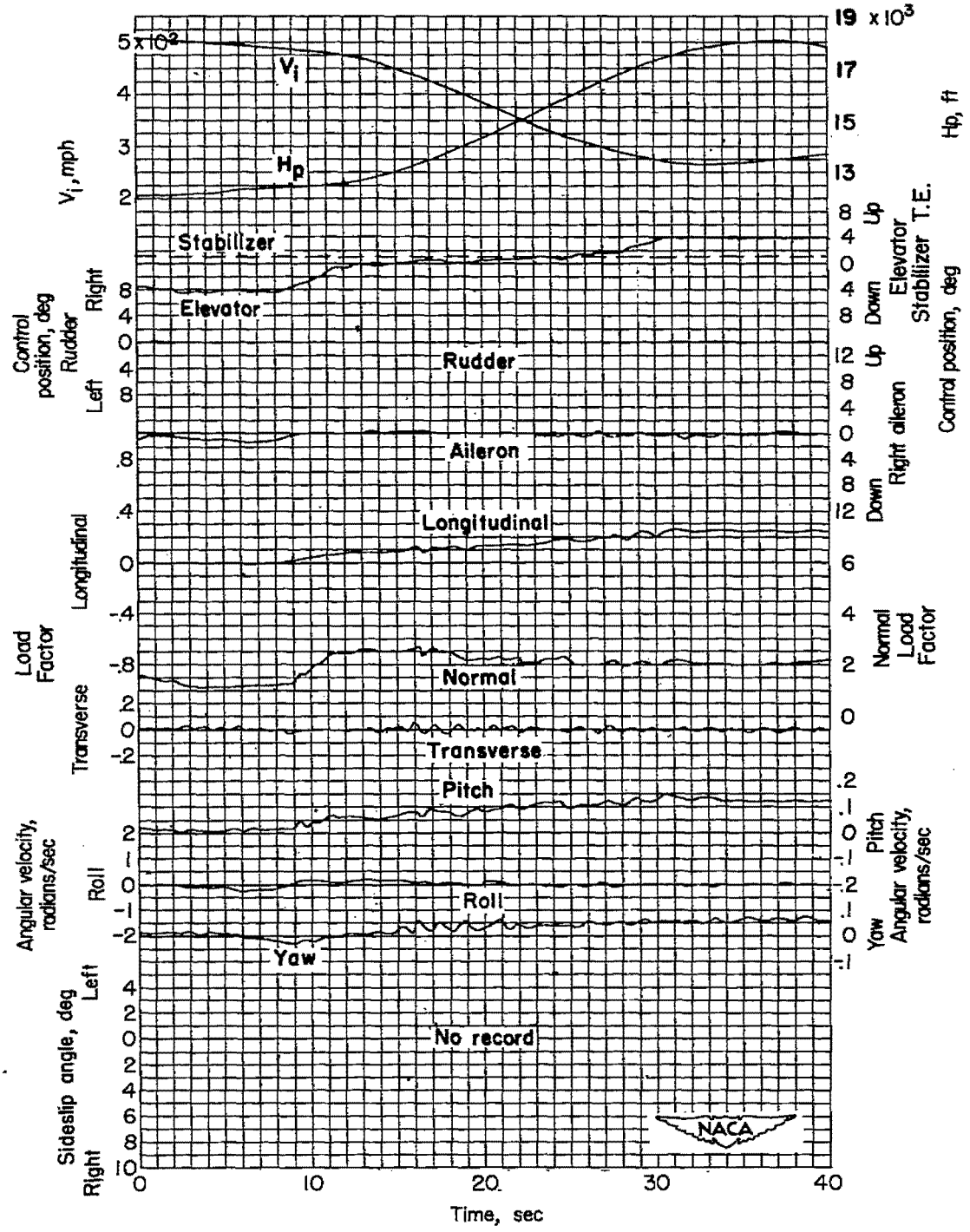


Figure 155.- Right climbing and diving turn. Airplane weight, 12,250 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

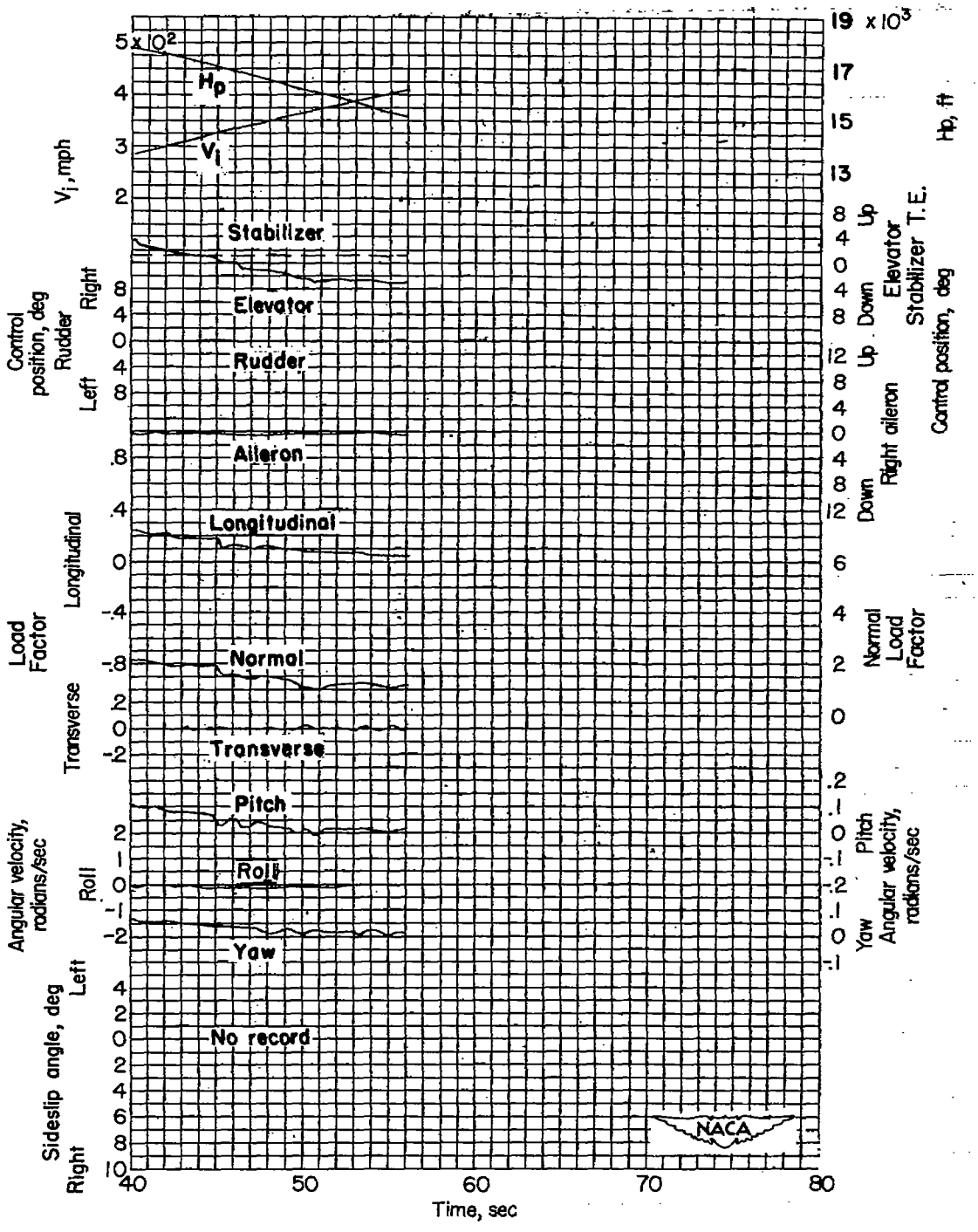


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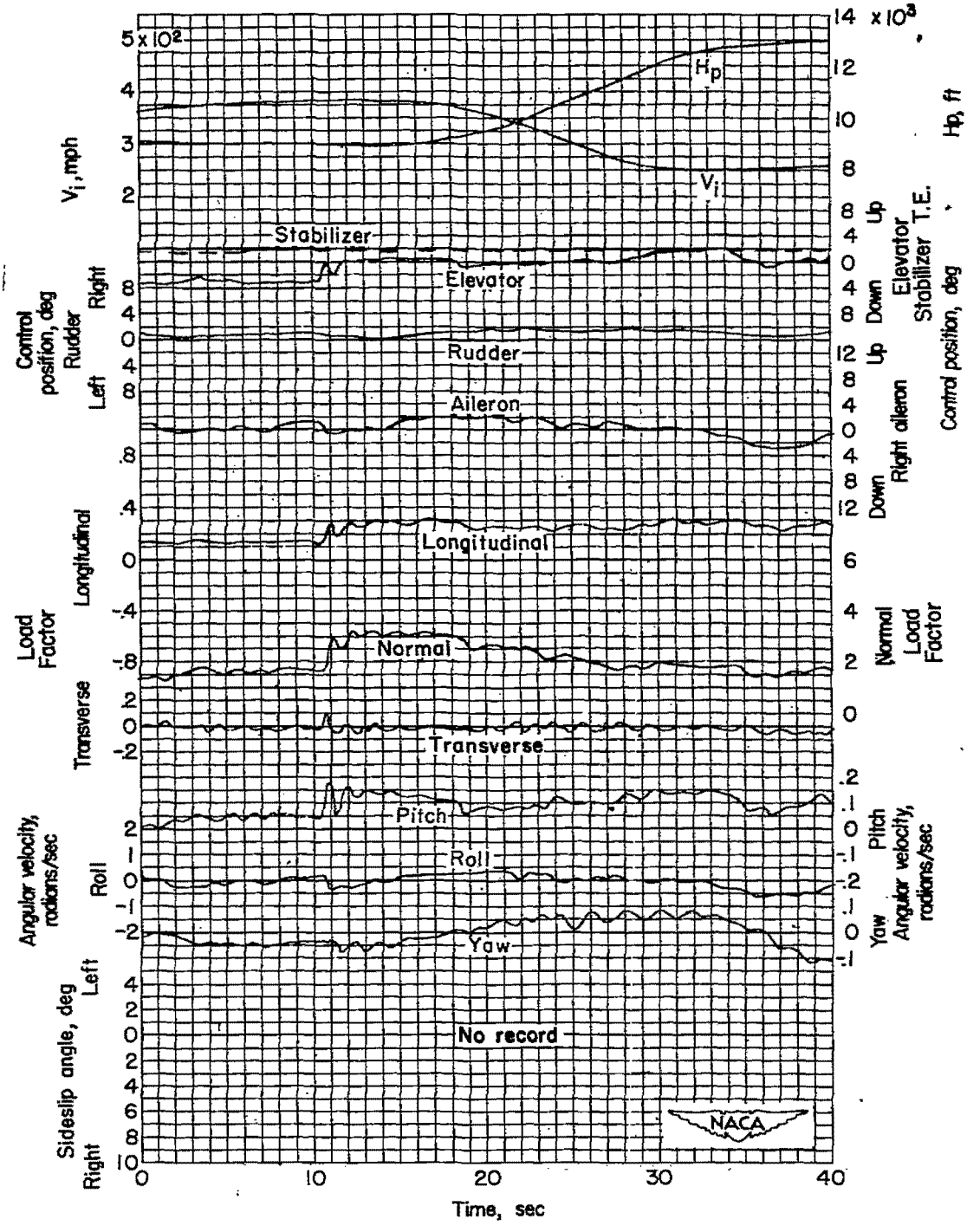


Figure 156.- Sharp left turn and right climbing turn followed by a left diving turn. Airplane weight, 12,700 pounds; center-of-gravity location 21.0 percent of the mean aerodynamic chord.

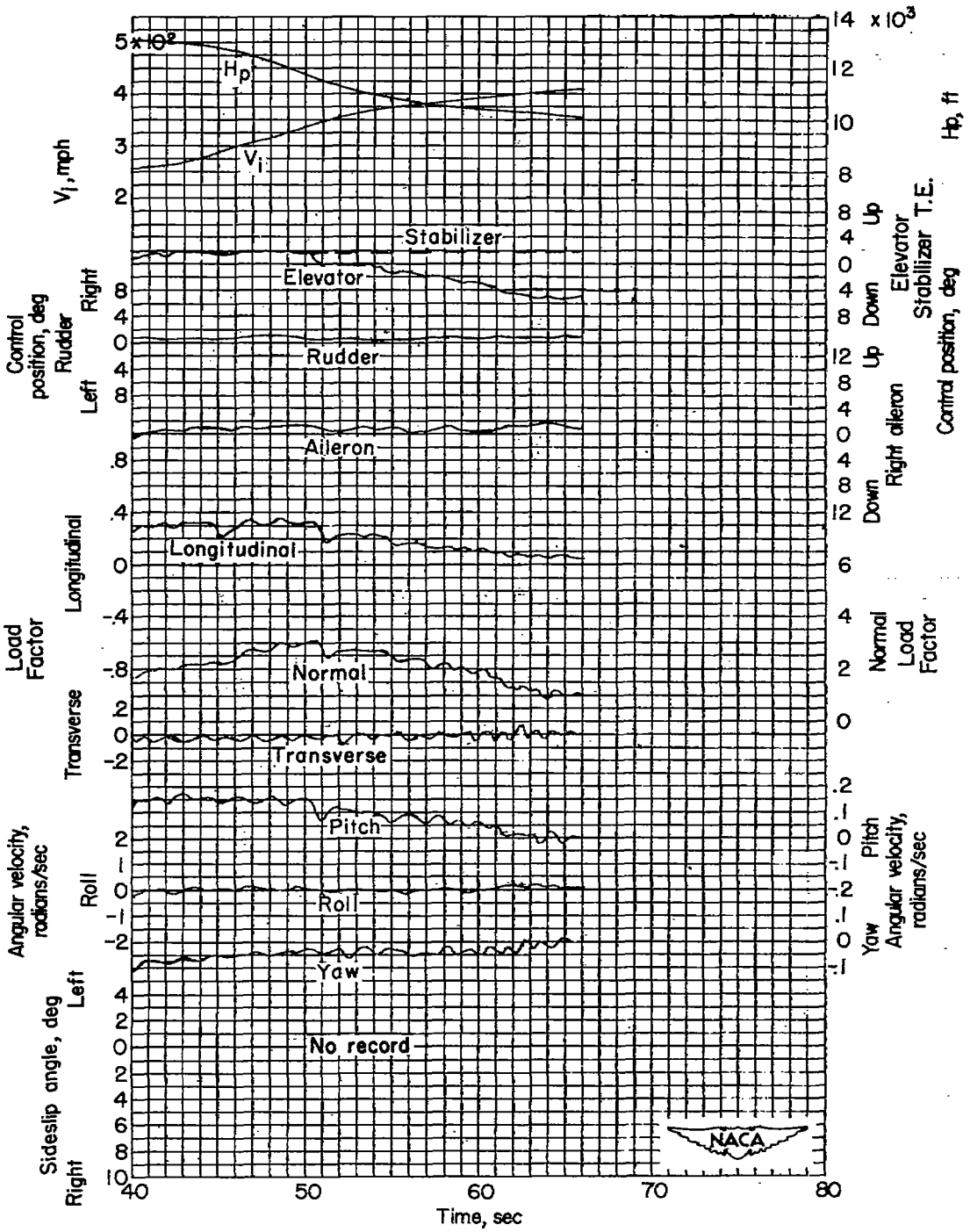


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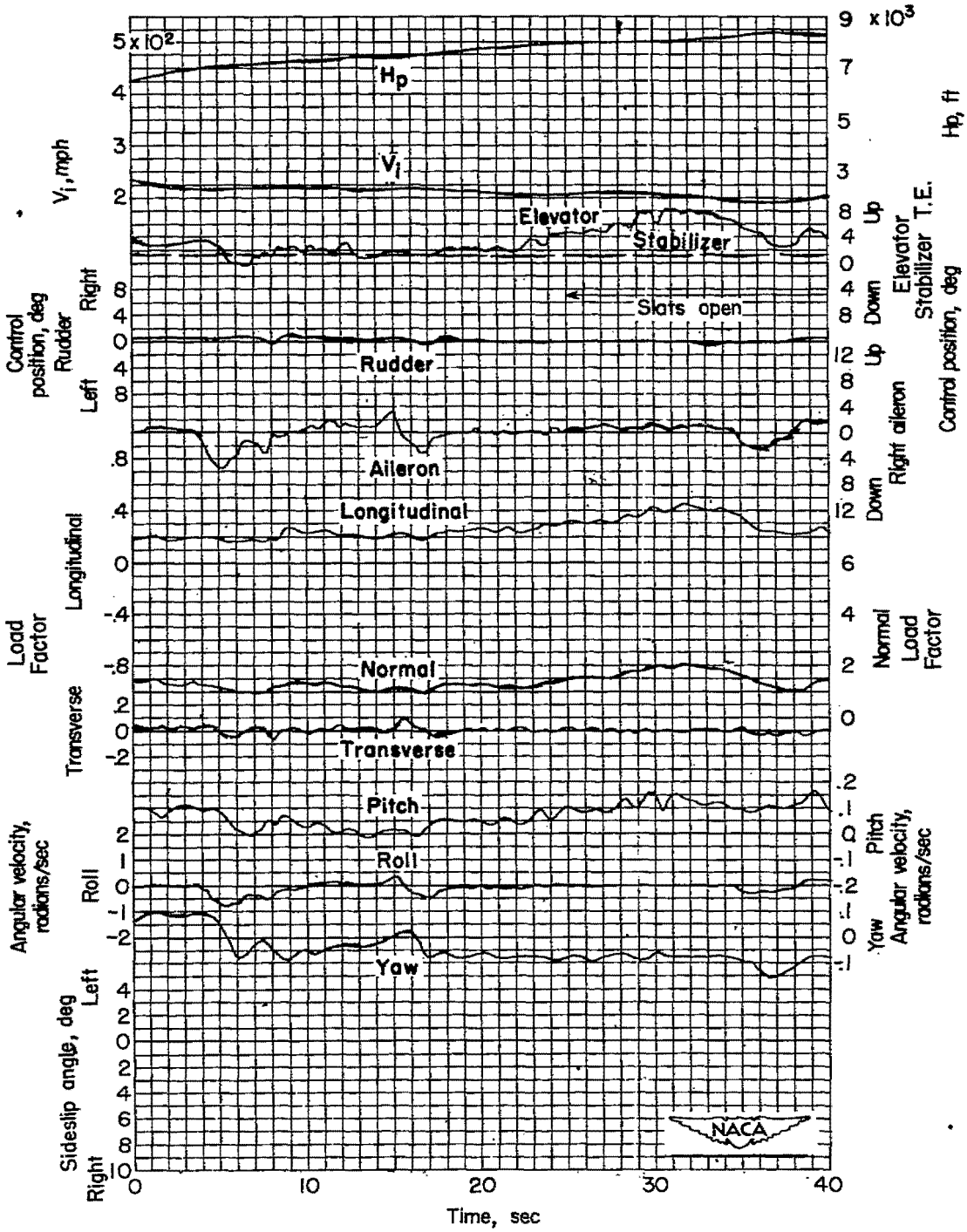


Figure 157.- Right and left climbing turns followed by a left diving turn. Airplane weight, 12,100 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

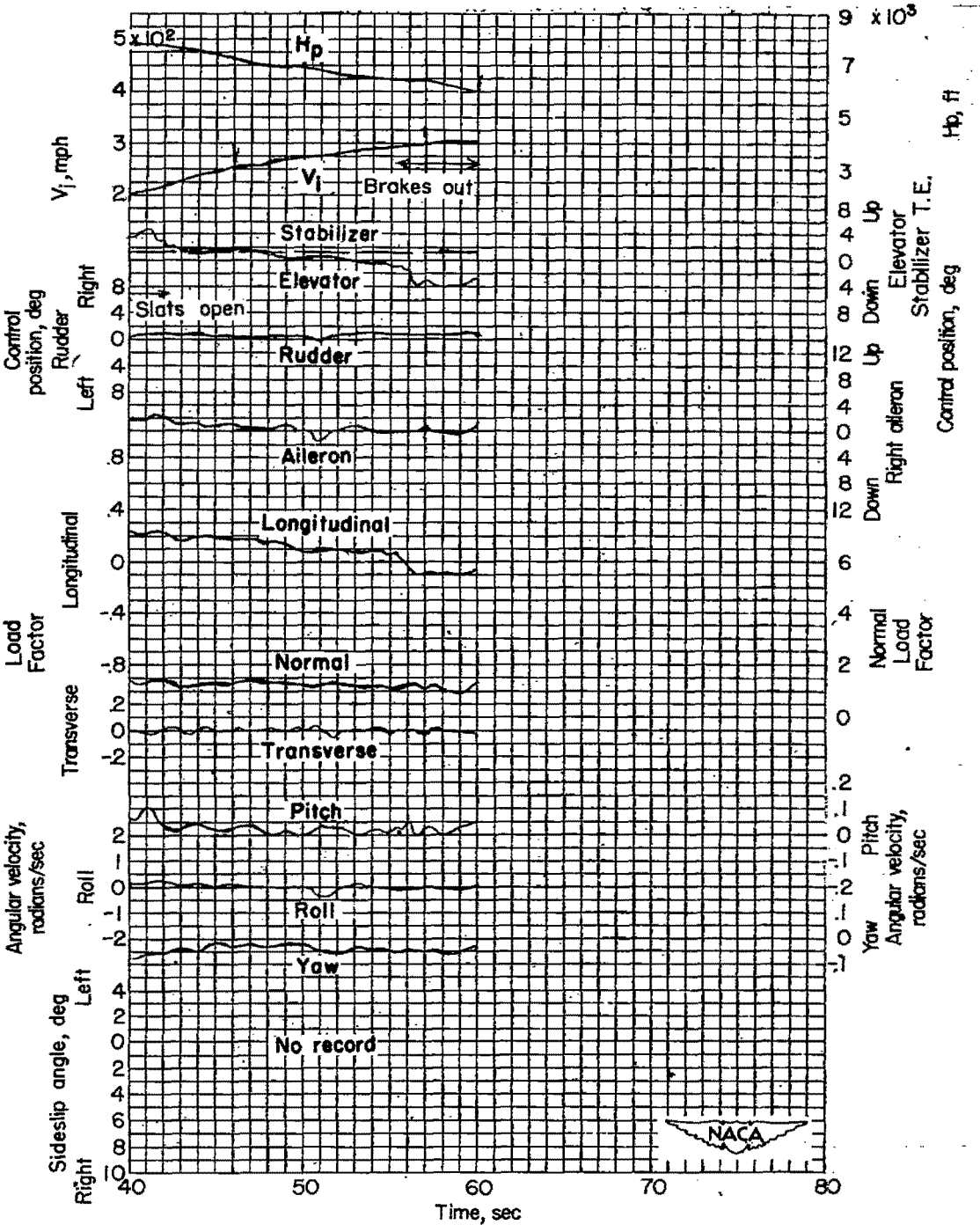


Figure 157.- Concluded.

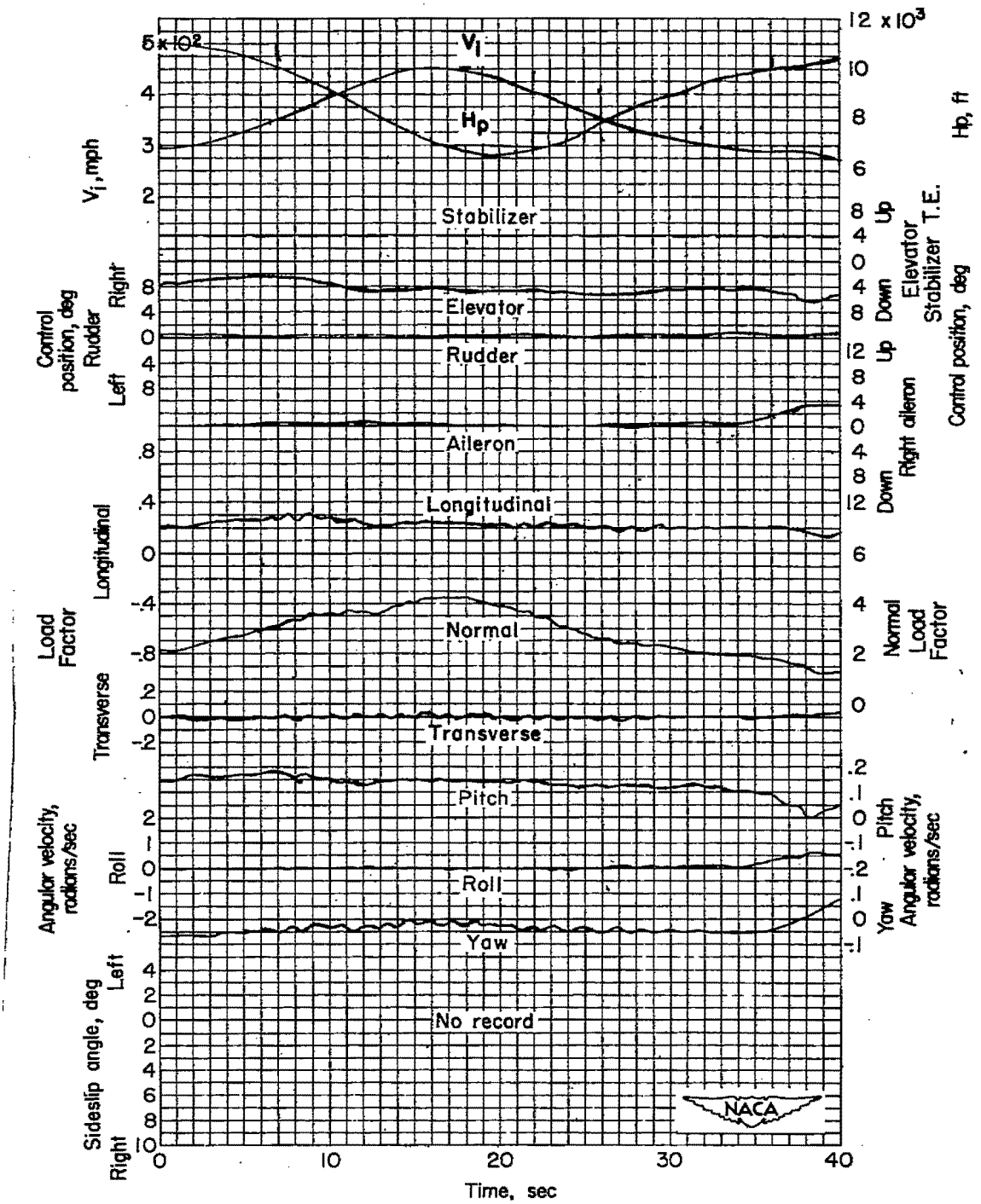


Figure 158.- Left and right diving and climbing turns. Airplane weight, 12,350 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

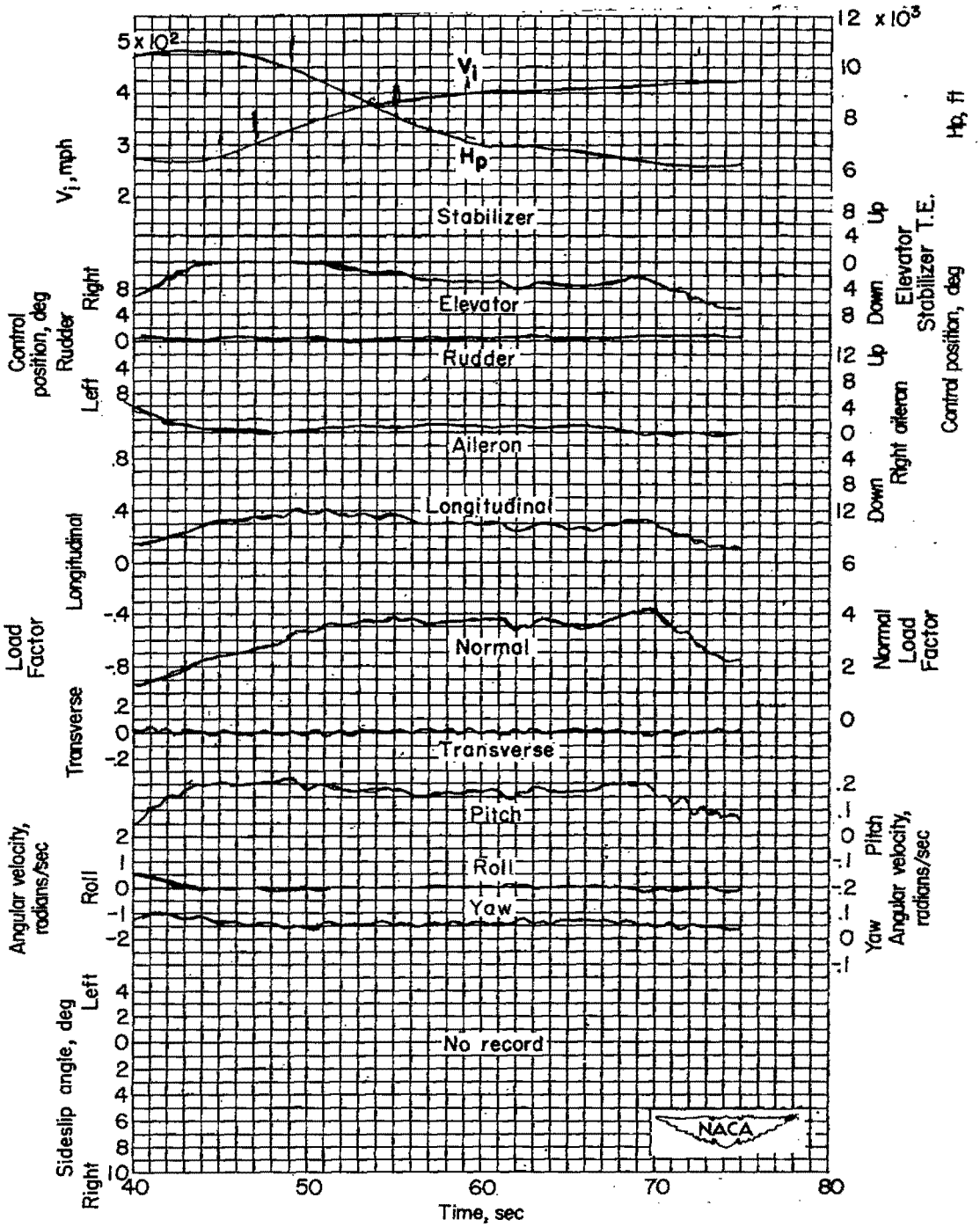


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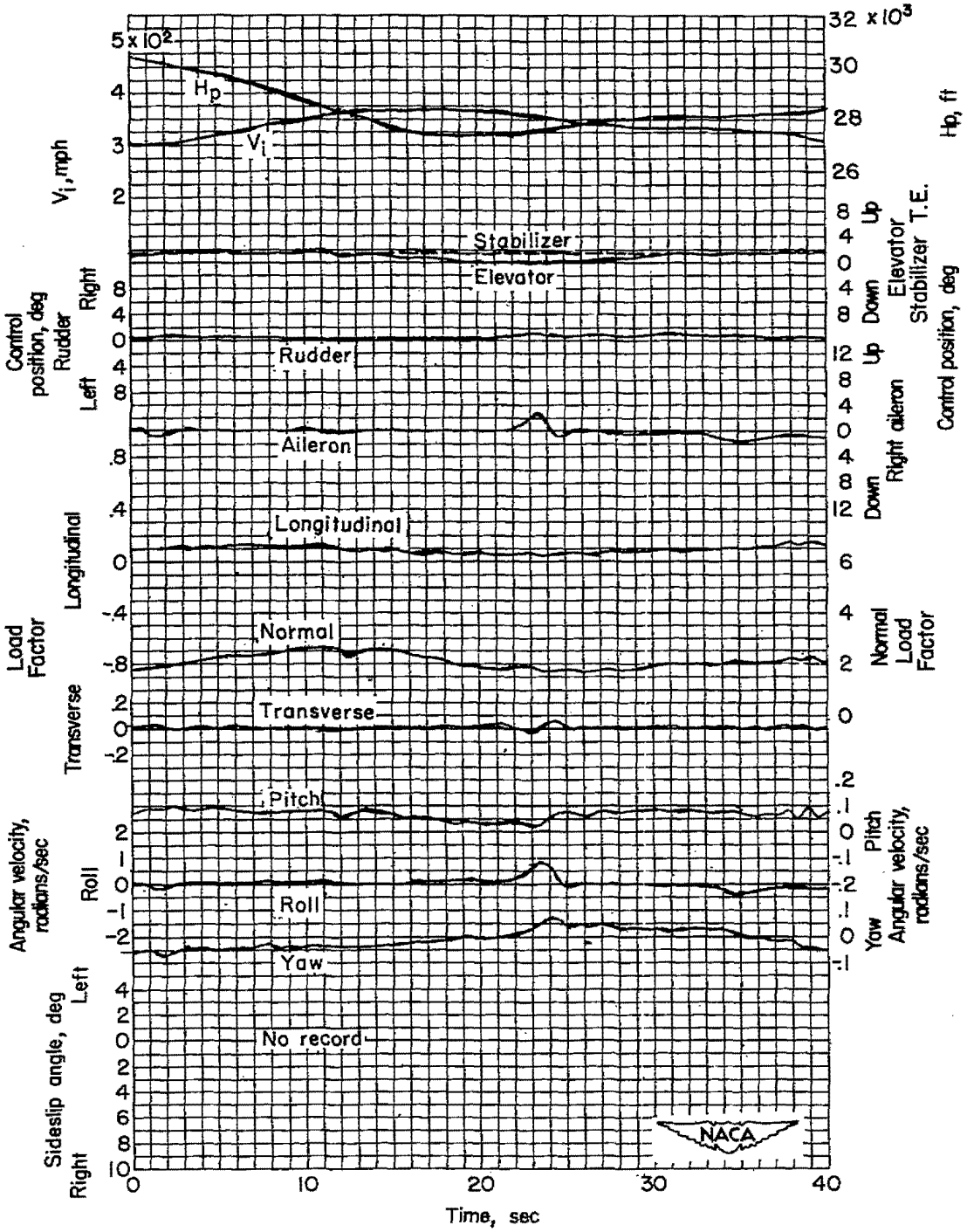


Figure 159.- Left and right climbing and diving turns. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

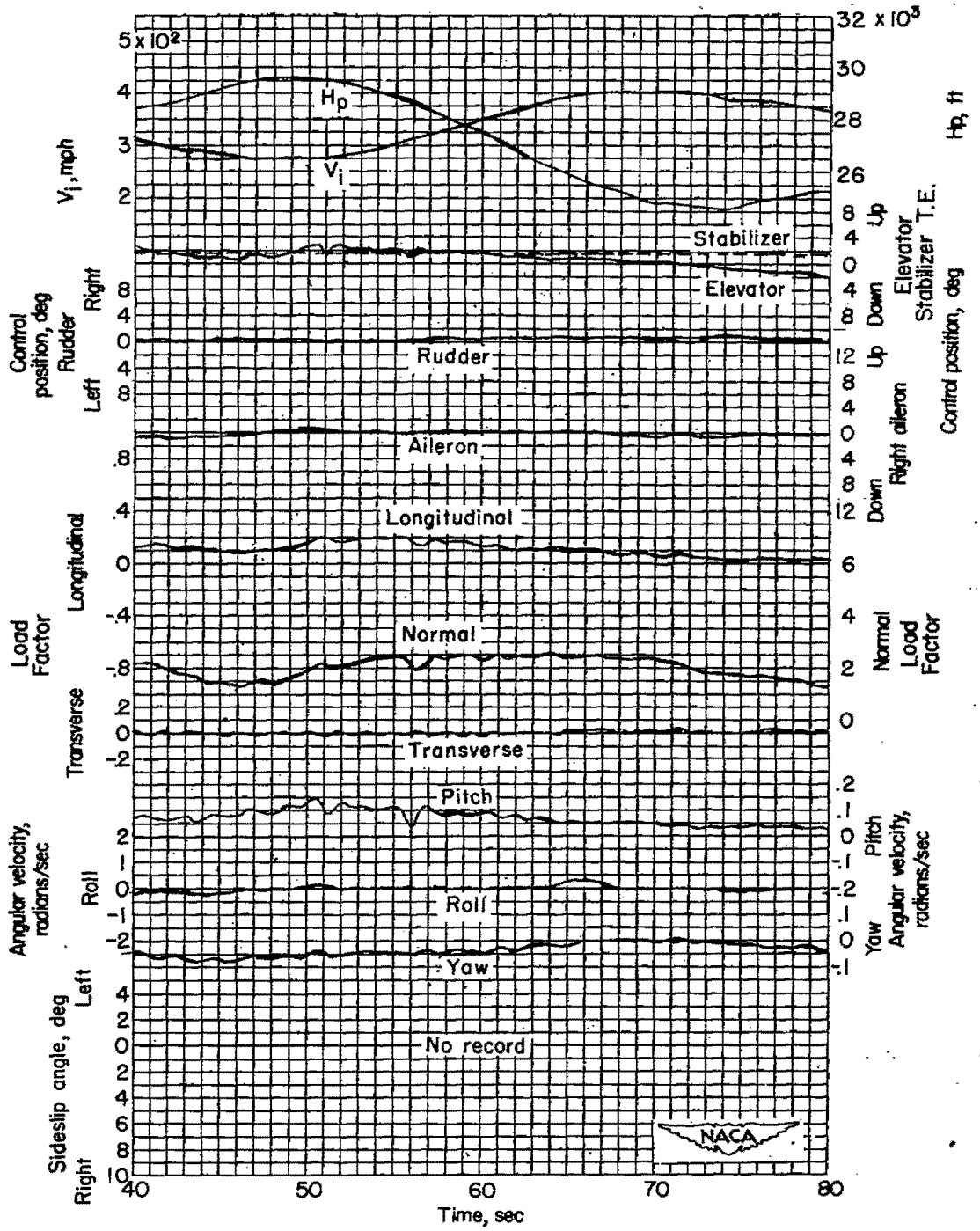


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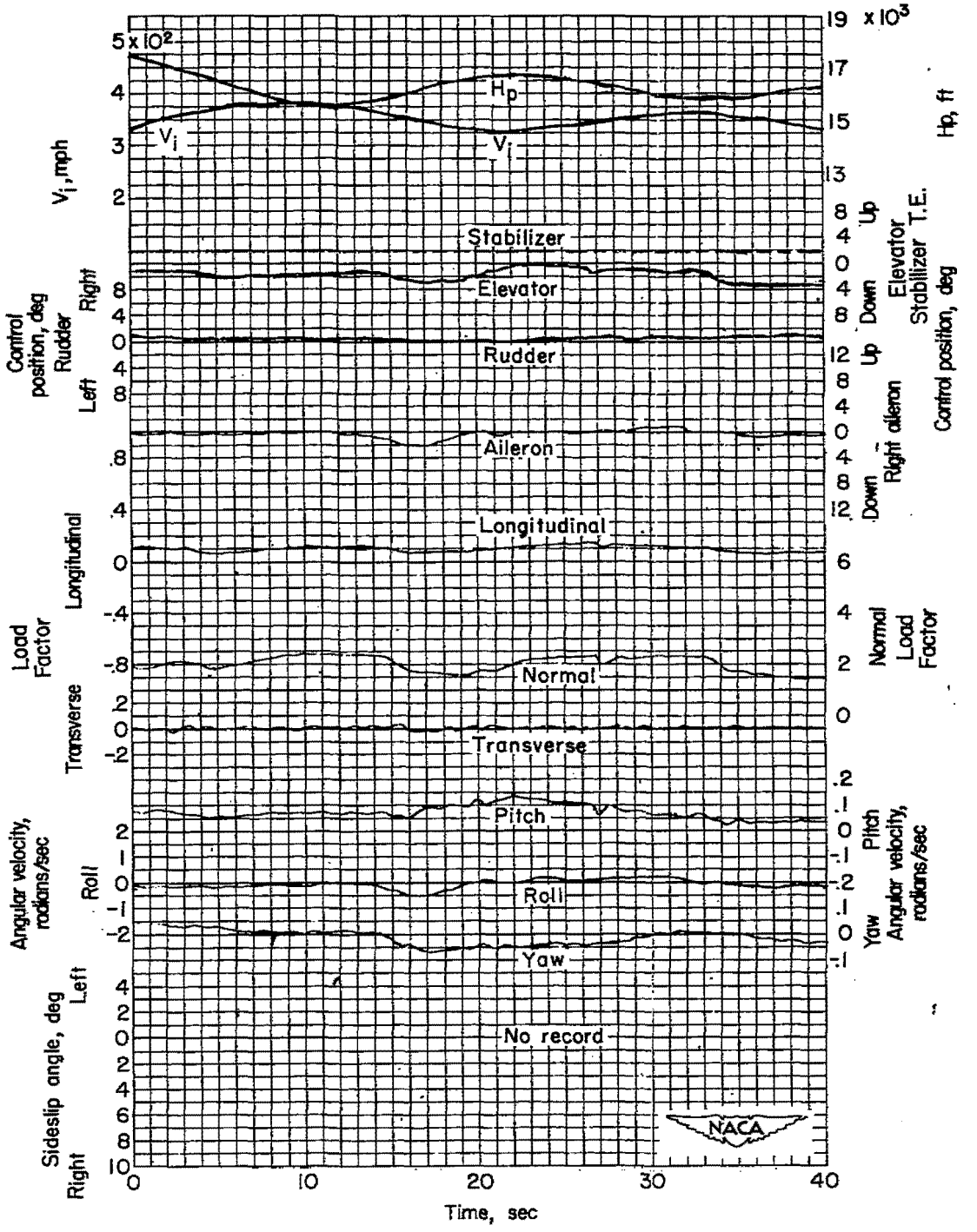


Figure 160.- Right and left diving and climbing turn. Airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

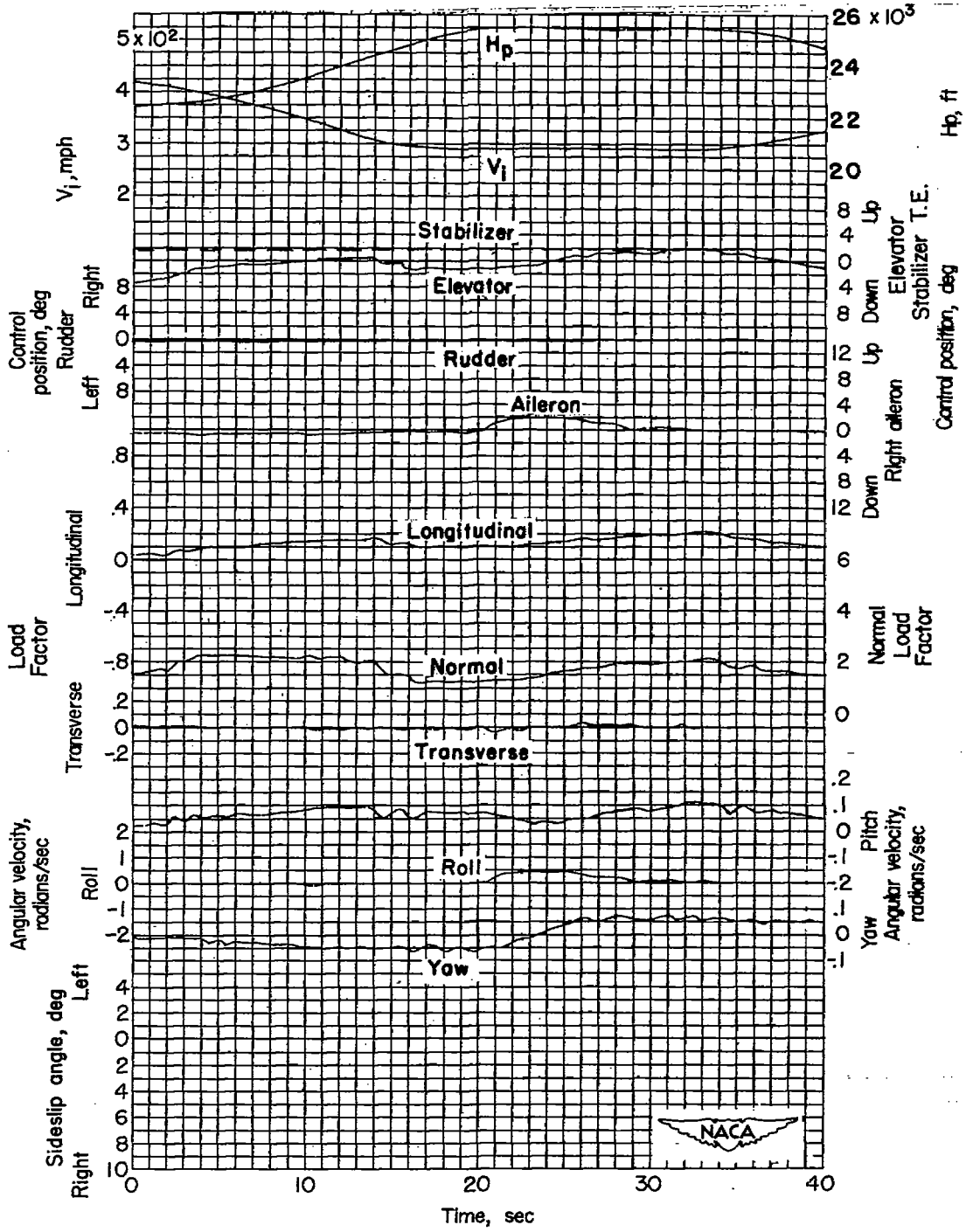


Figure 161.- Left climbing turn followed by a right turn. Airplane weight, 12,900 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

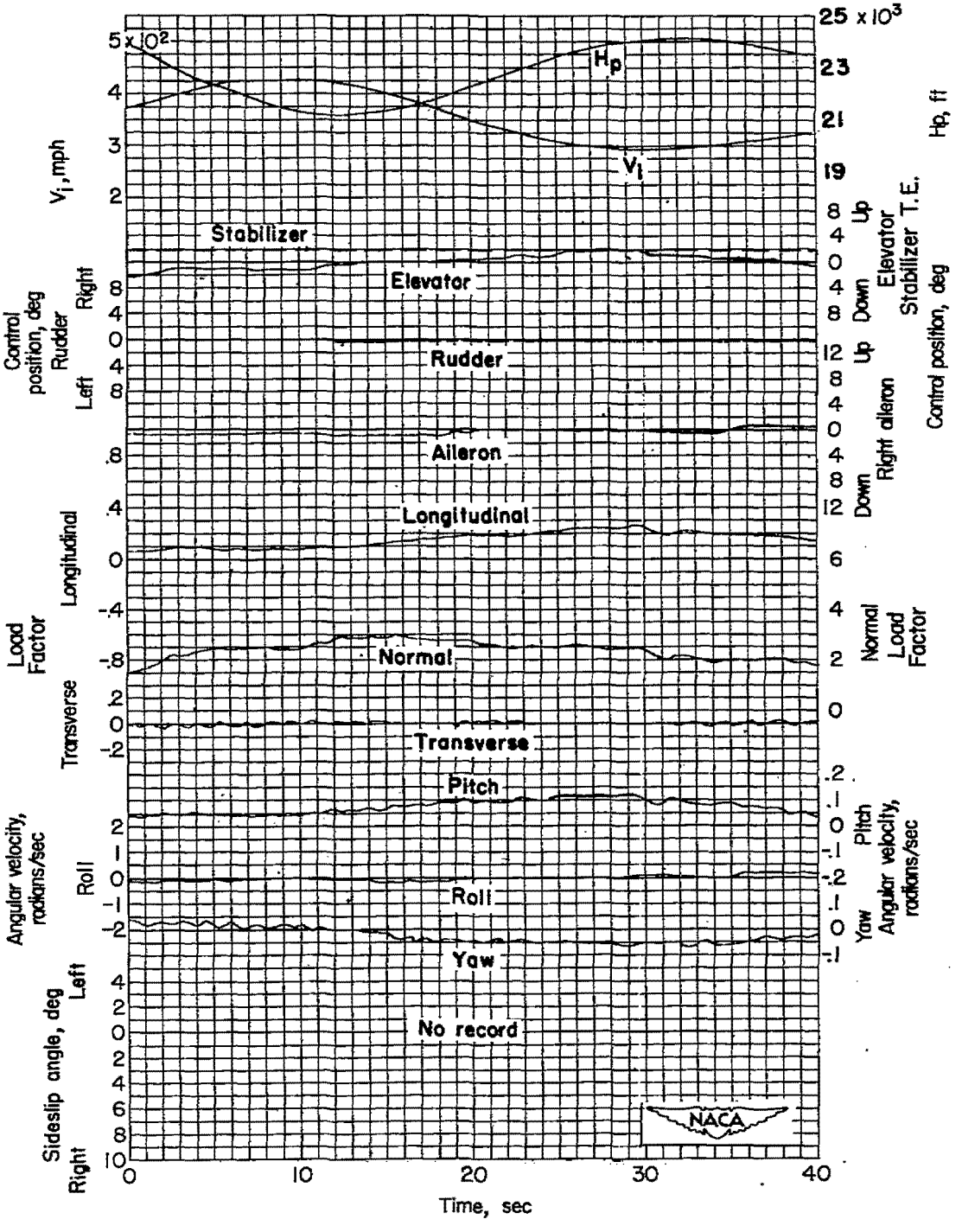


Figure 162.- Right and left diving and climbing turns. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

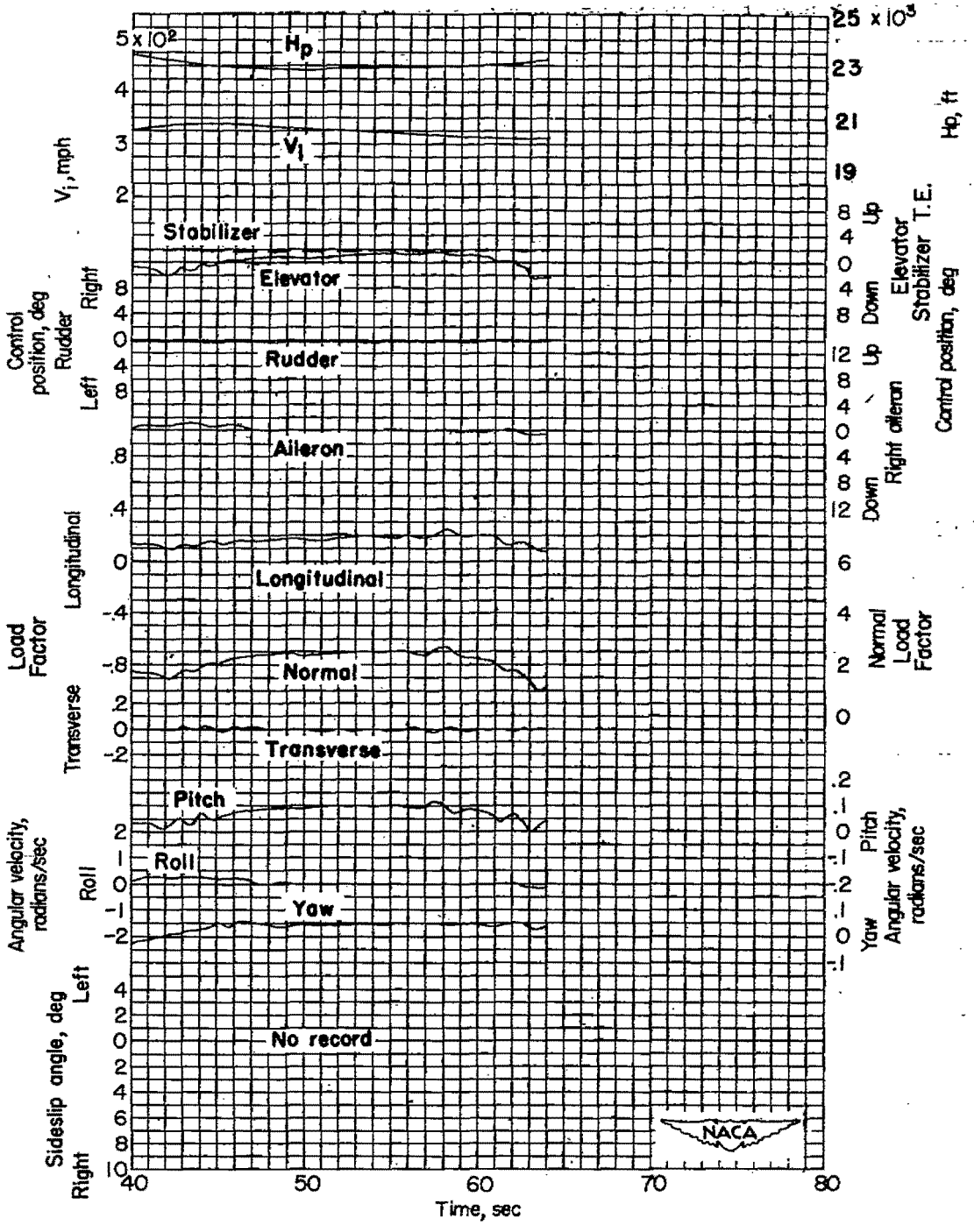


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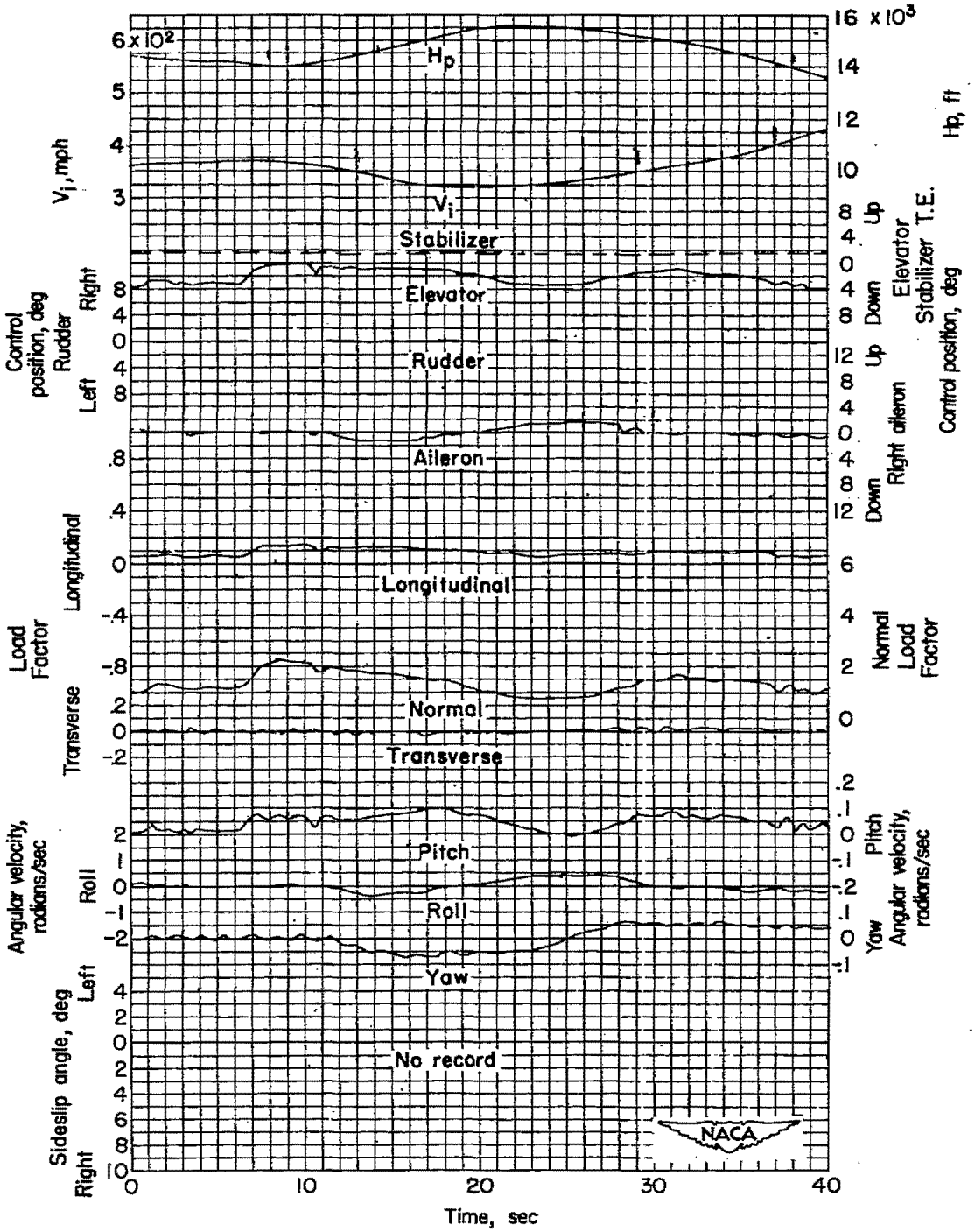


Figure 163.- Dive and pull-out followed by left and right climbing and diving turns. Airplane weight, 12,650 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

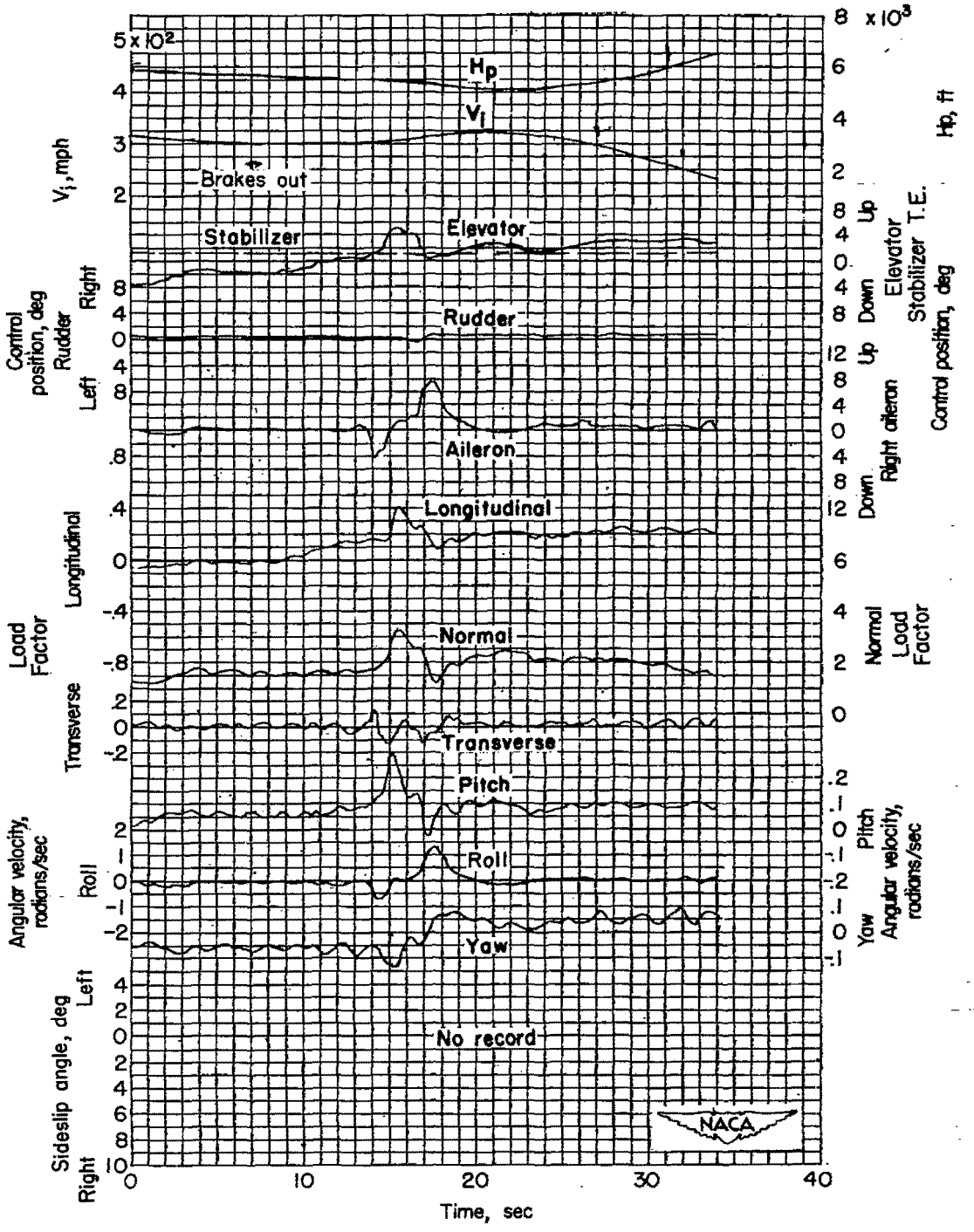


Figure 164.- Left turn followed by a right climbing turn. Airplane weight, 12,150 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

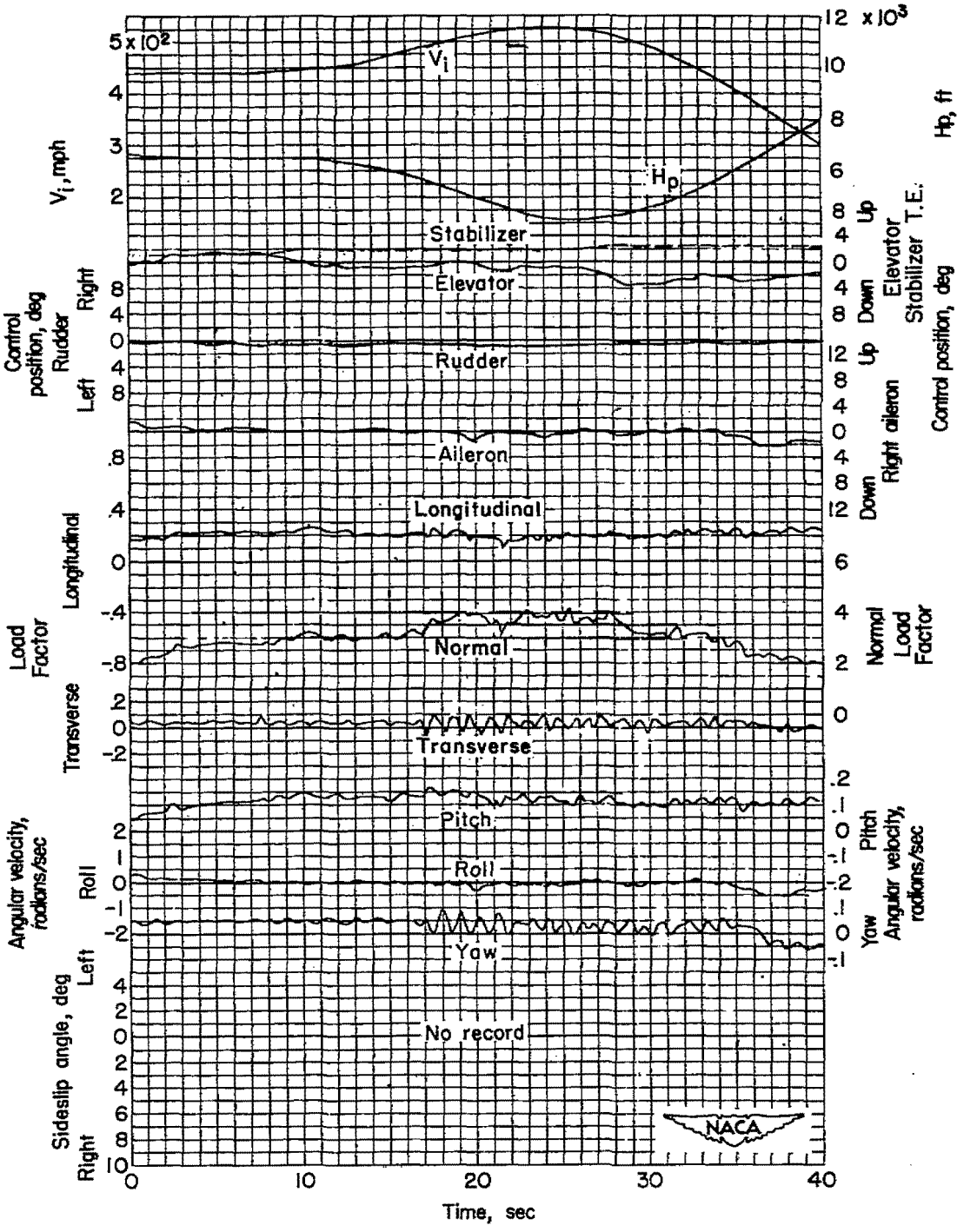


Figure 165.- Right diving turn and pull-out, left and right climbing half-rolls followed by fishtails. Airplane weight, 14,000 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

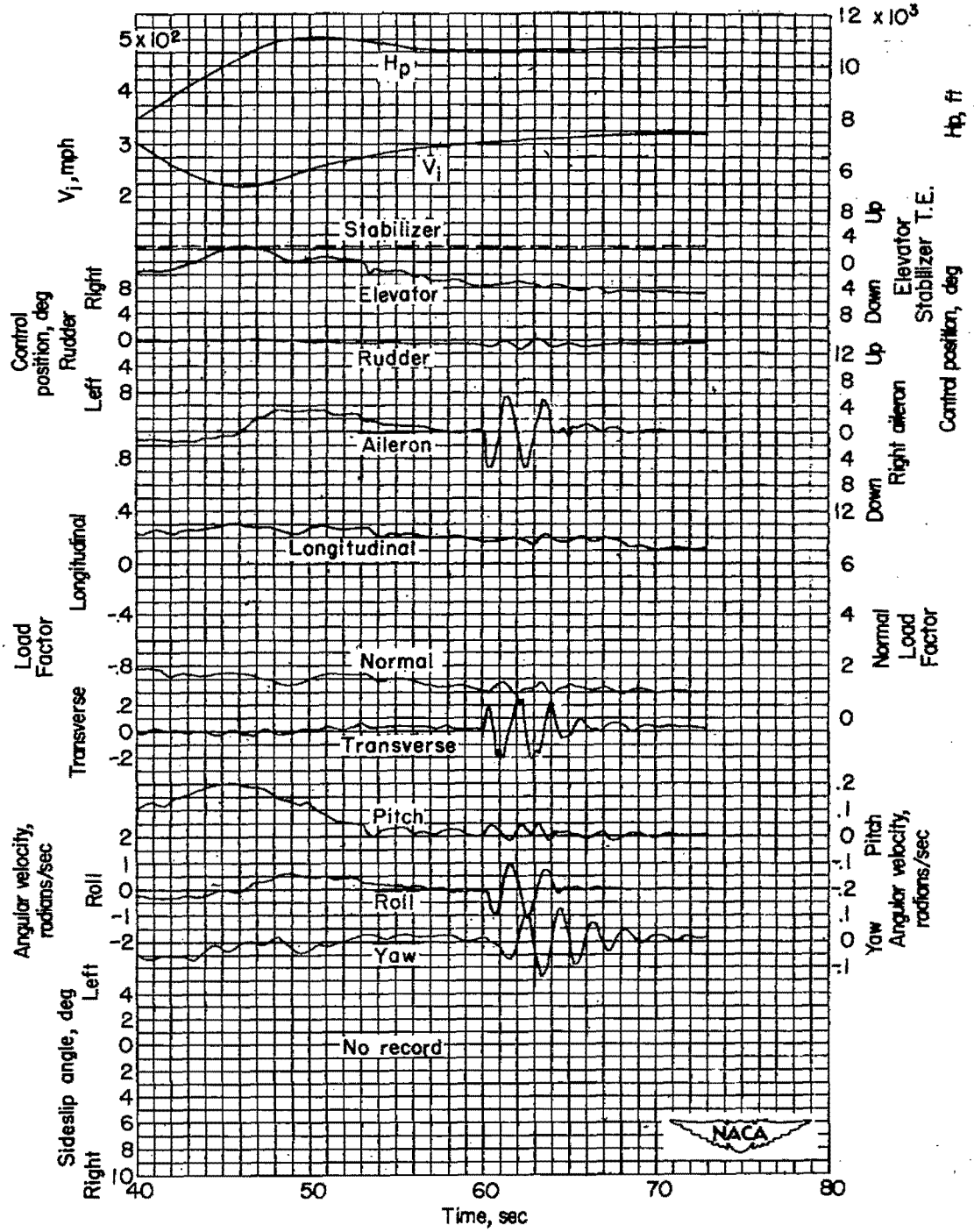


Figure 165.- Concluded.

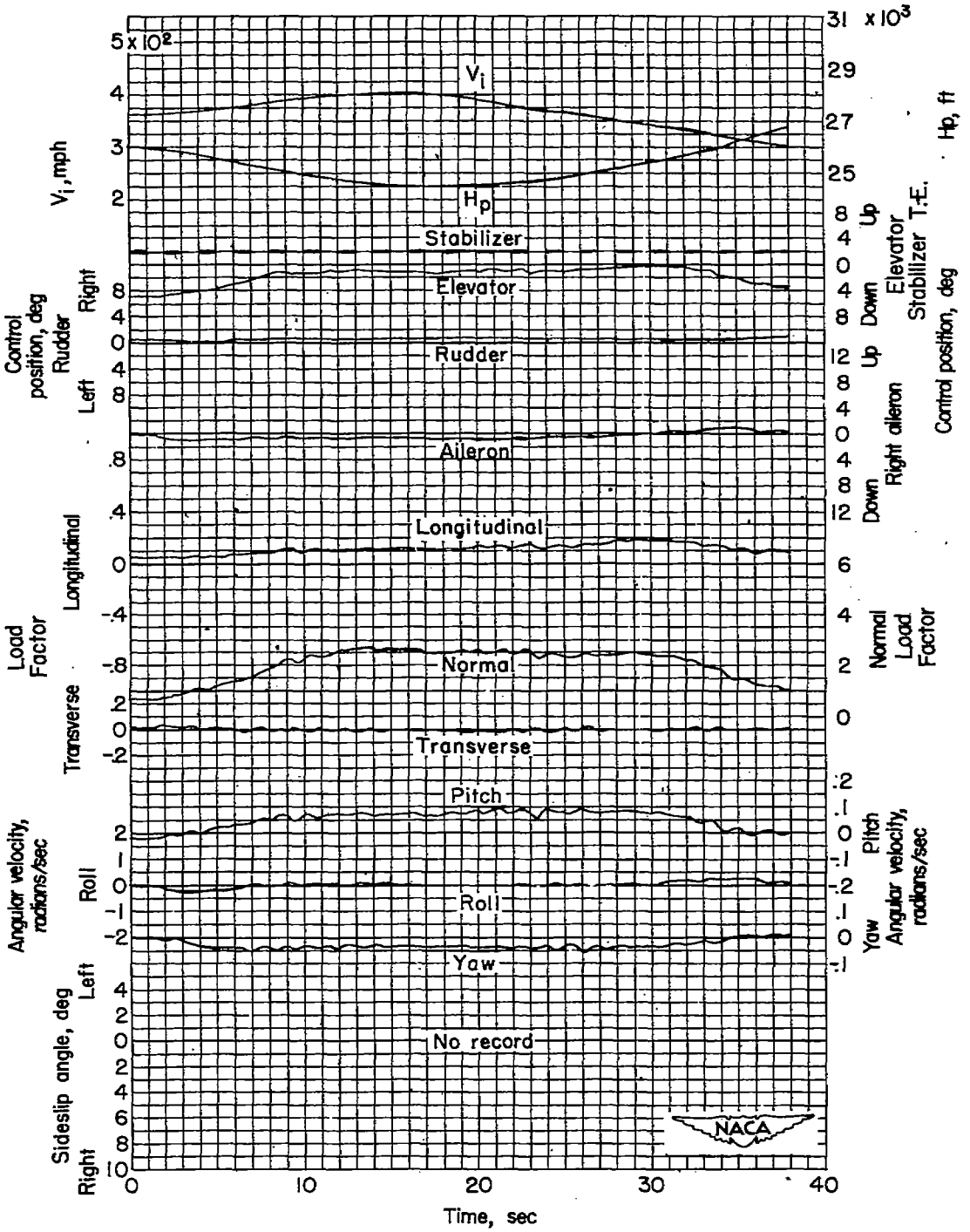


Figure 166.- Sharp left diving and climbing turn. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

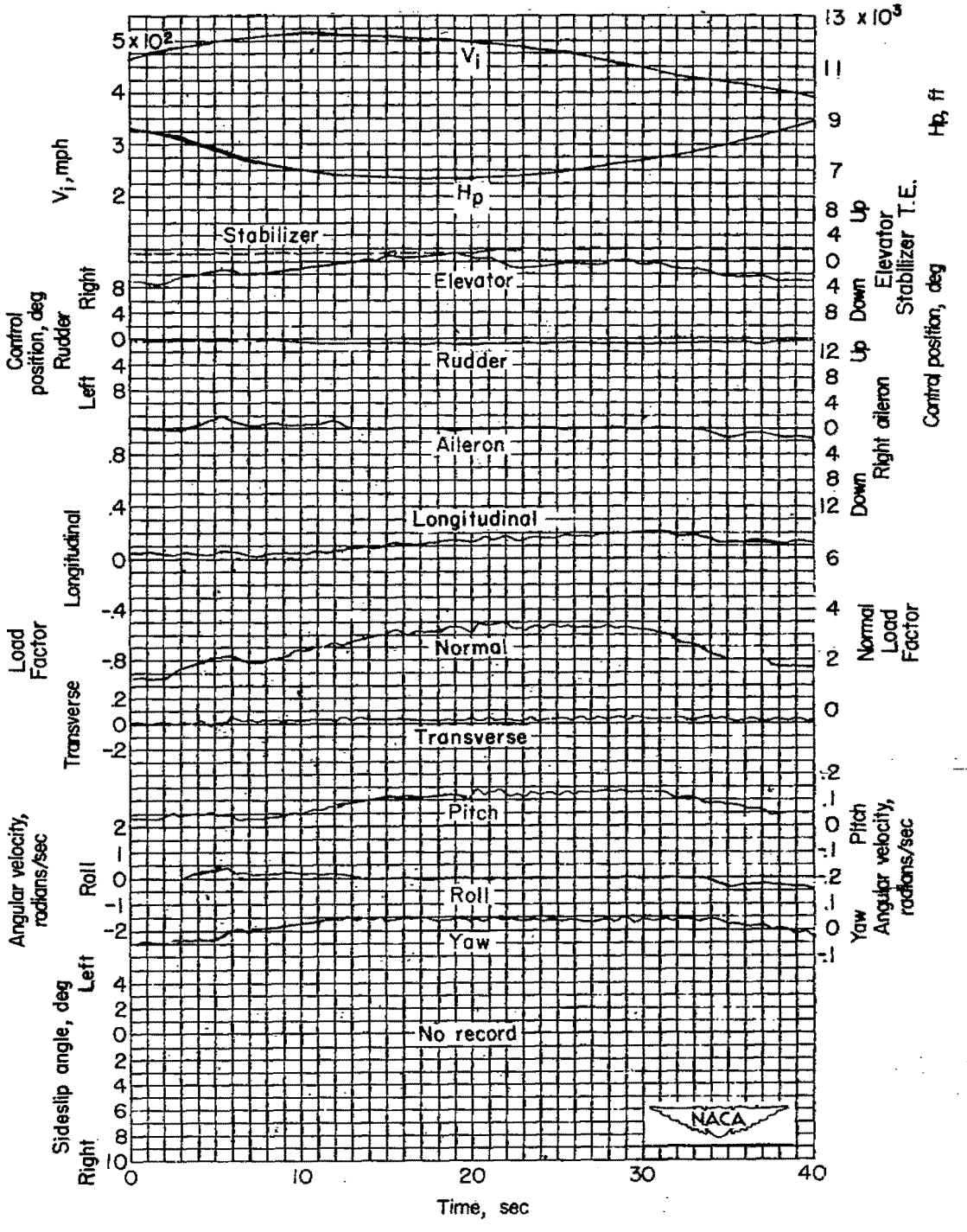


Figure 167.- Sharp right diving and climbing turn followed by a left barrel roll. Airplane weight, 14,150 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

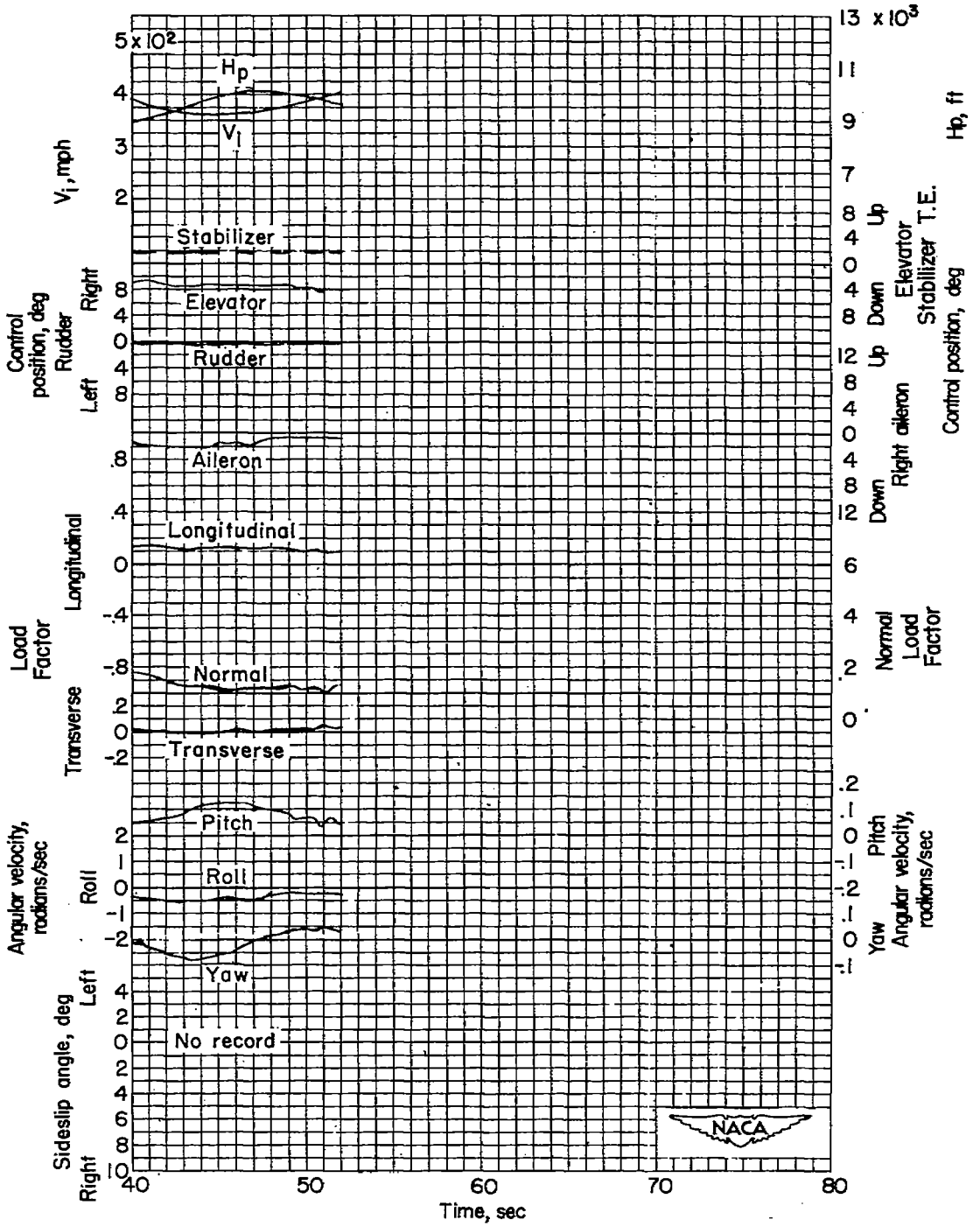


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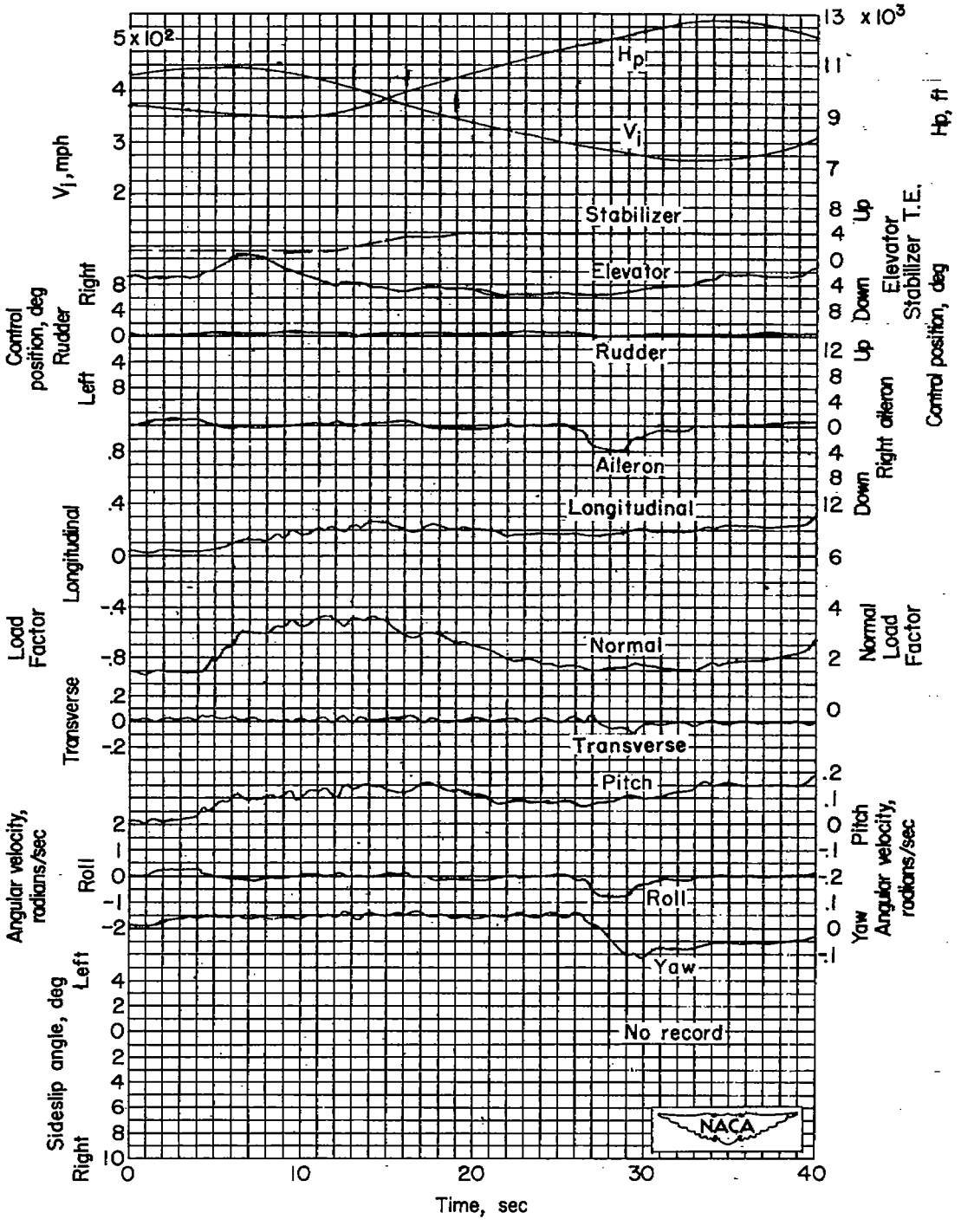


Figure 168.- Sharp right and left climbing and diving turn. Airplane weight, 12,500 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

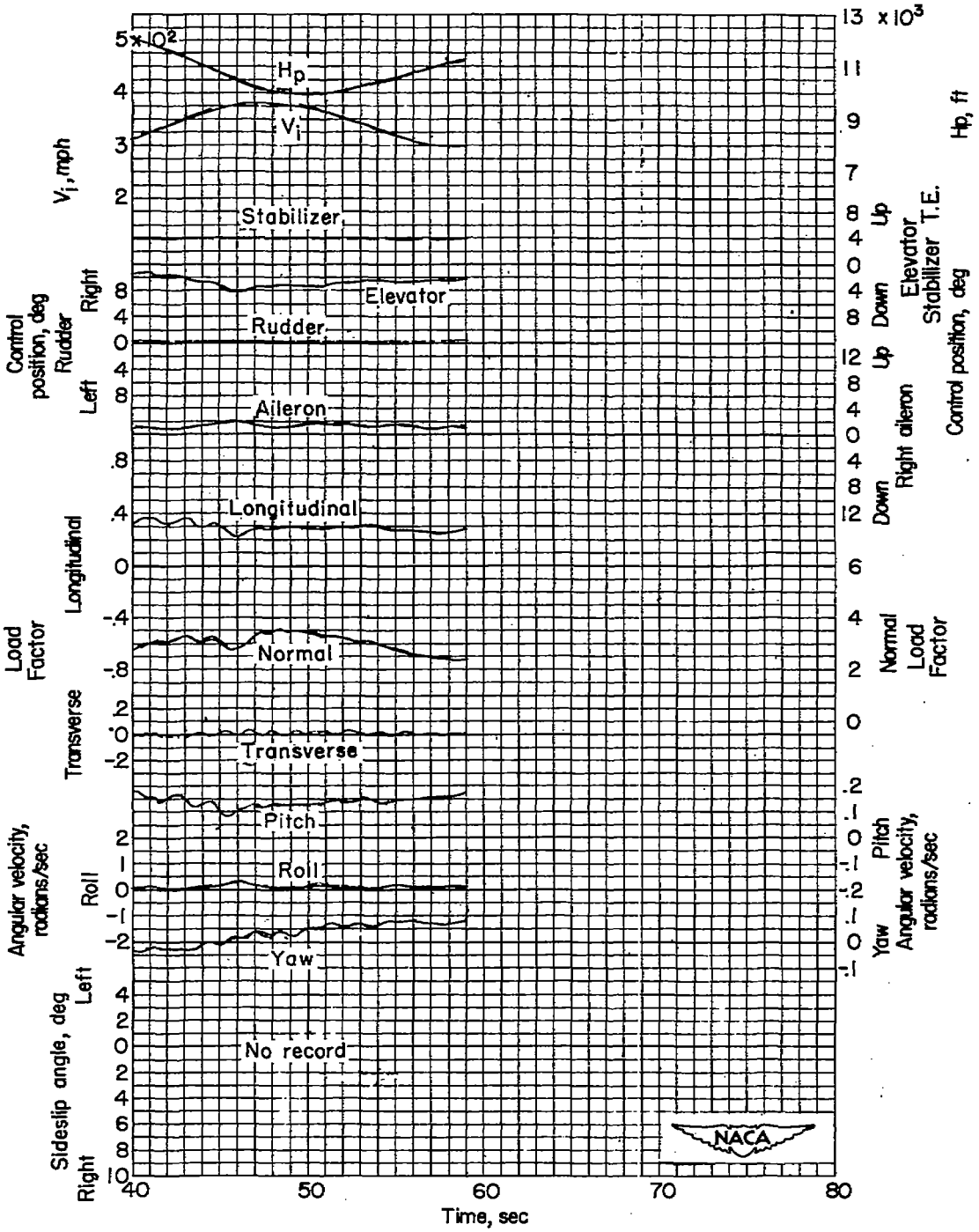


Figure 168.- Concluded.

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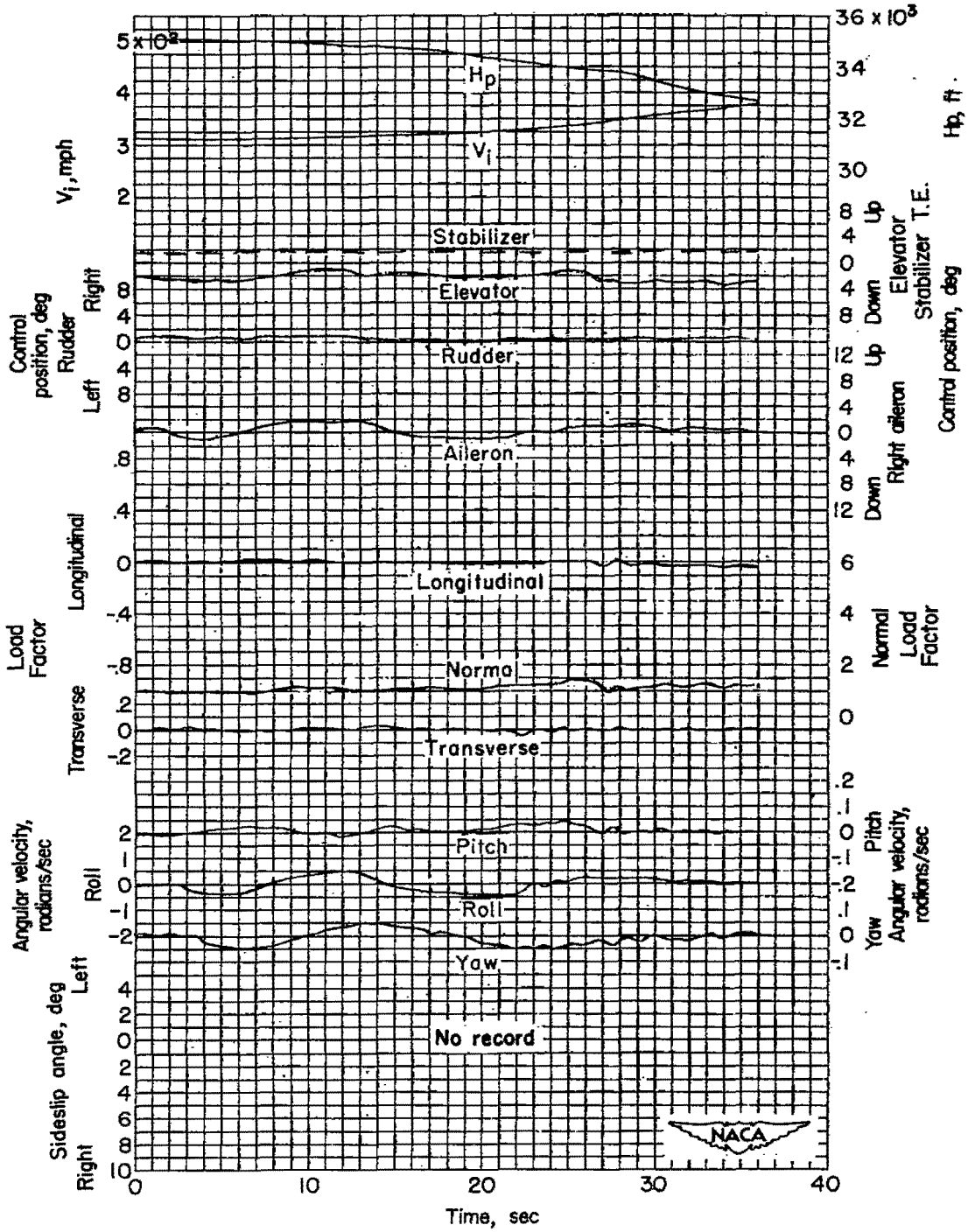


Figure 169.- Gentle left and right diving turns. Airplane weight, 13,500 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

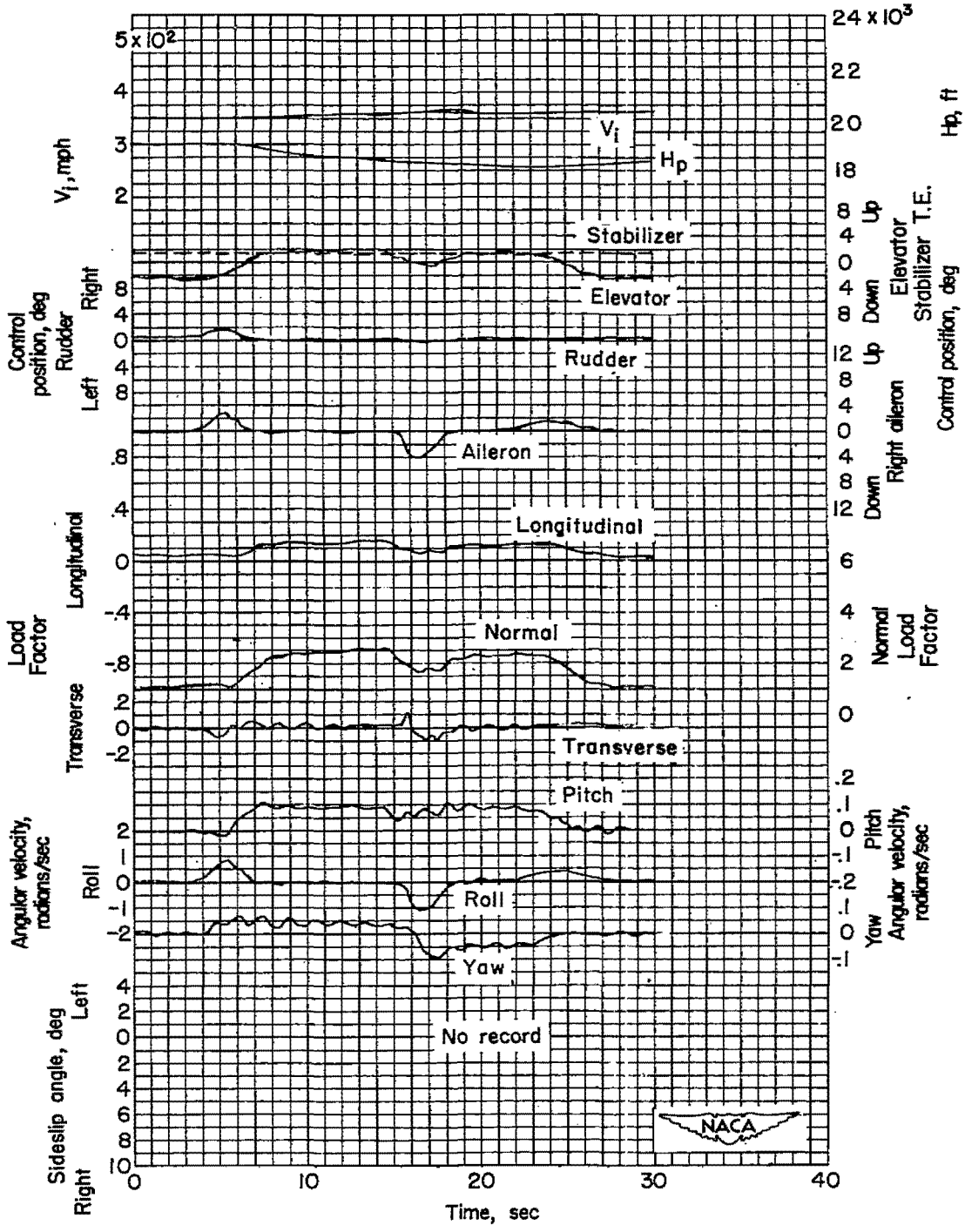


Figure 170.- Gentle right and left diving turns. Airplane weight, 13,900 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

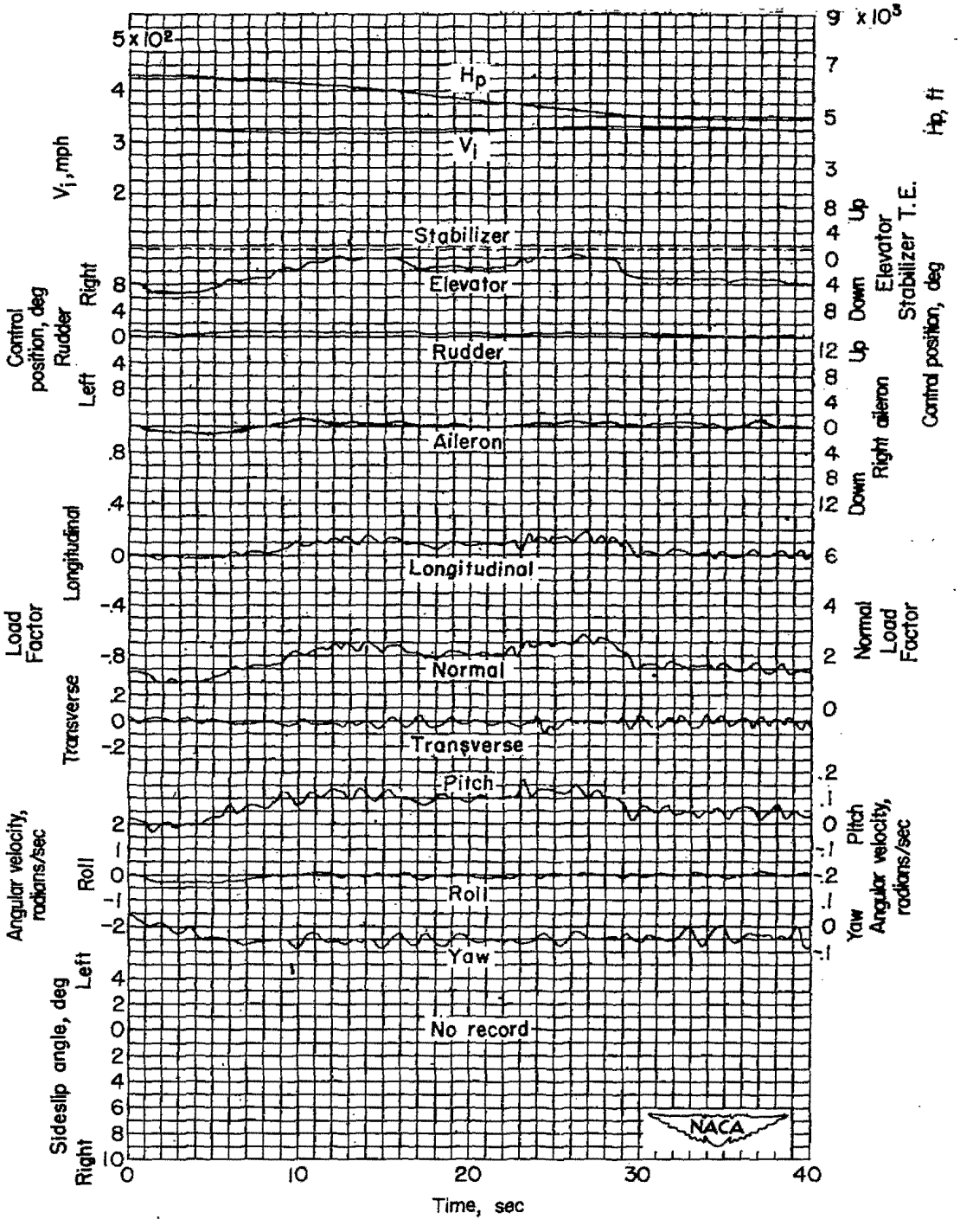


Figure 171.- Left diving turn. Airplane weight, 12,700 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

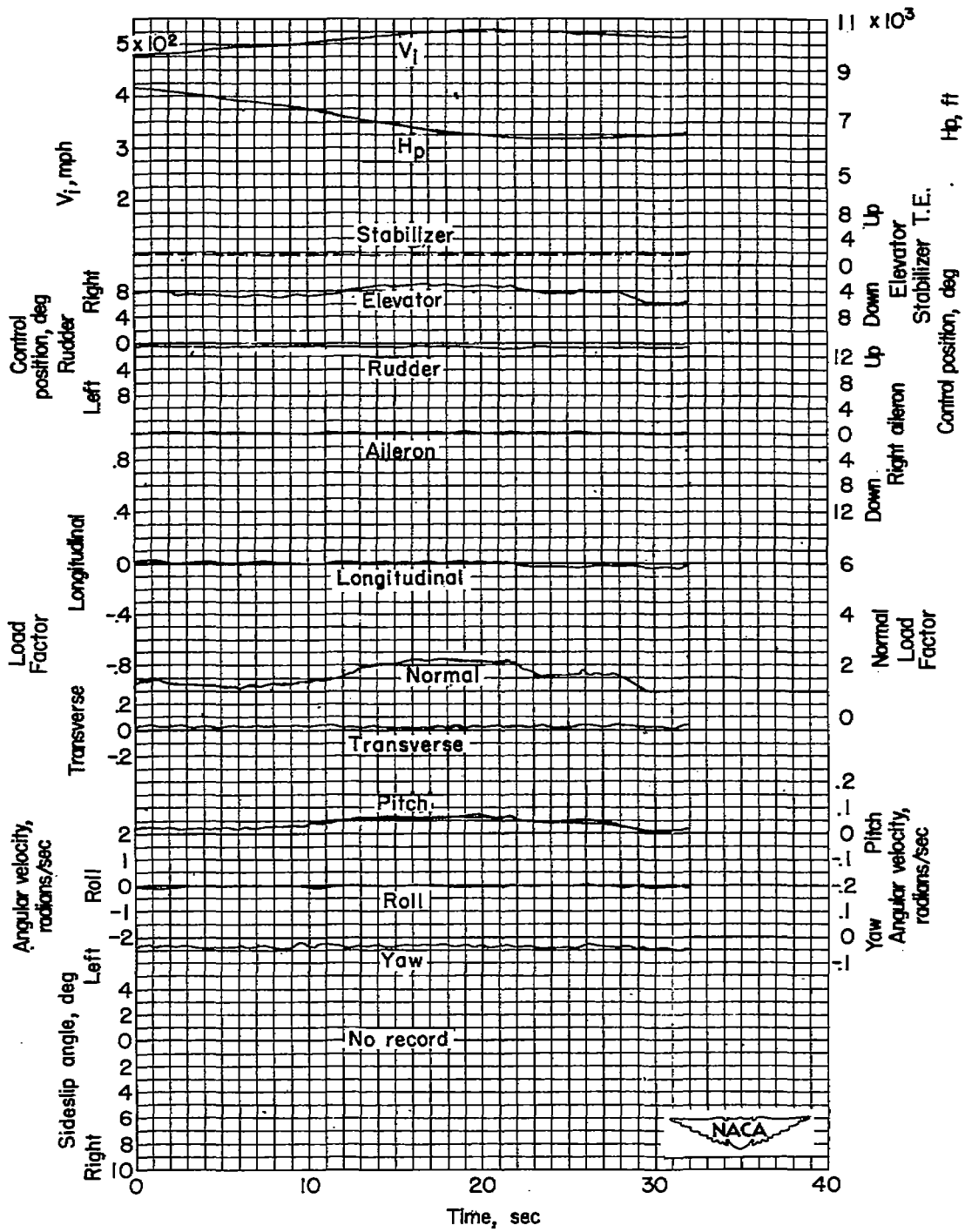


Figure 172.- Left diving turn. Airplane weight, 13,700 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

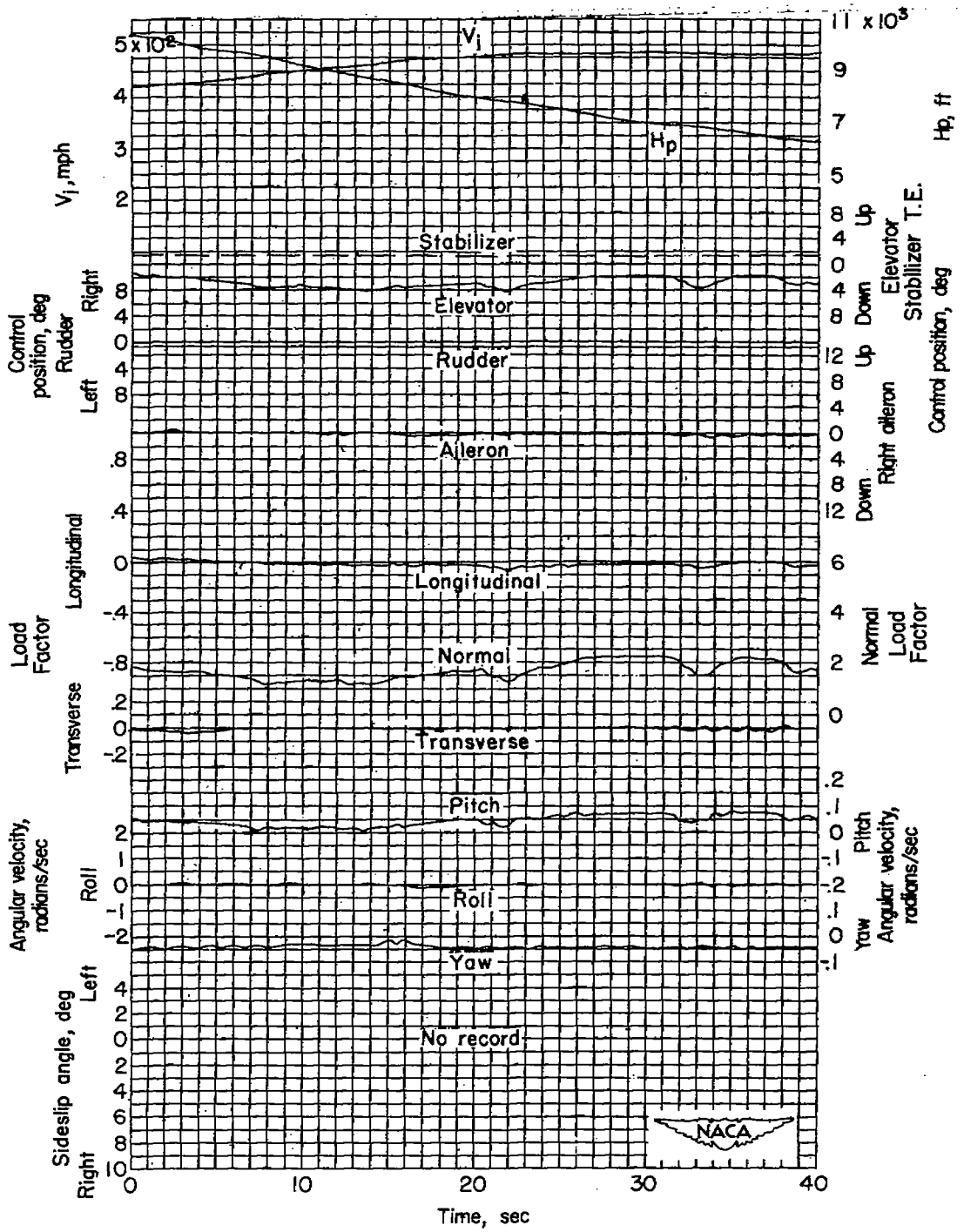


Figure 173.- Left diving turn. Airplane weight, 13,100 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

[redacted]

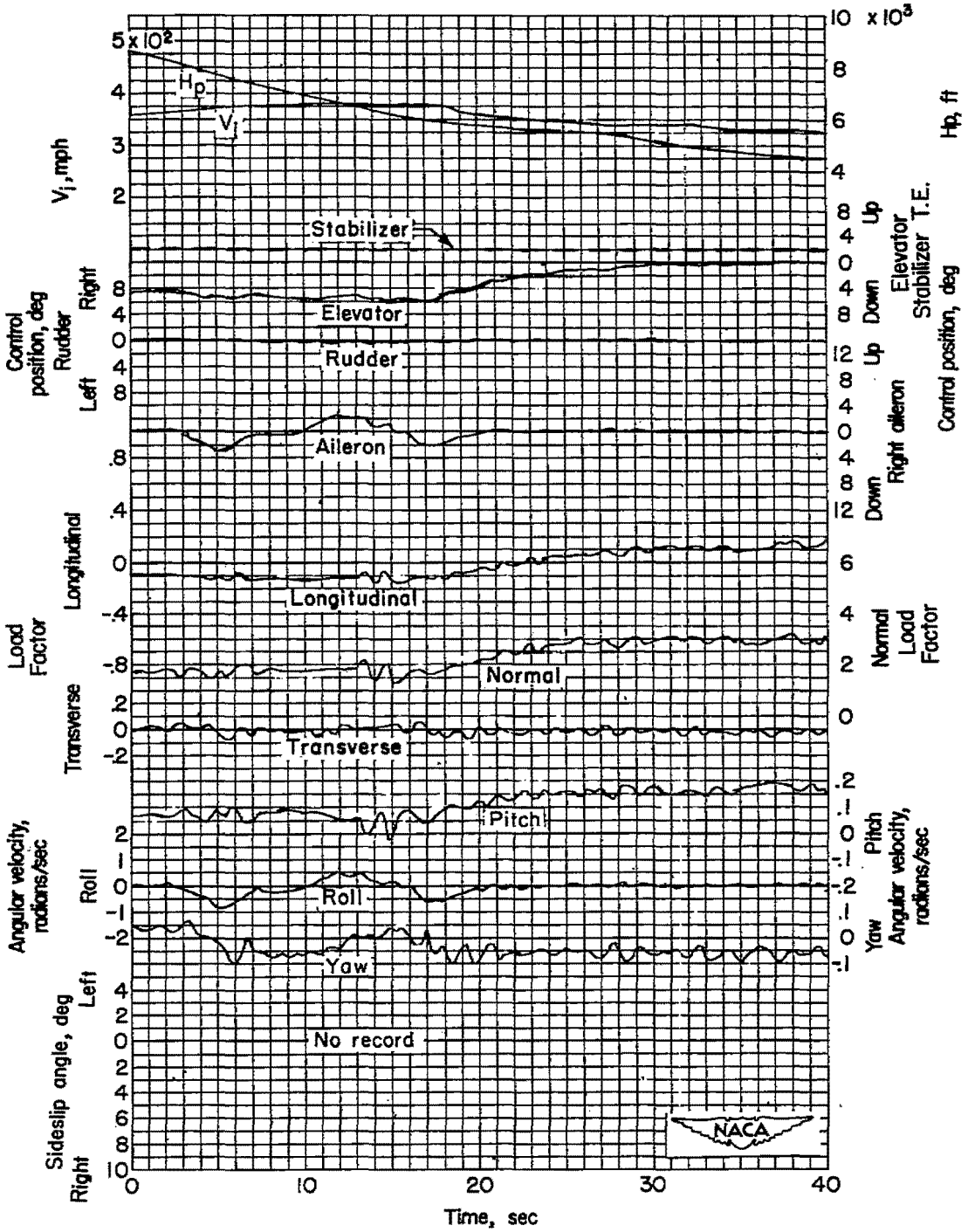


Figure 174.- Left diving turns. Airplane weight, 11,950 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

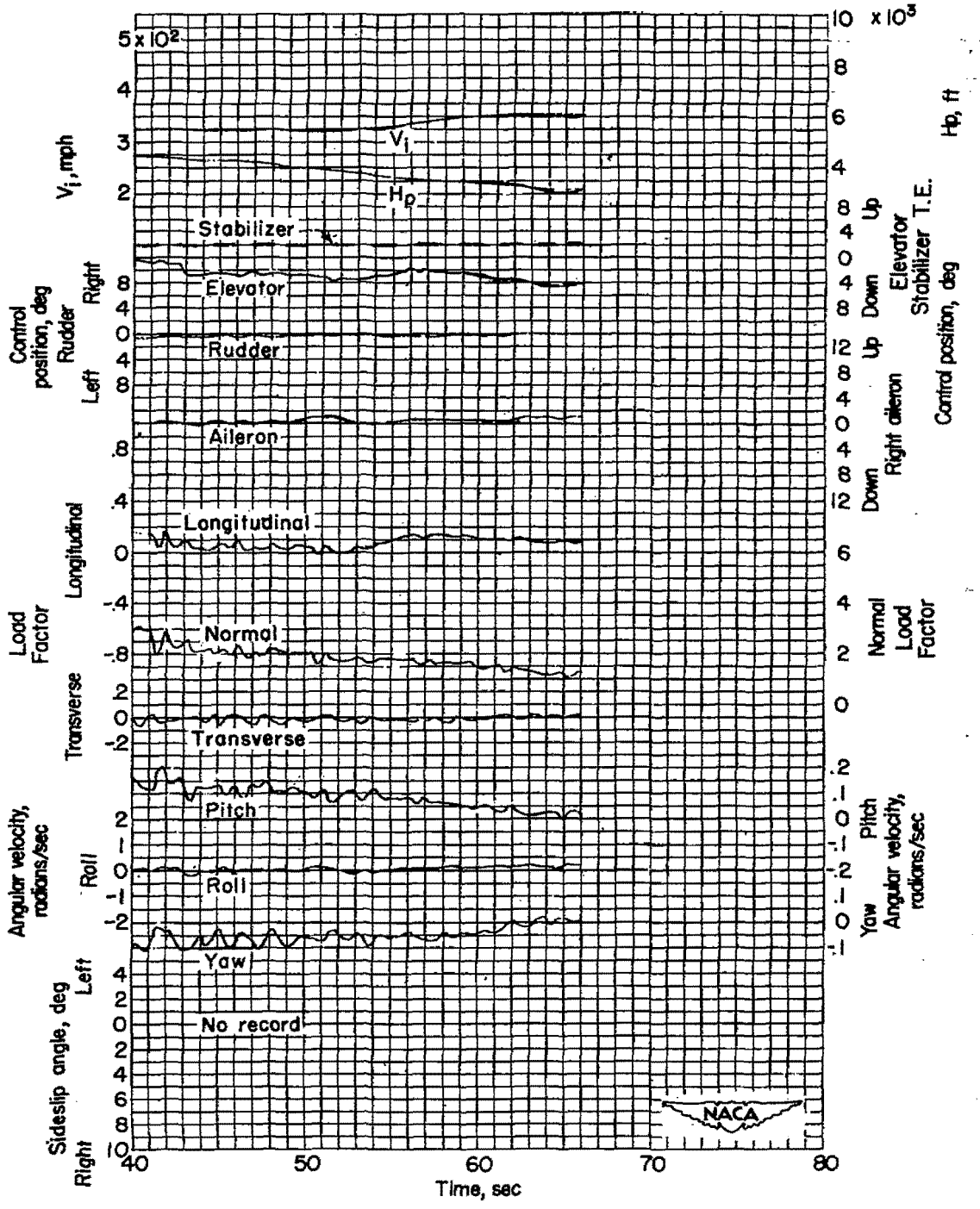


Figure 174.- Concluded.

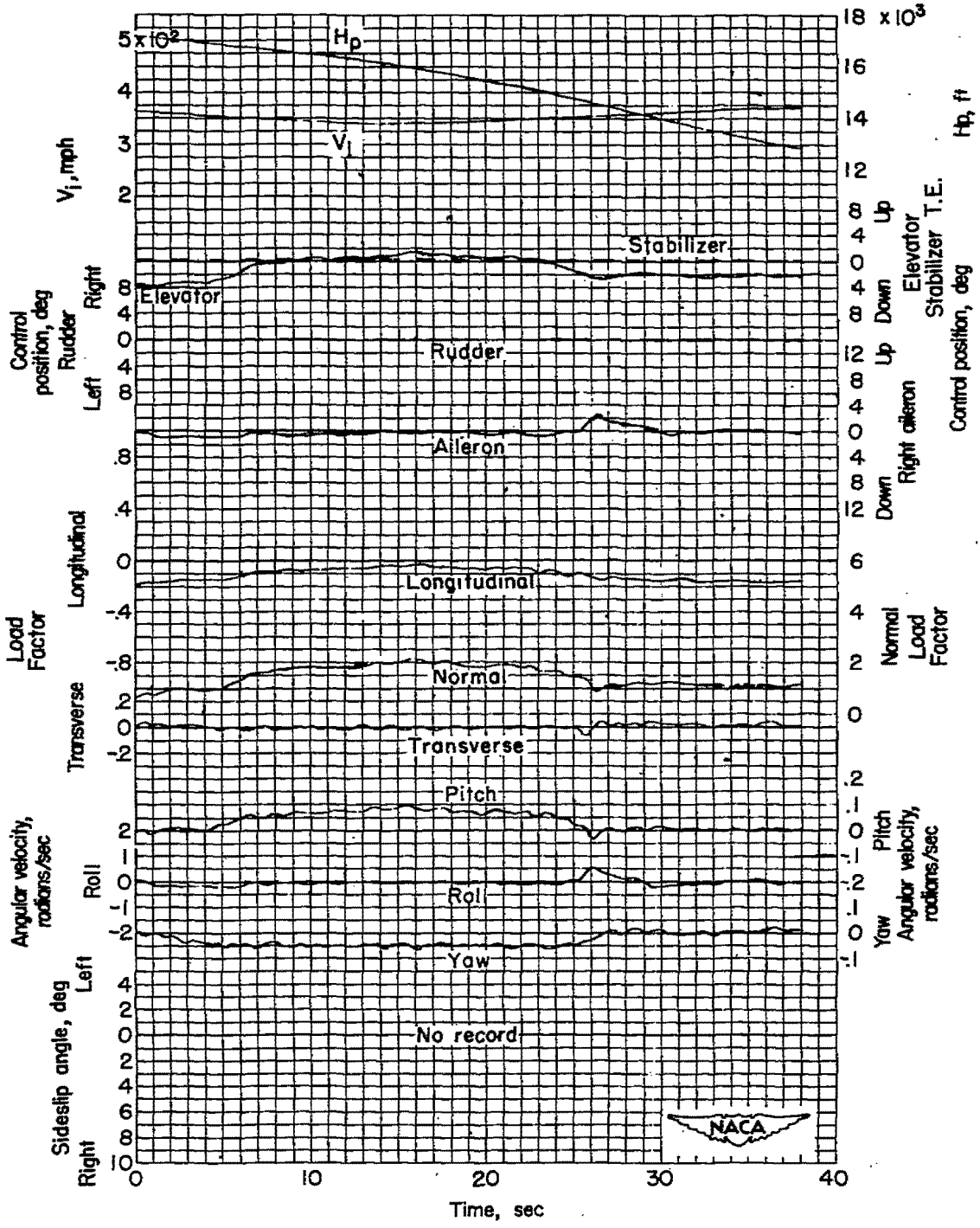


Figure 175.- Left diving turn. Airplane weight, 12,700 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

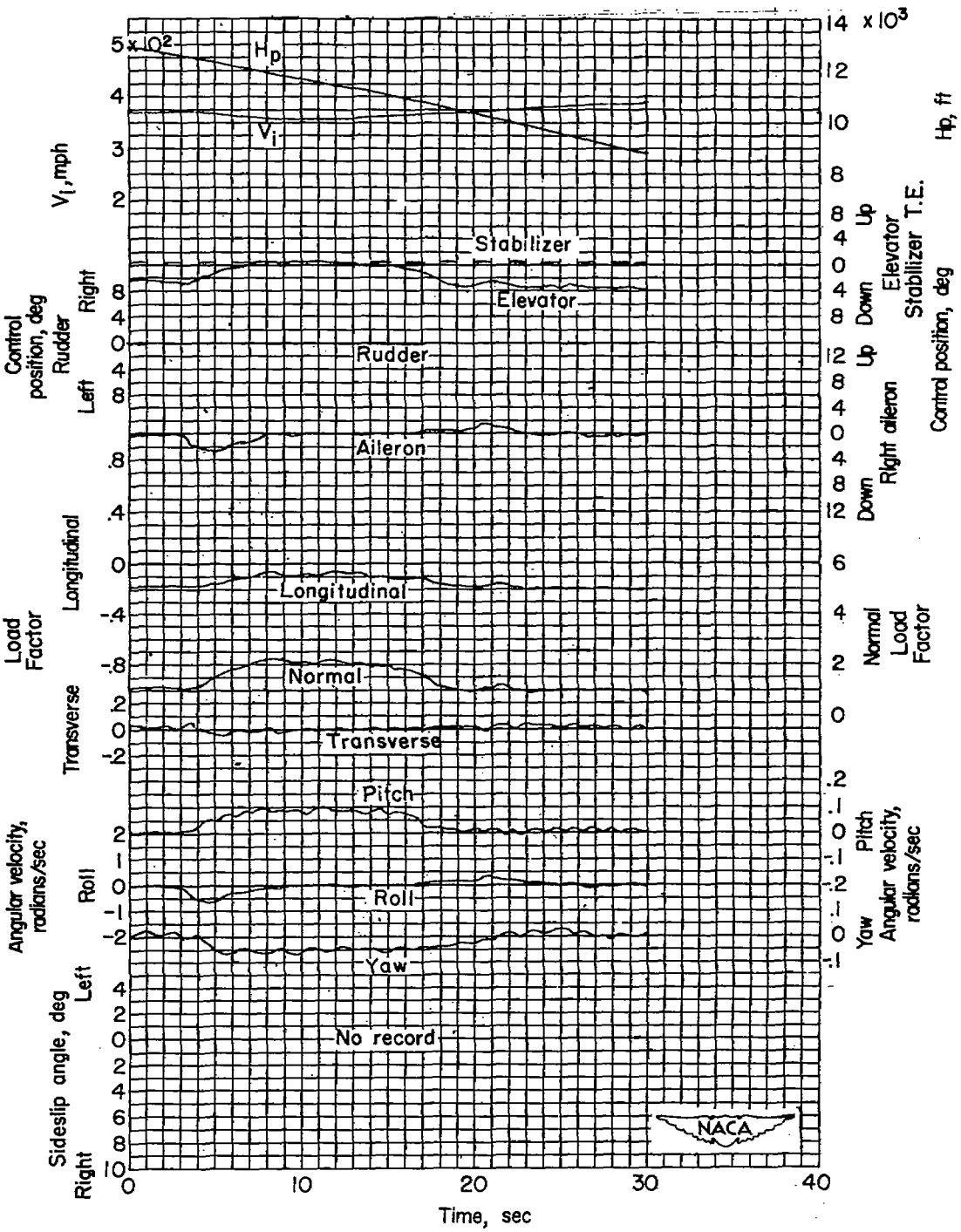


Figure 176.- Left diving turn. Airplane weight, 12,650 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

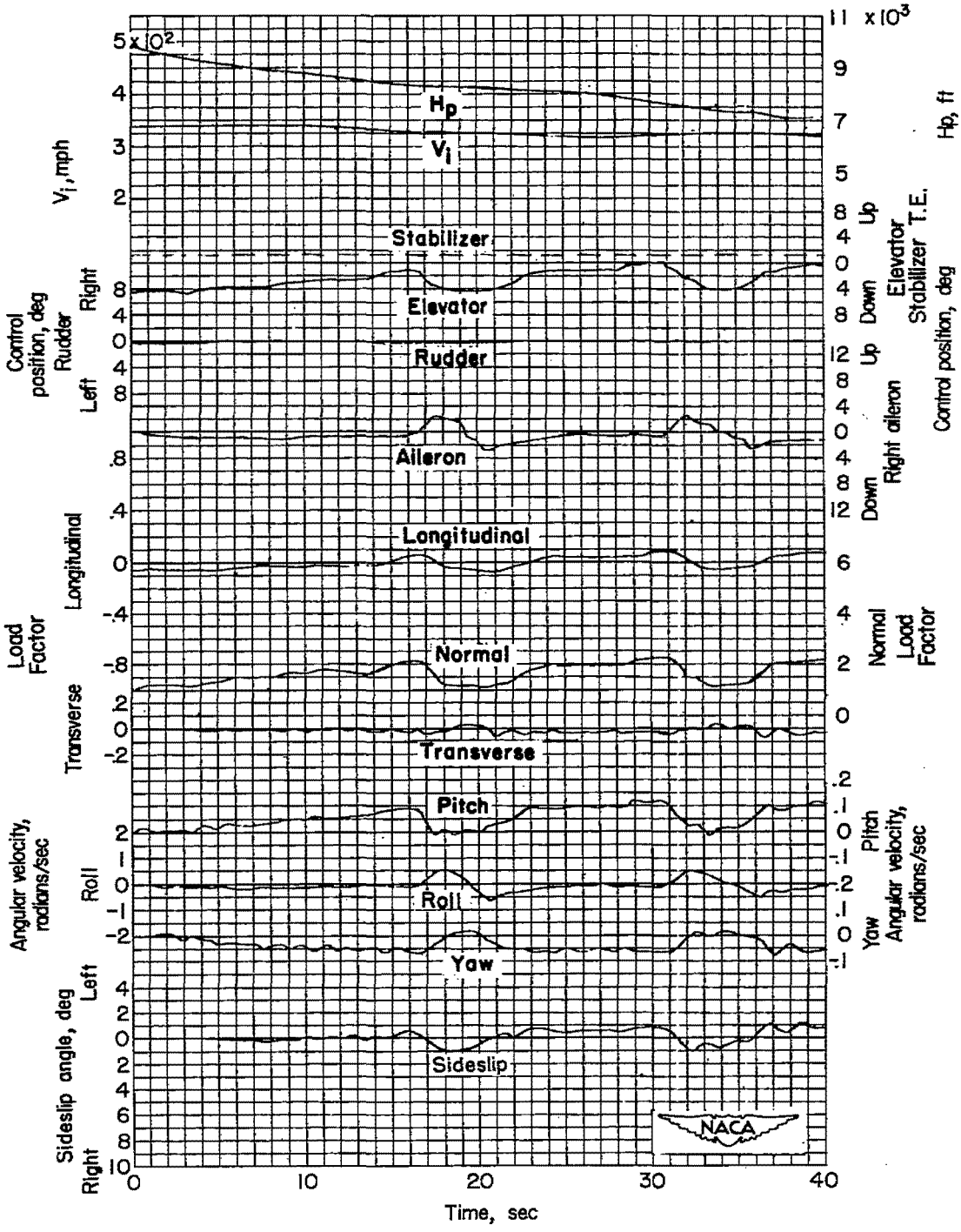


Figure 177.- Left diving turns. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

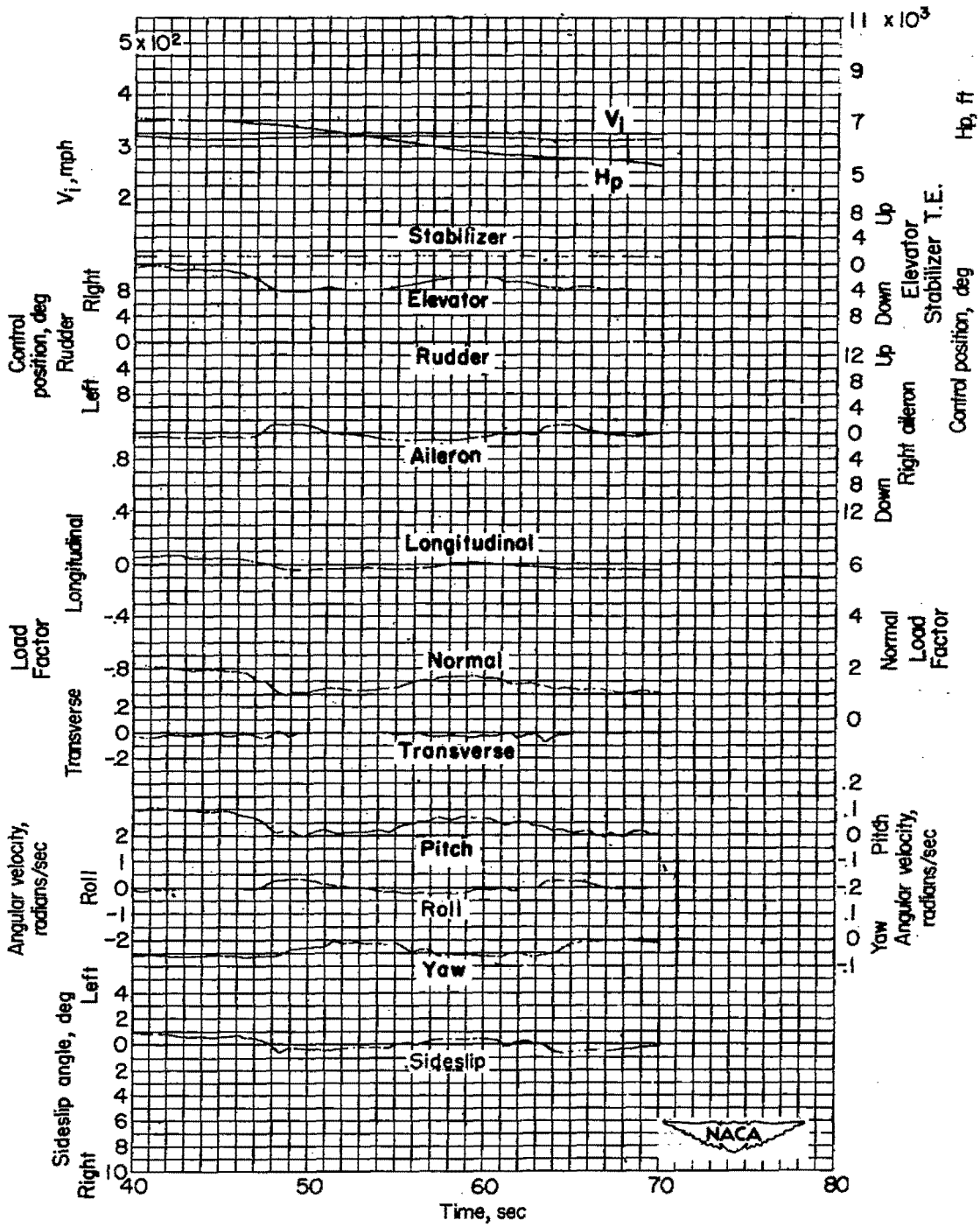


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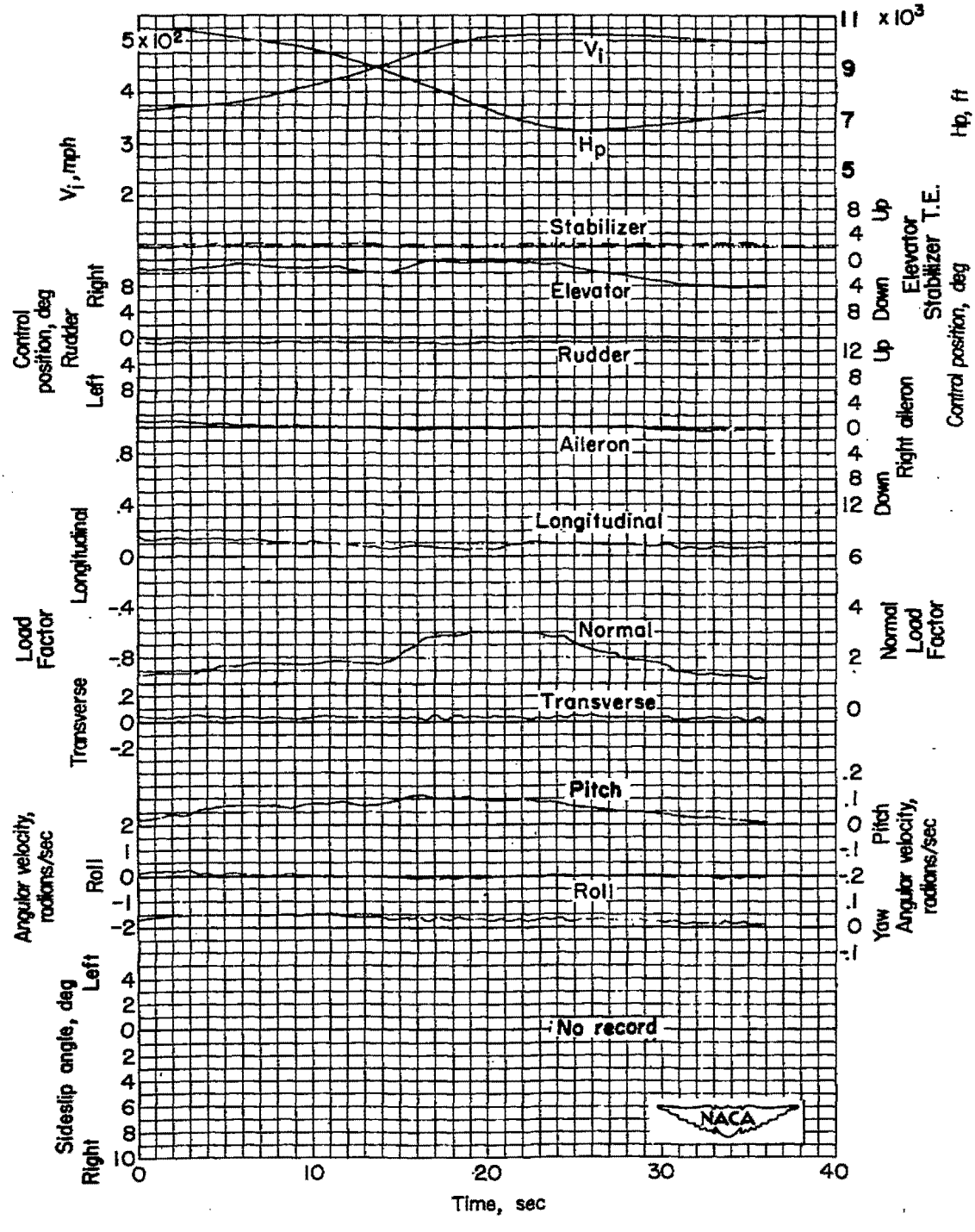


Figure 178.- Right diving turn and pull-out. Airplane weight, 12,950 pounds; center-of-gravity location, 21.3 percent of the mean aerodynamic chord.

[redacted]

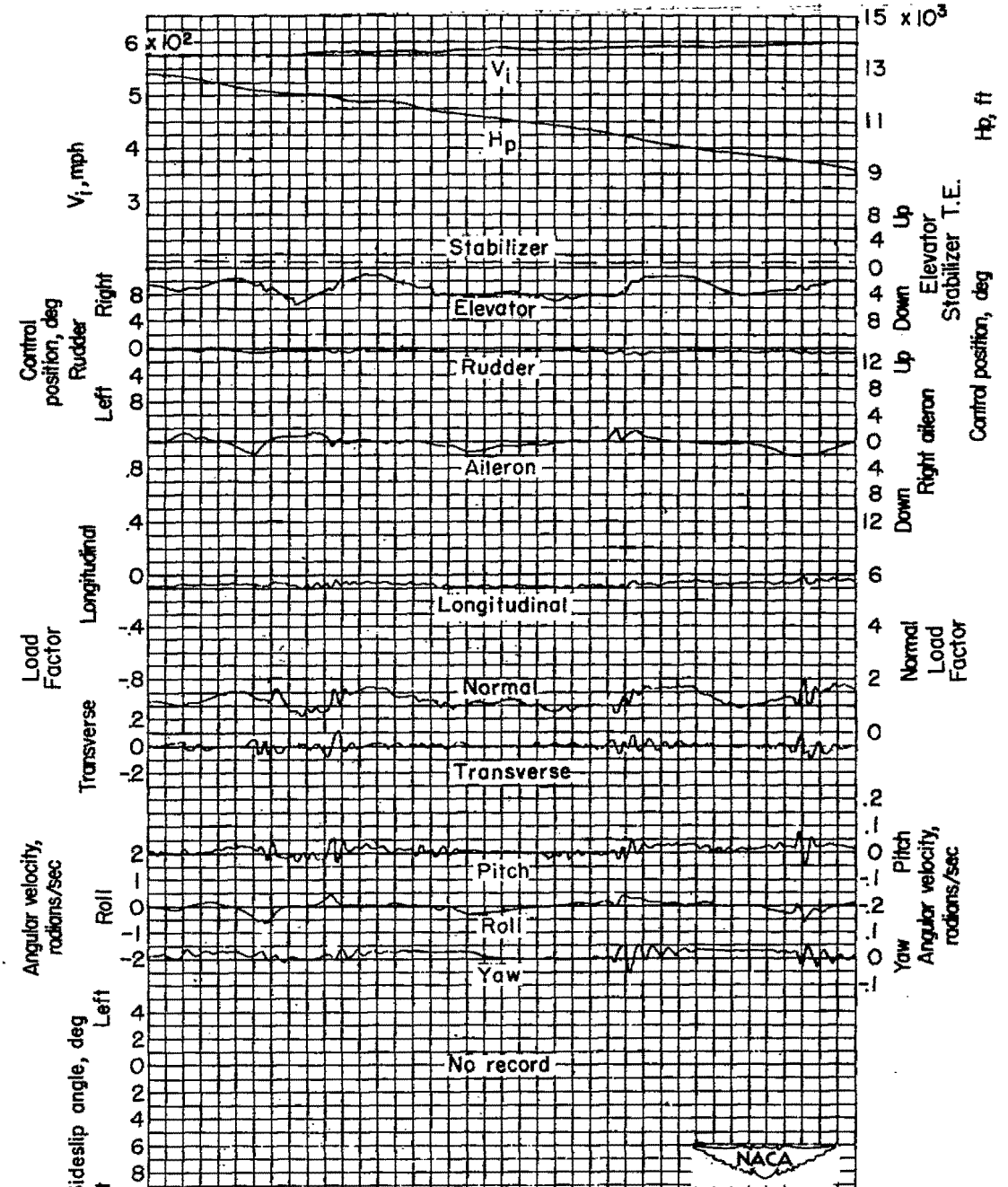


Figure 179.- Right diving turns. Airplane weight, 13,800 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

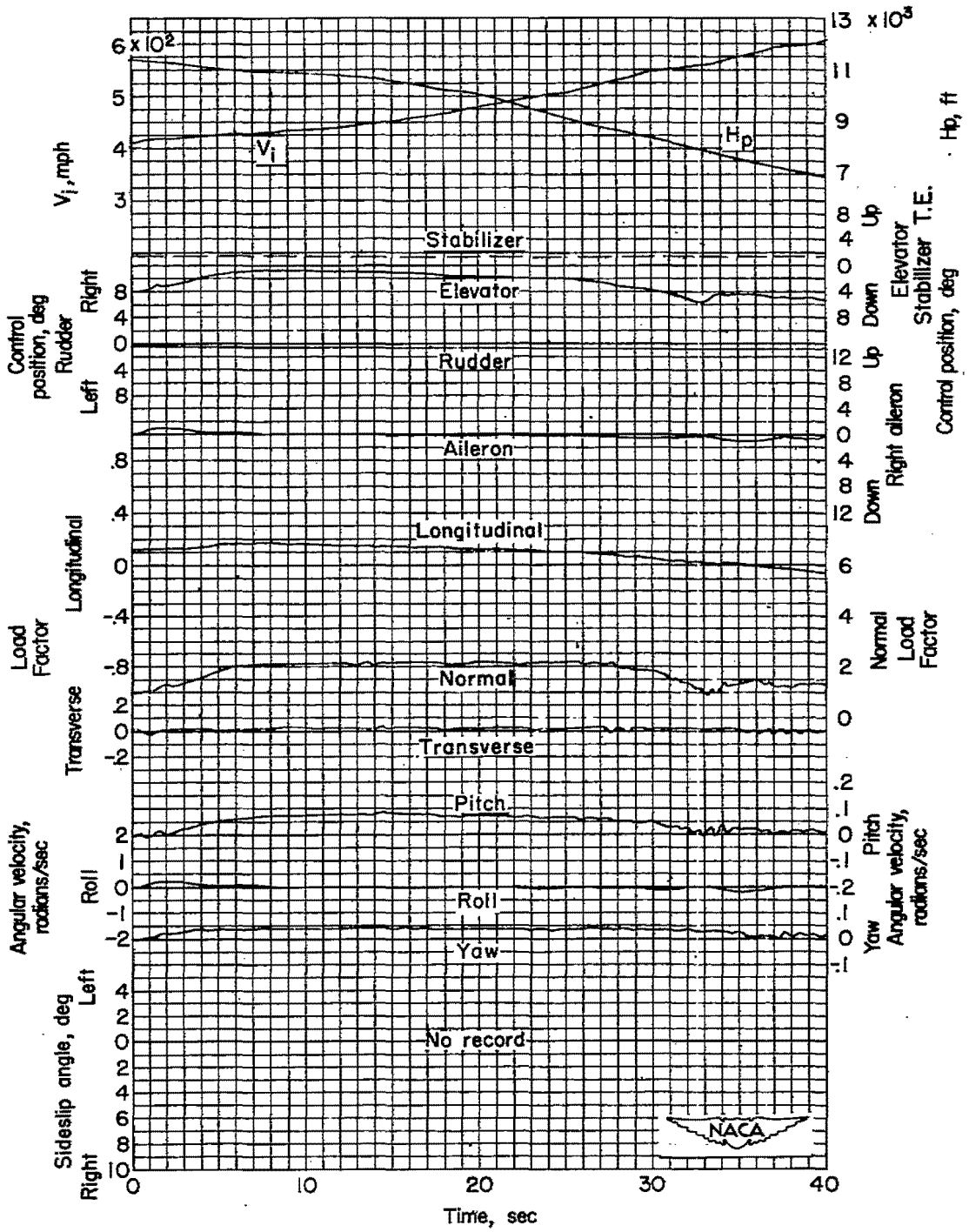


Figure 180.- Right diving turn. Airplane weight, 13,400 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

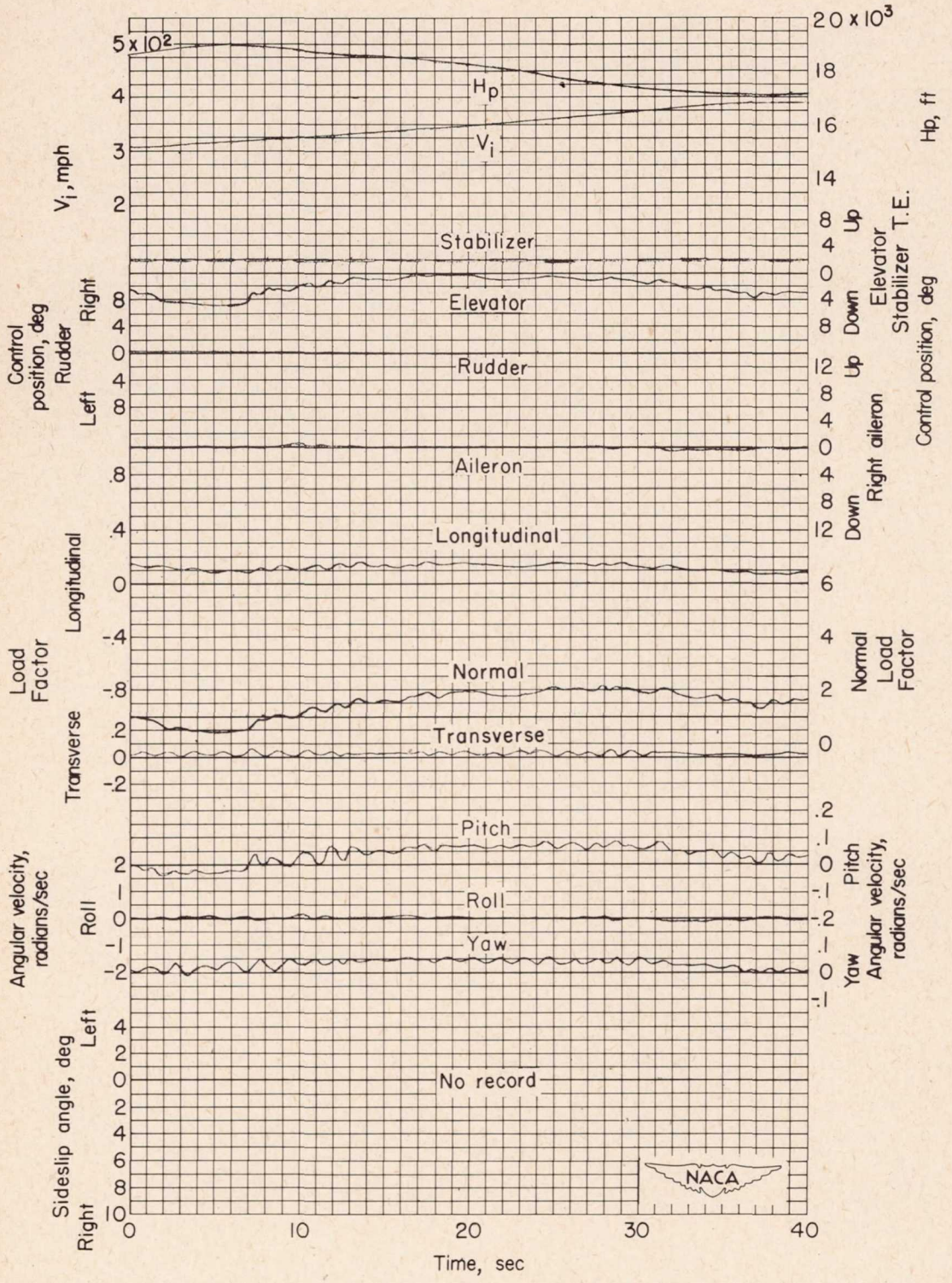


Figure 181.- Right diving turn. Airplane weight, 13,800 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

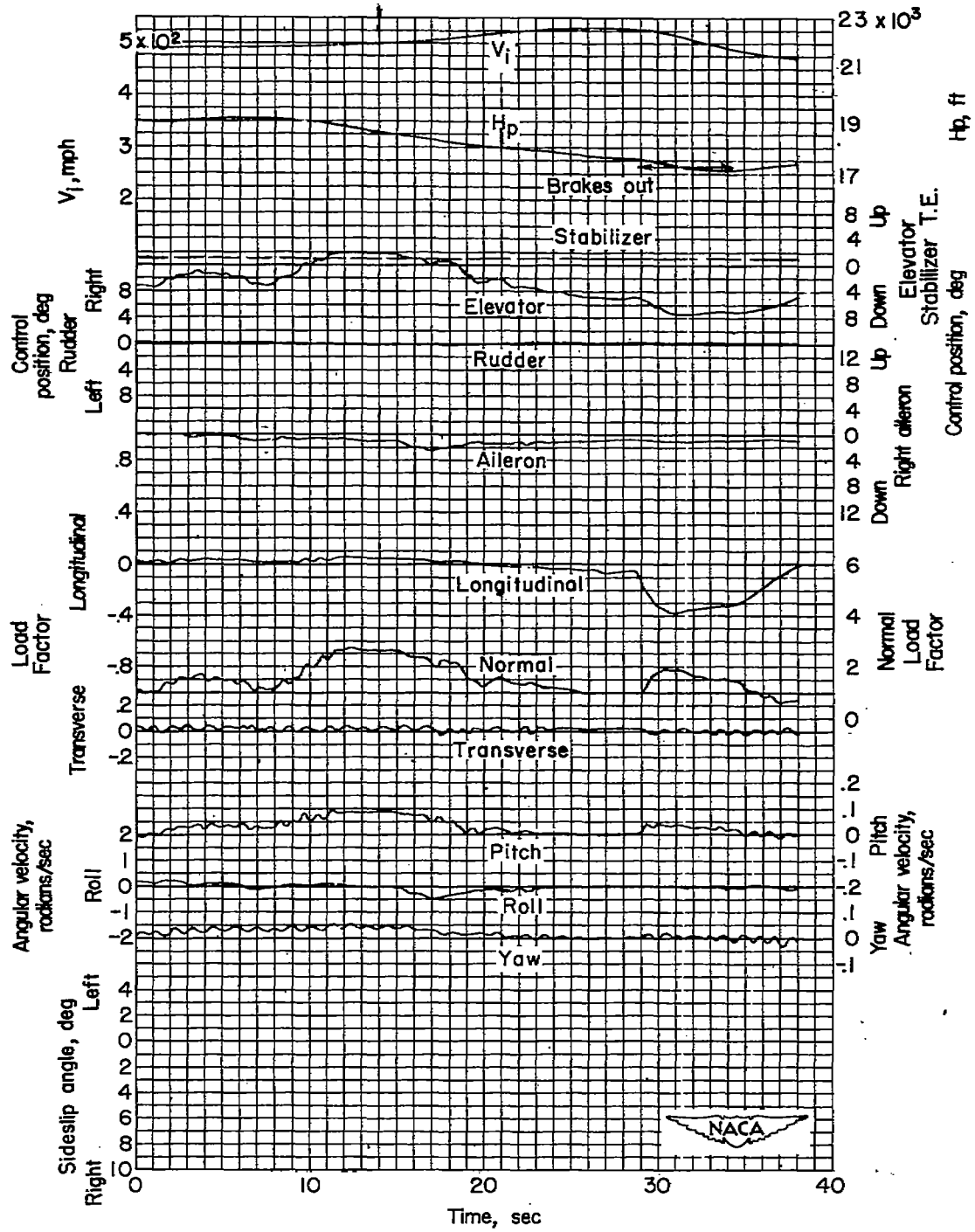


Figure 182.- Right diving turn and pull-up. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

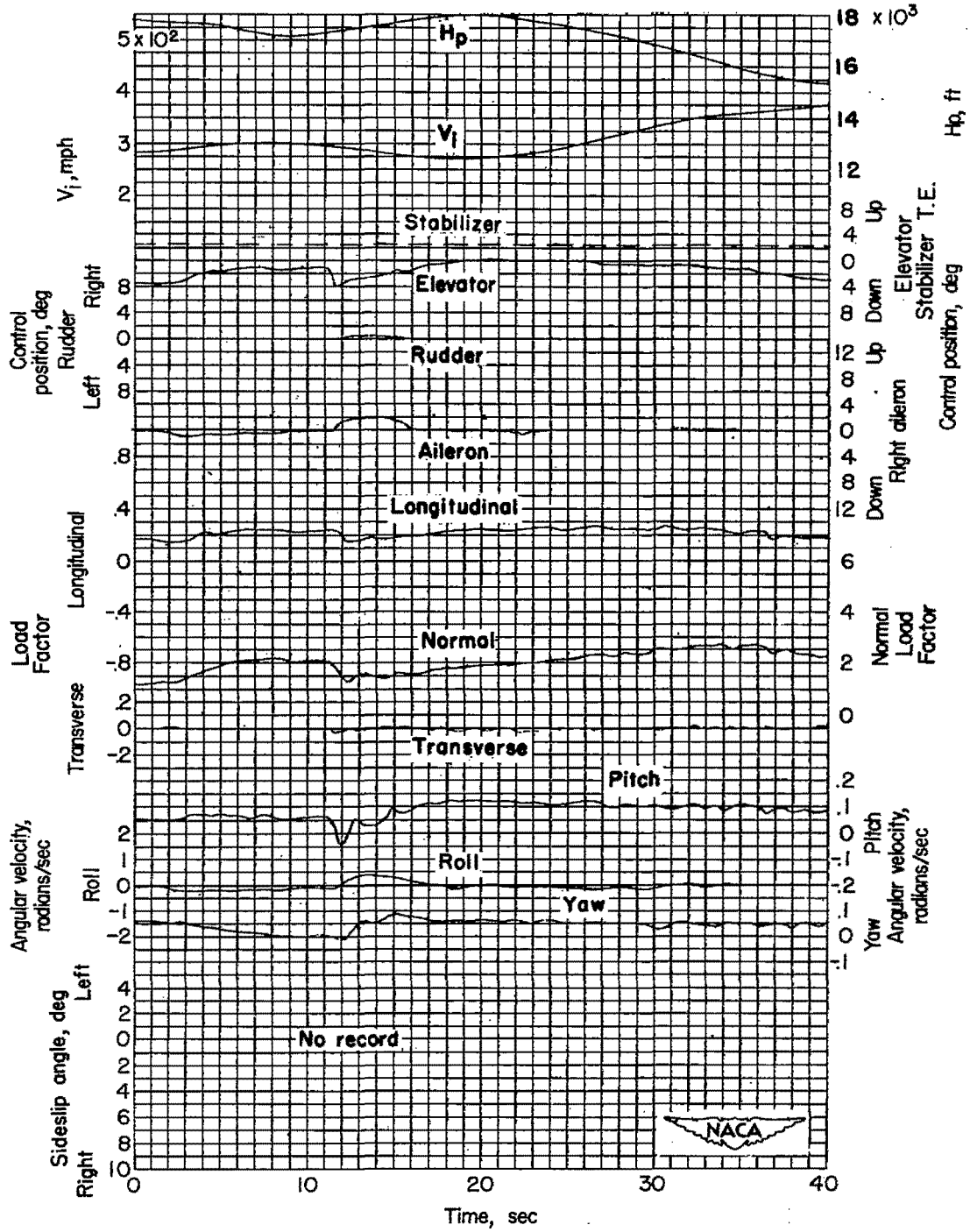


Figure 183.- Right diving turns. Airplane weight, 12,450 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

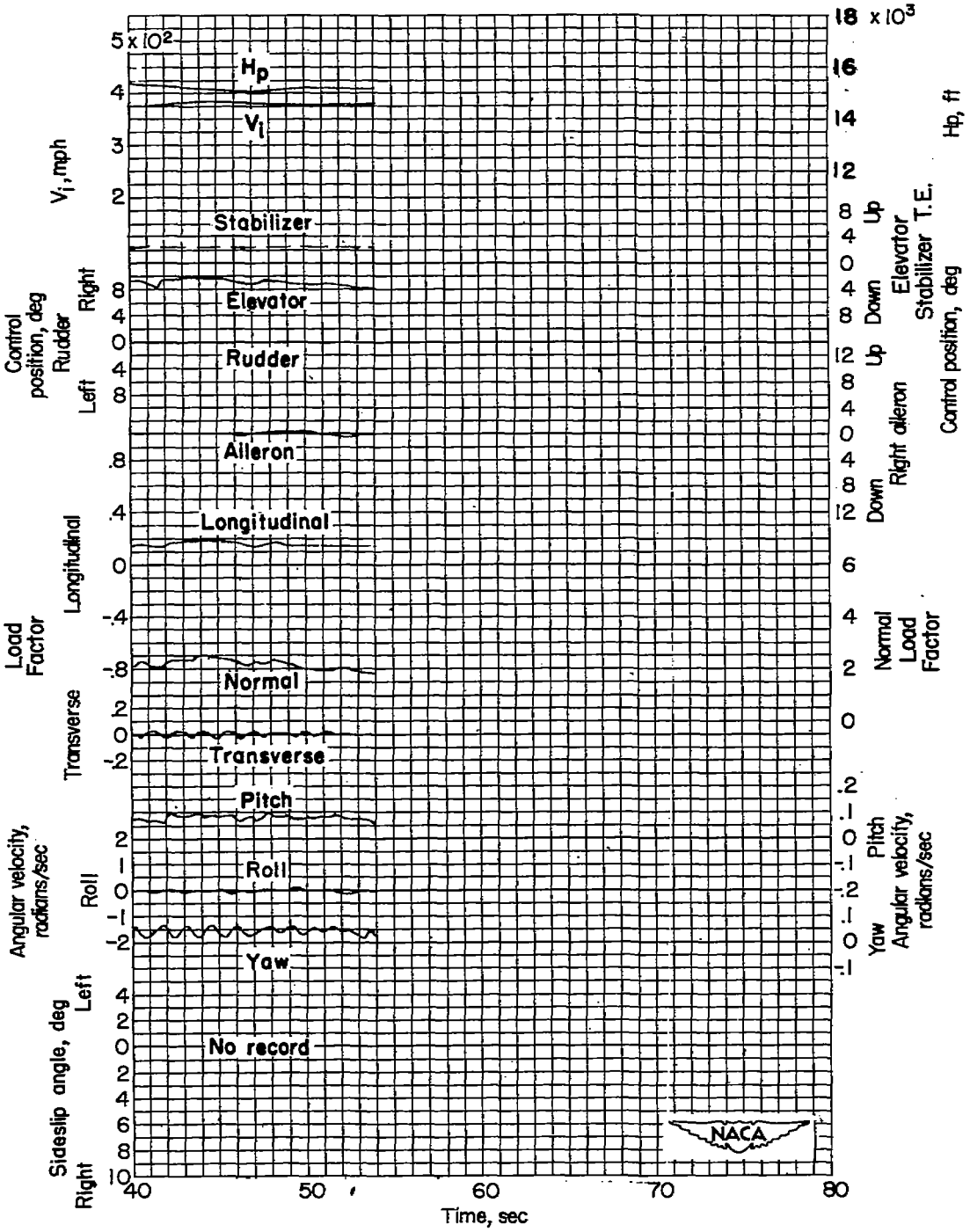


Figure 183.- Concluded.

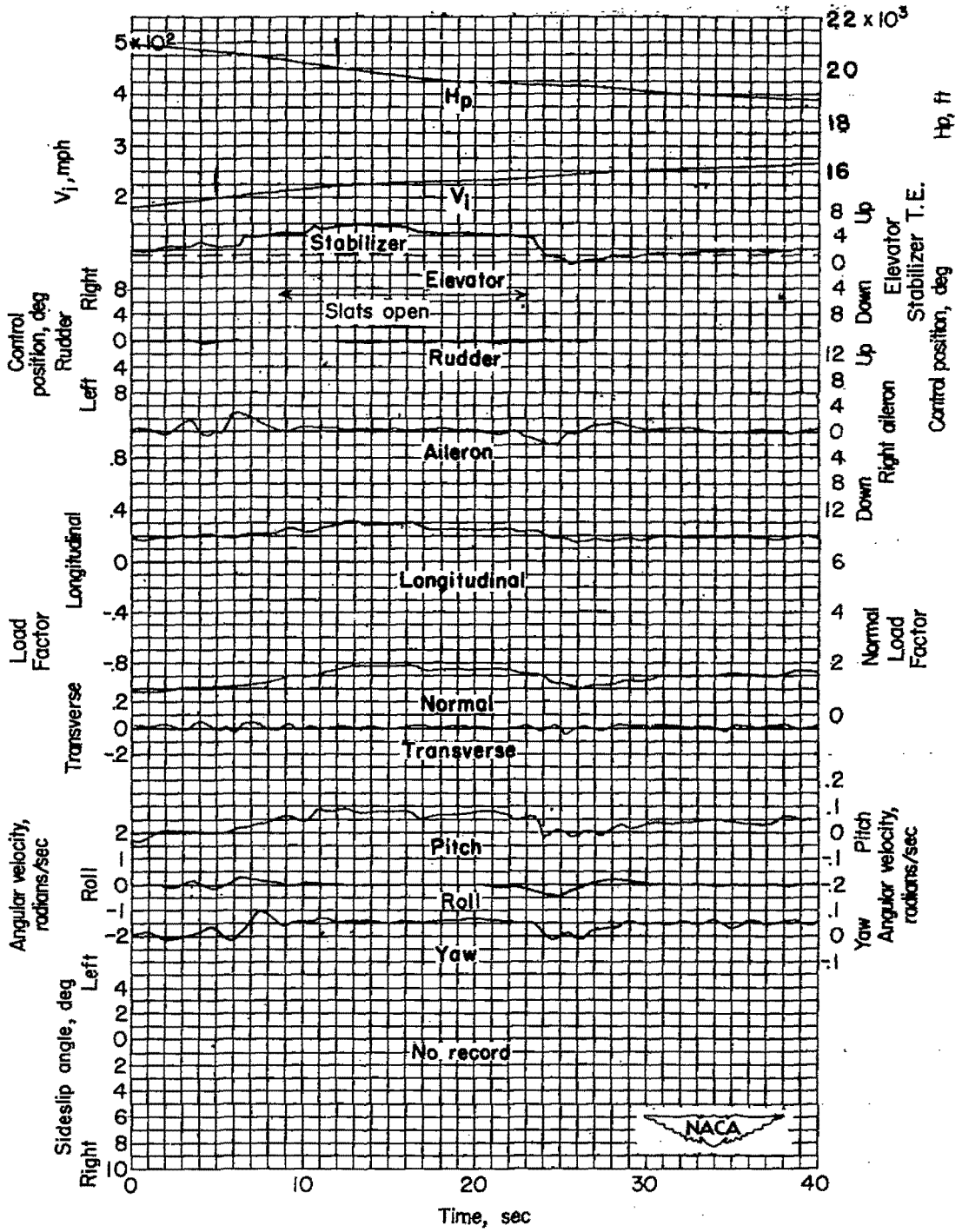


Figure 184.- Right diving turns. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

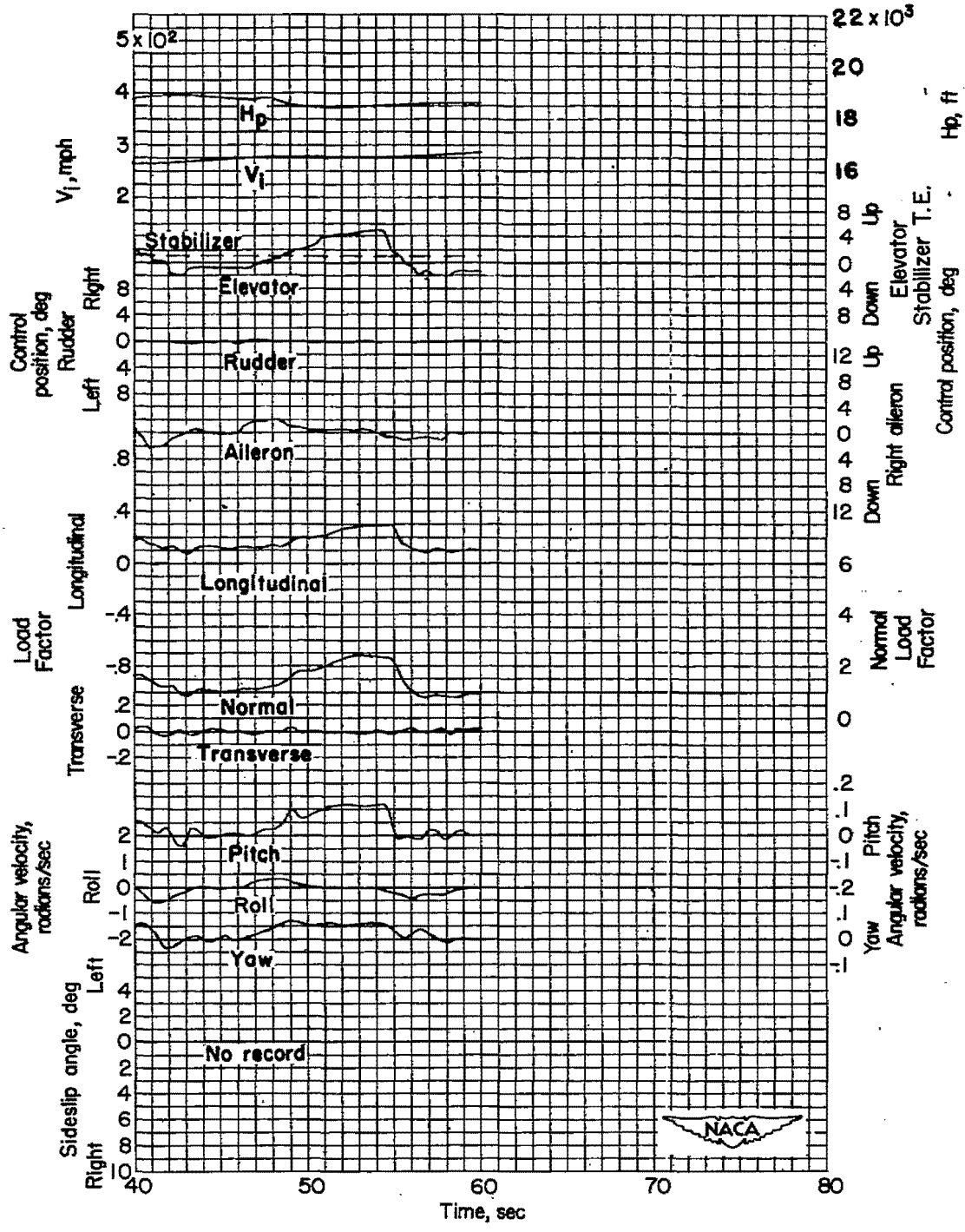


Figure 184.- Concluded.

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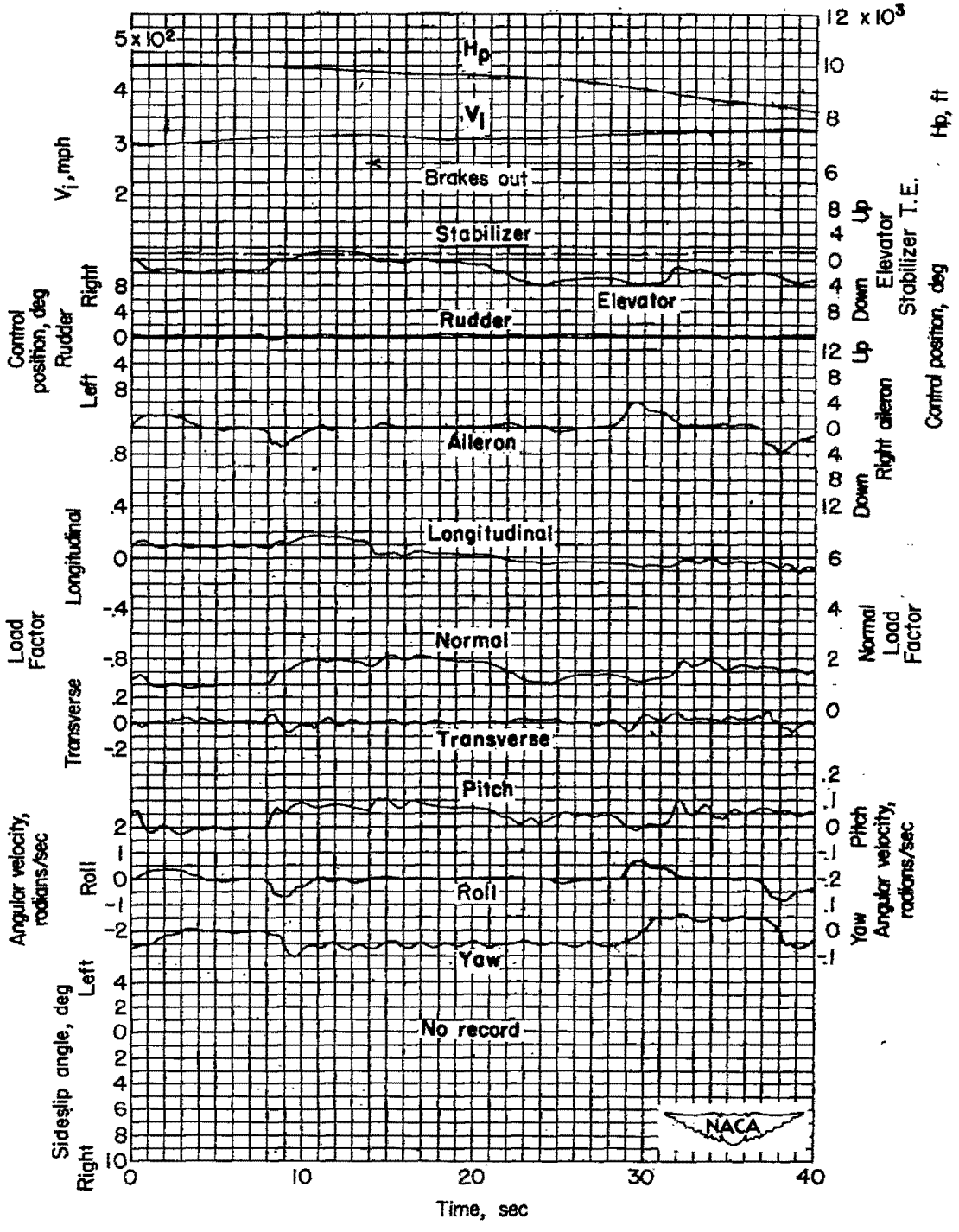


Figure 185.- Left and right diving turns. Airplane weight, 12,250 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

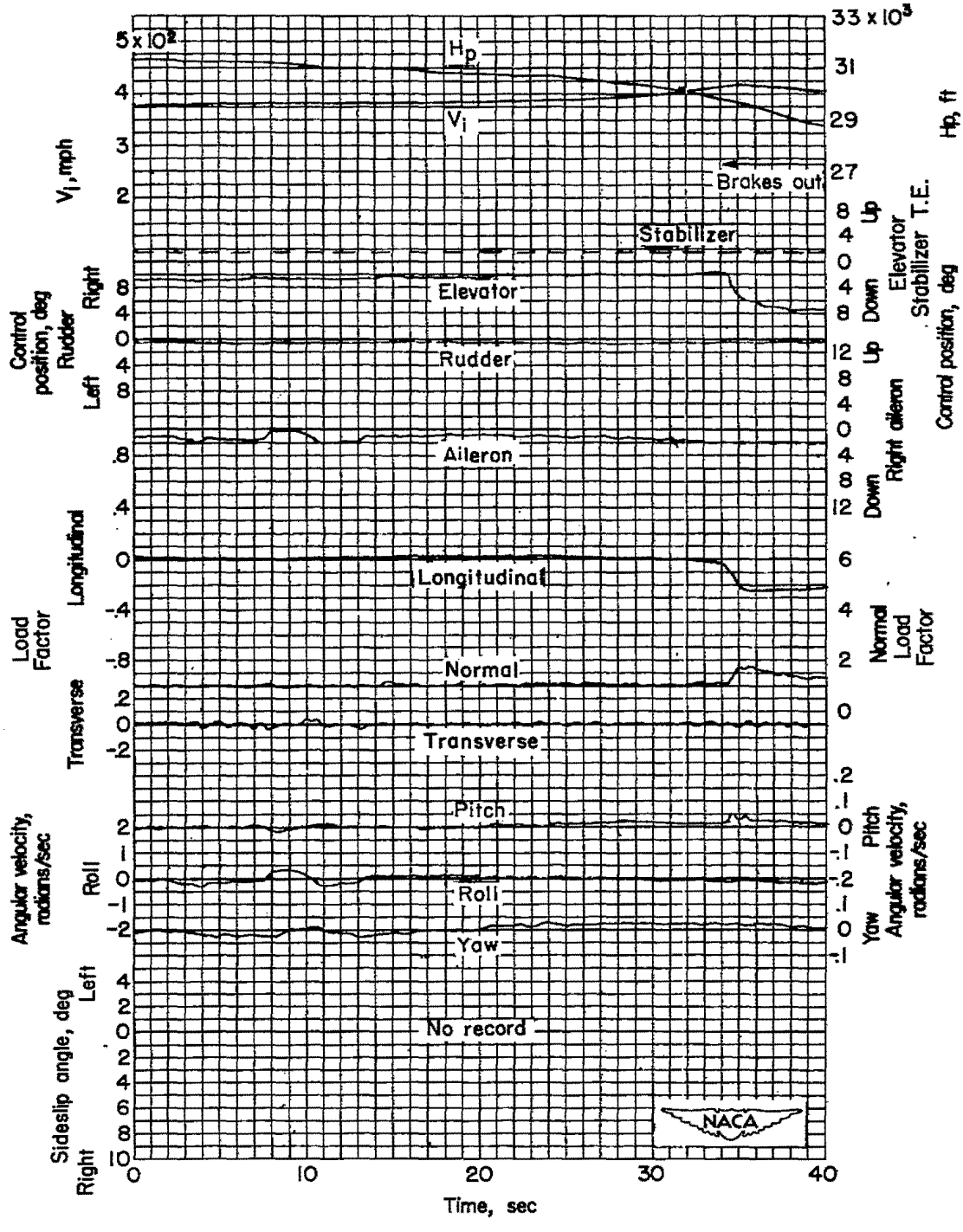


Figure 186.- Right and left diving turns. Airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

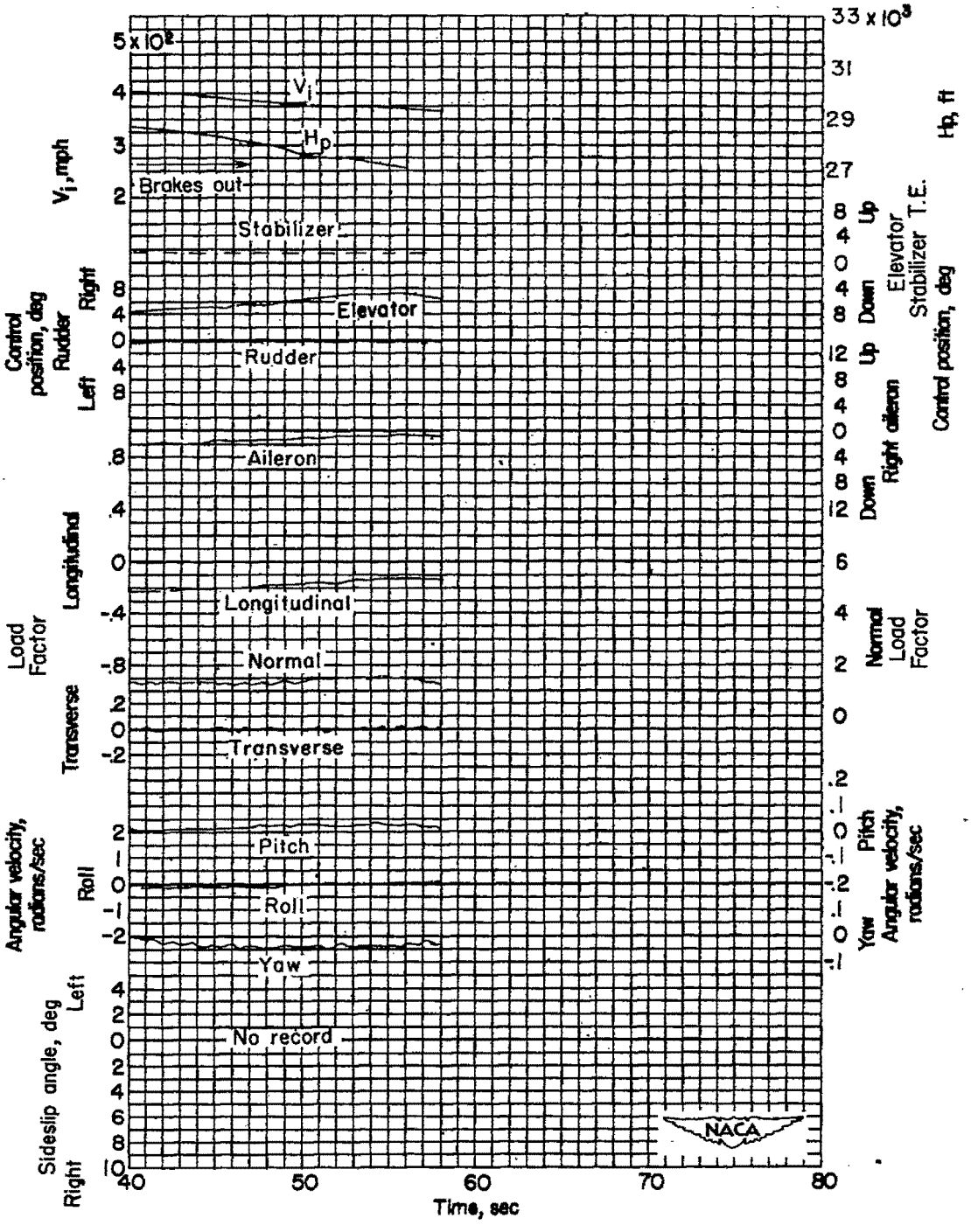


Figure 186.- Concluded.

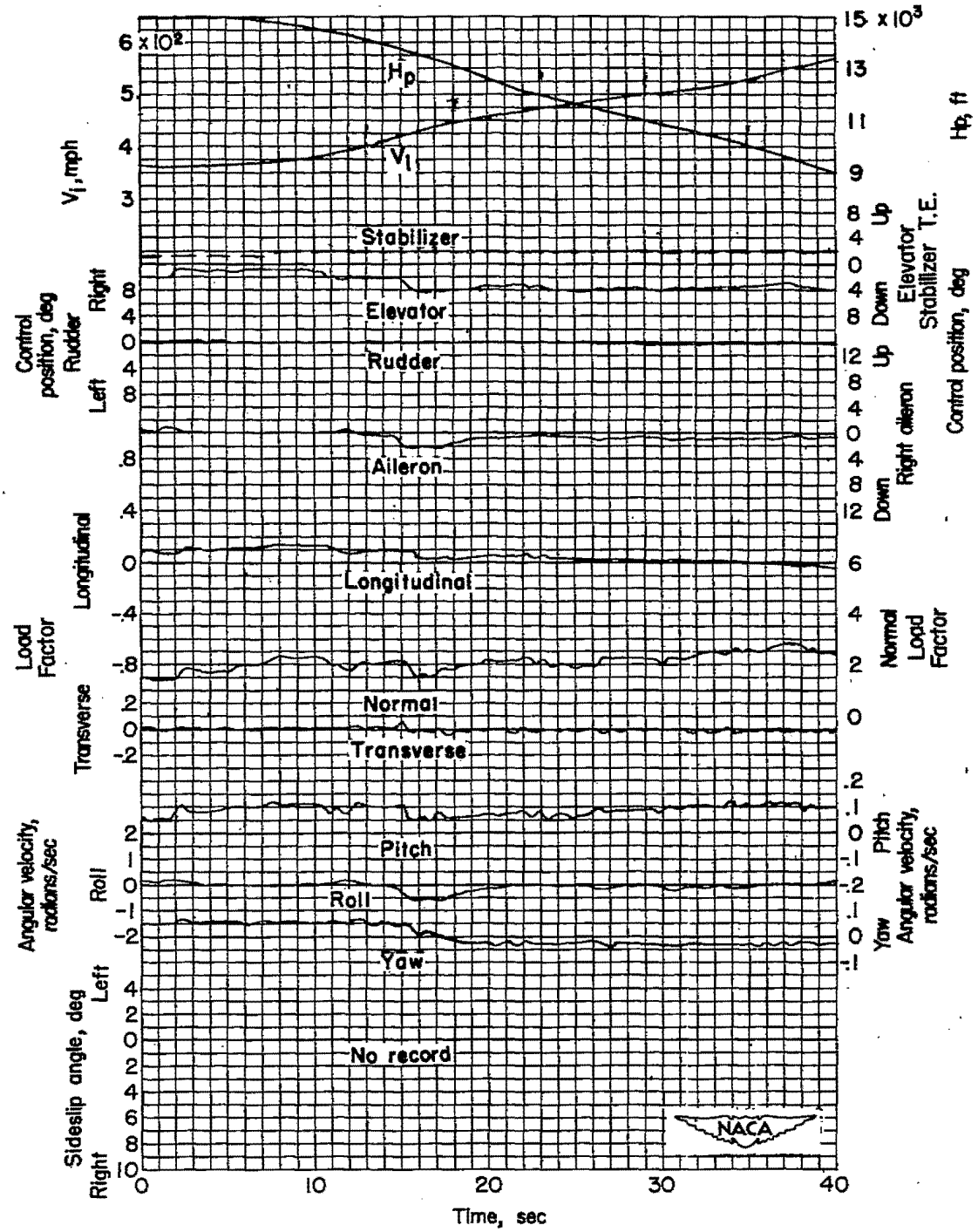


Figure 187.- Left and right diving turns and a pull-out. Airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

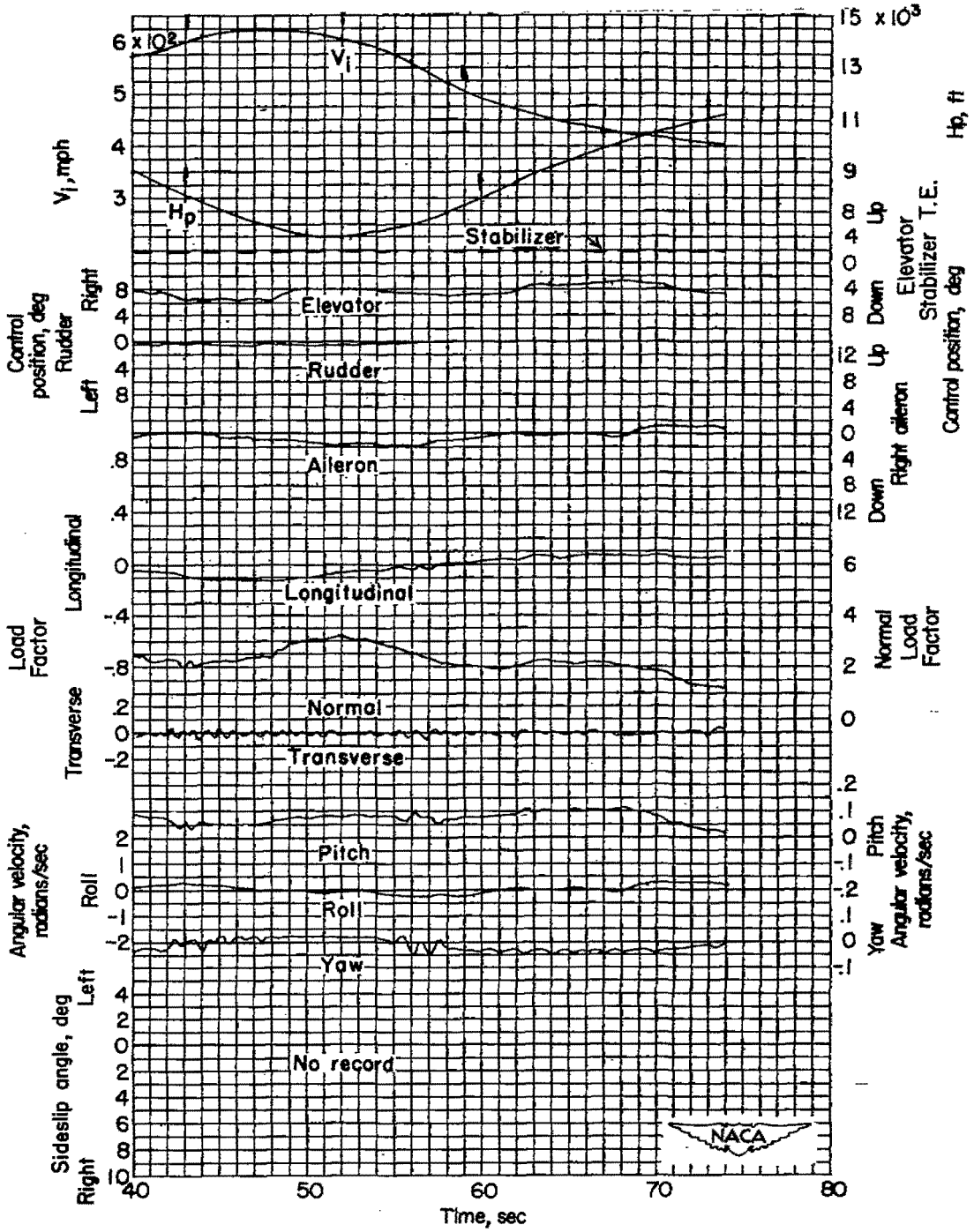


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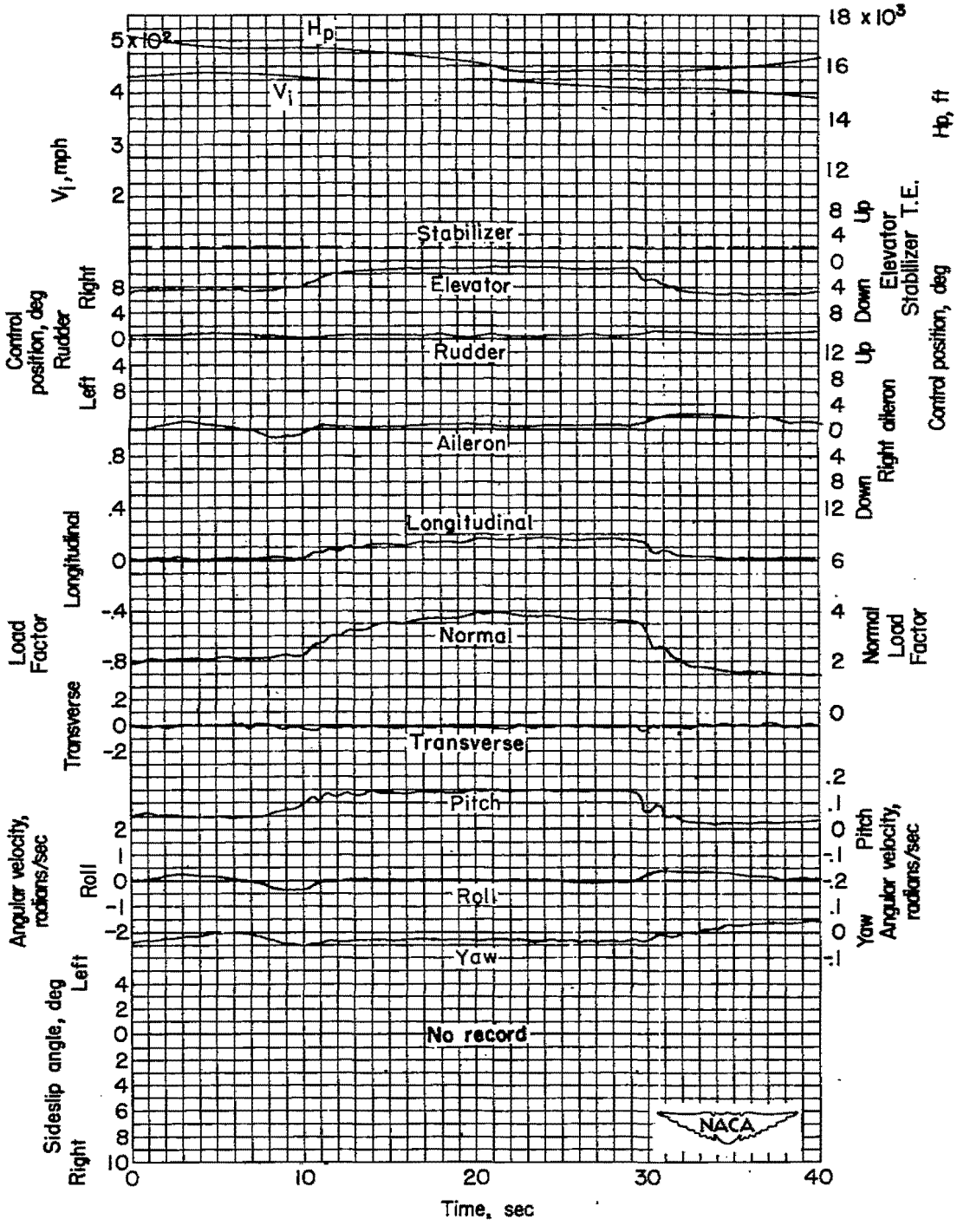


Figure 188.- Sharp left diving turn and recovery. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

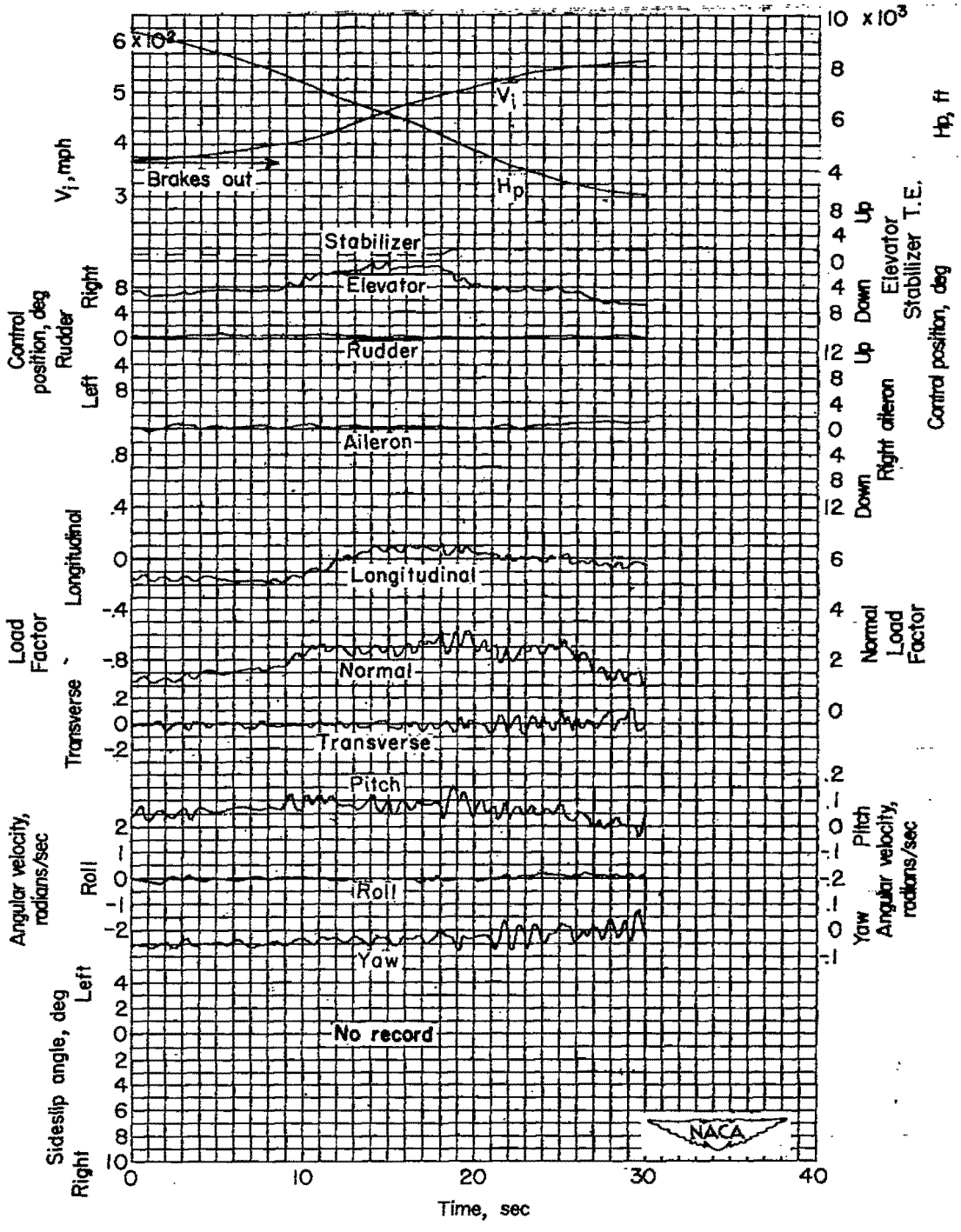


Figure 189.- Sharp left diving turn and pull-out. Airplane weight, 12,750 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

[redacted]

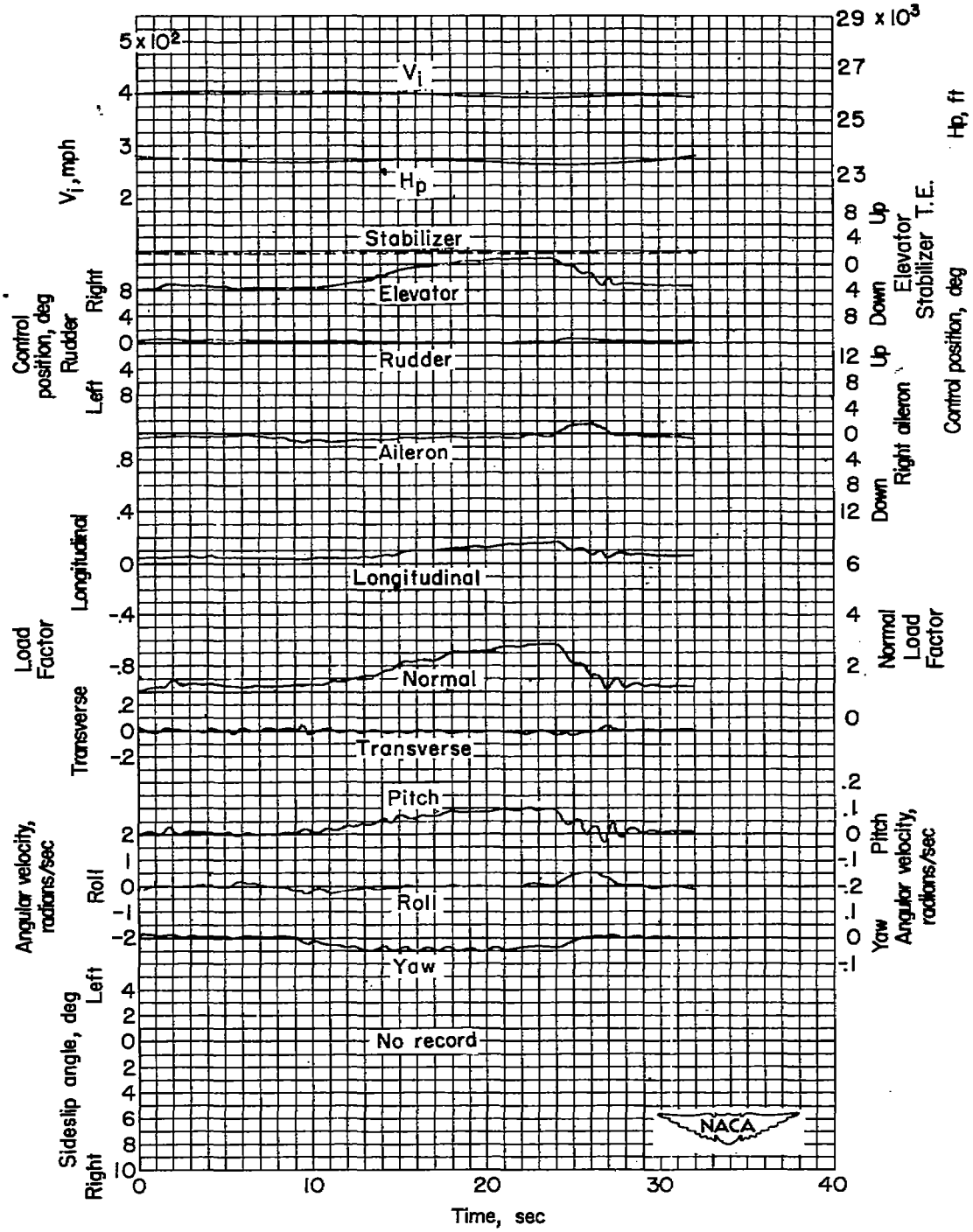


Figure 190.- Sharp left turn. Airplane weight, 13,650 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

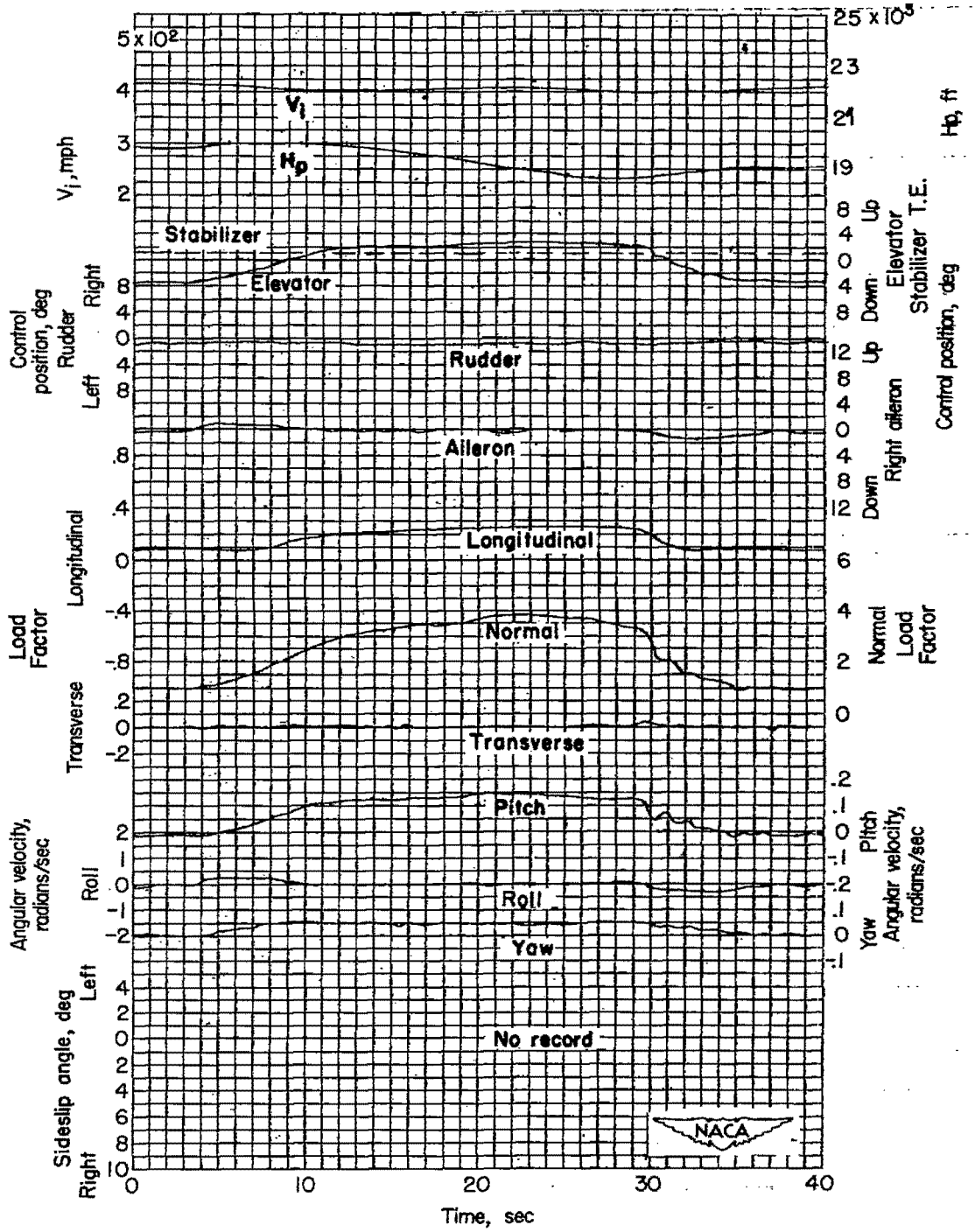


Figure 191.- Sharp right diving turn. Airplane weight, 12,800 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

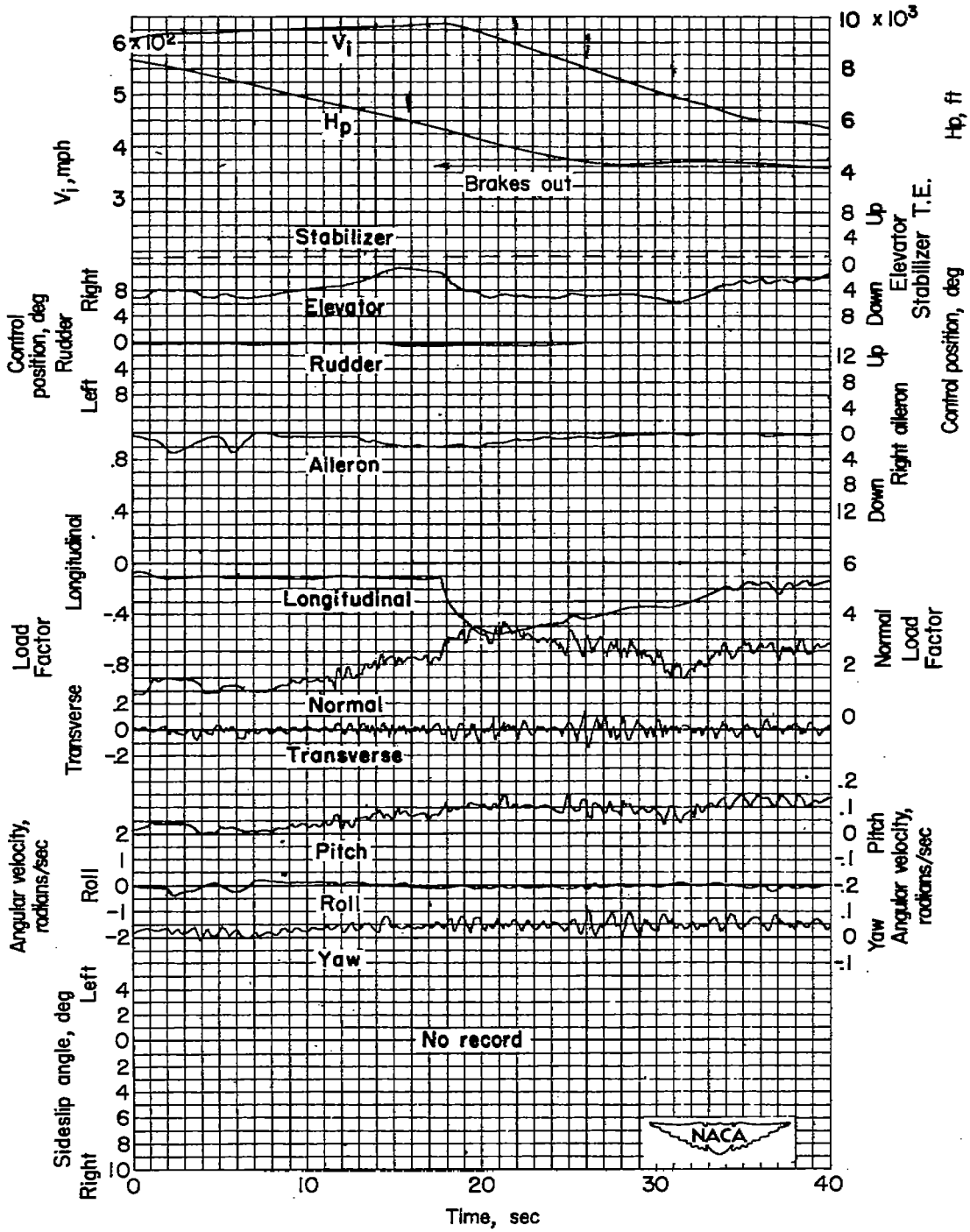


Figure 192.- Sharp right diving turn. Airplane weight, 12,600 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

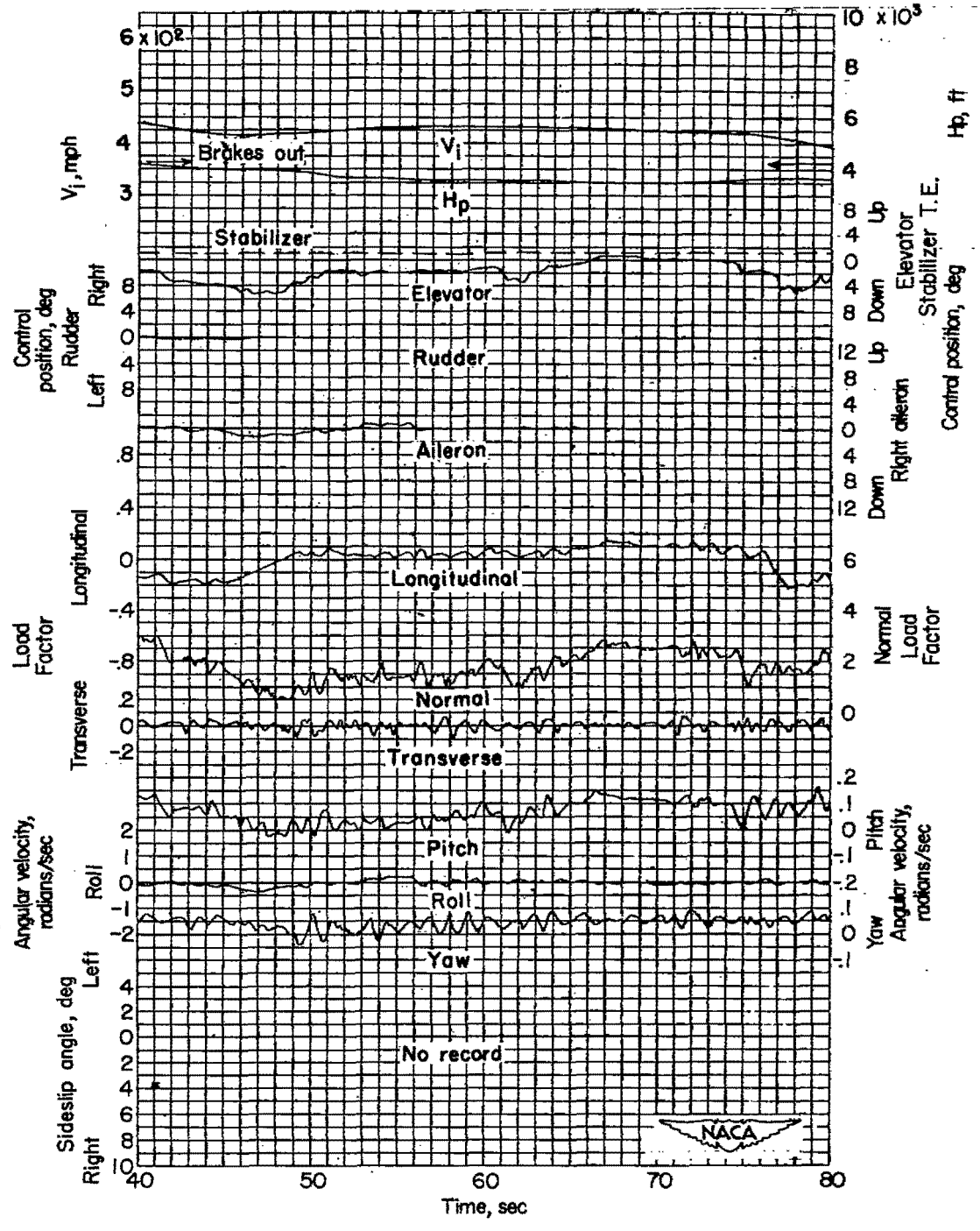


Figure 192.- Continued.

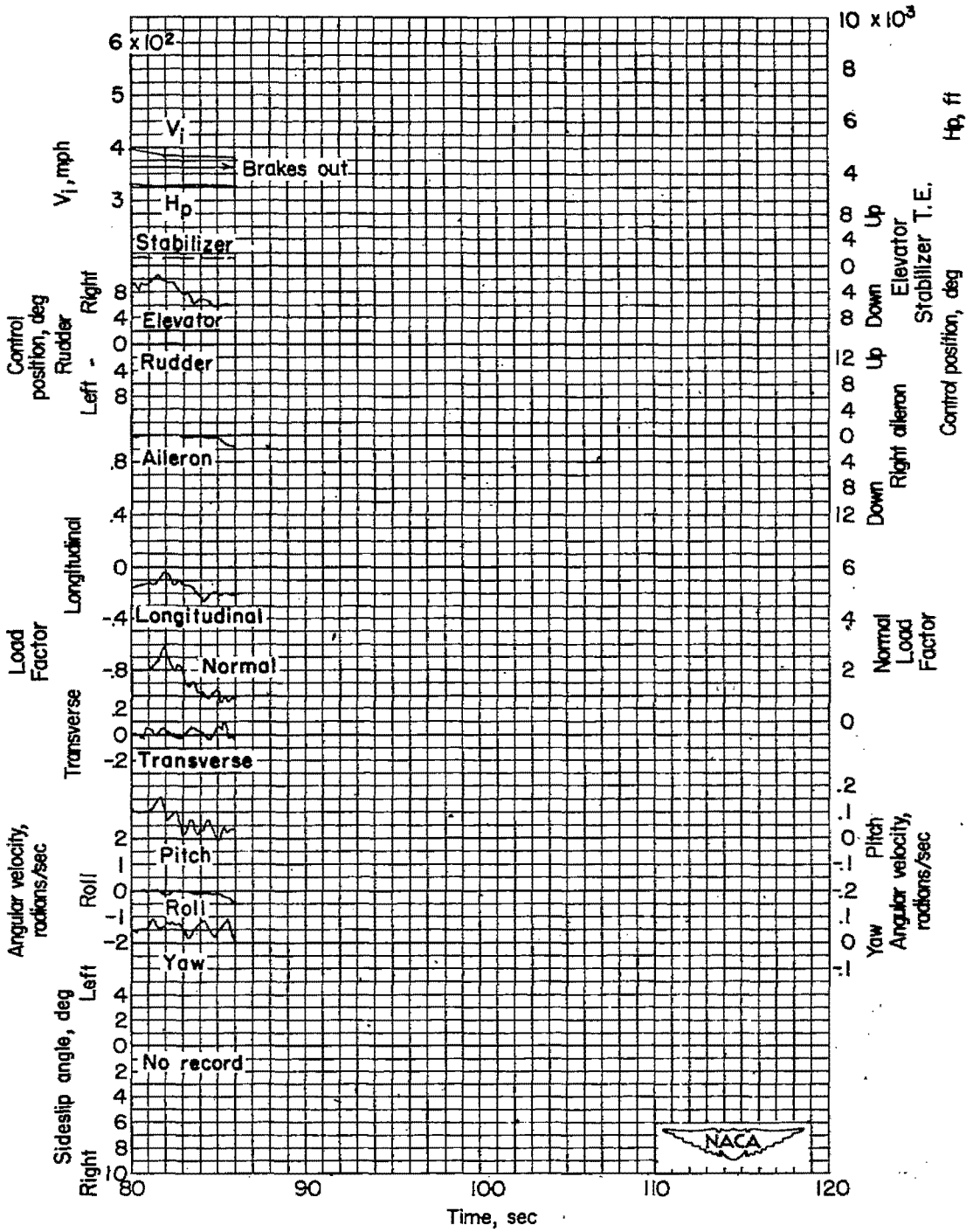


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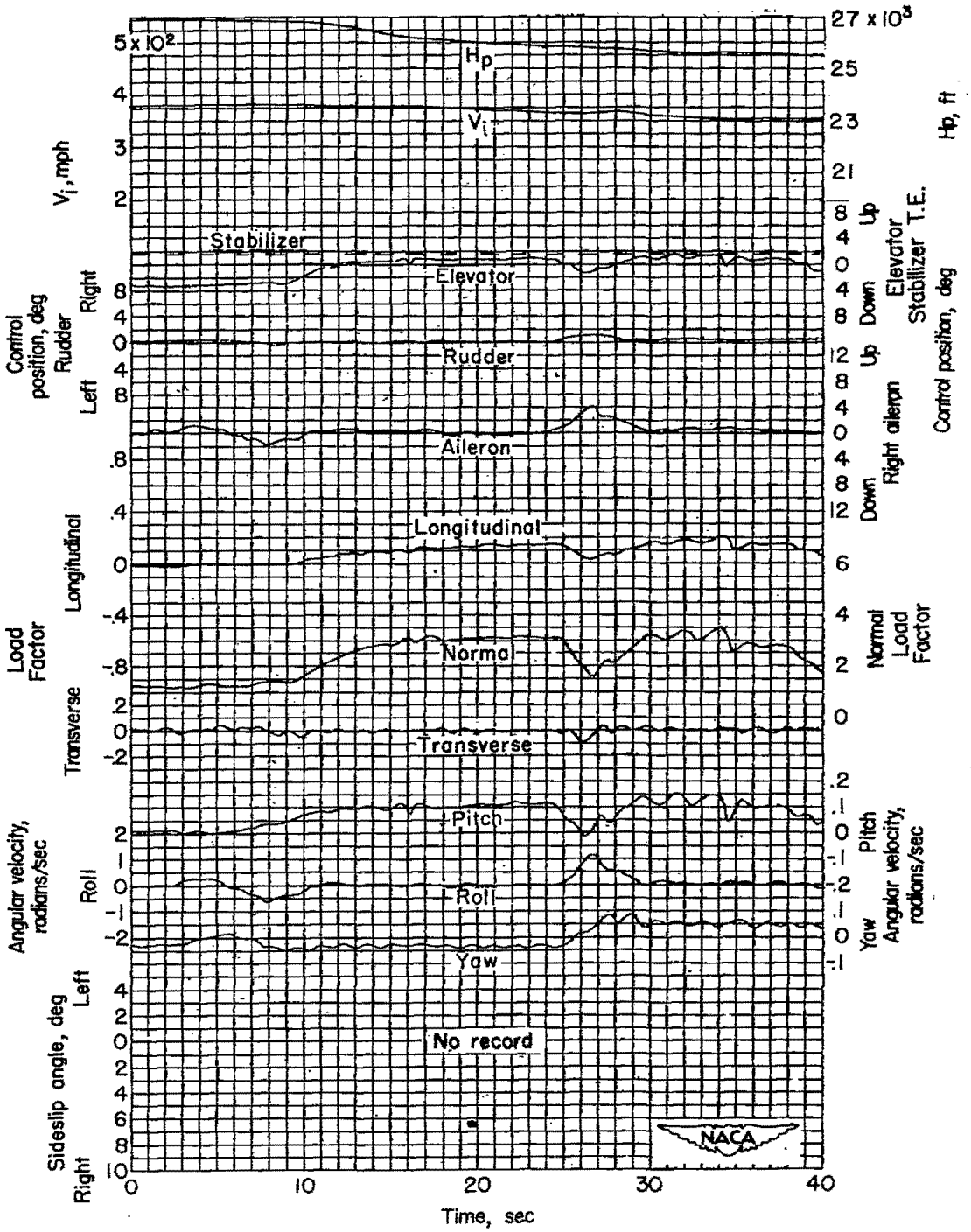


Figure 193.- Sharp left and right diving turns. Airplane weight, 13,400 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

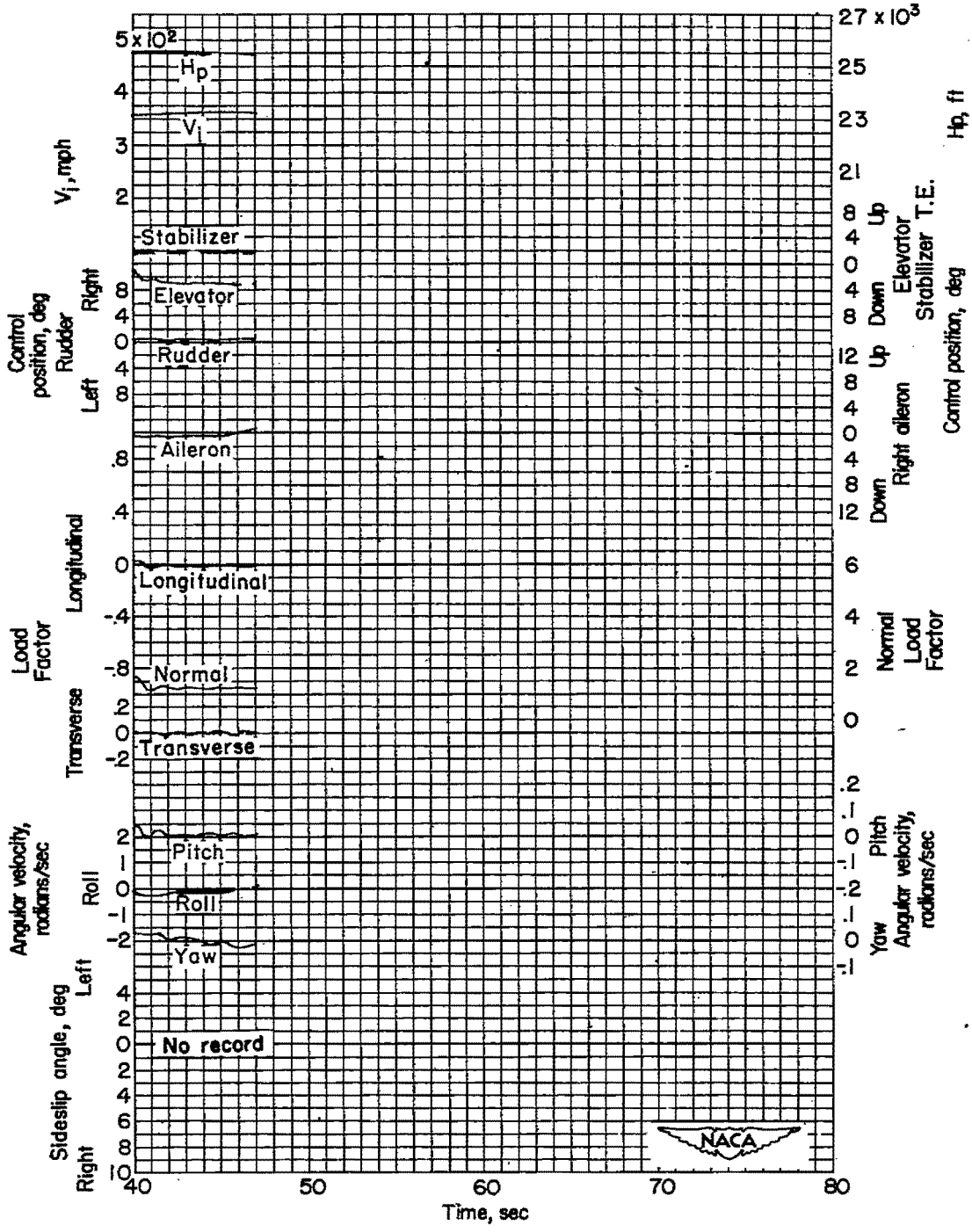


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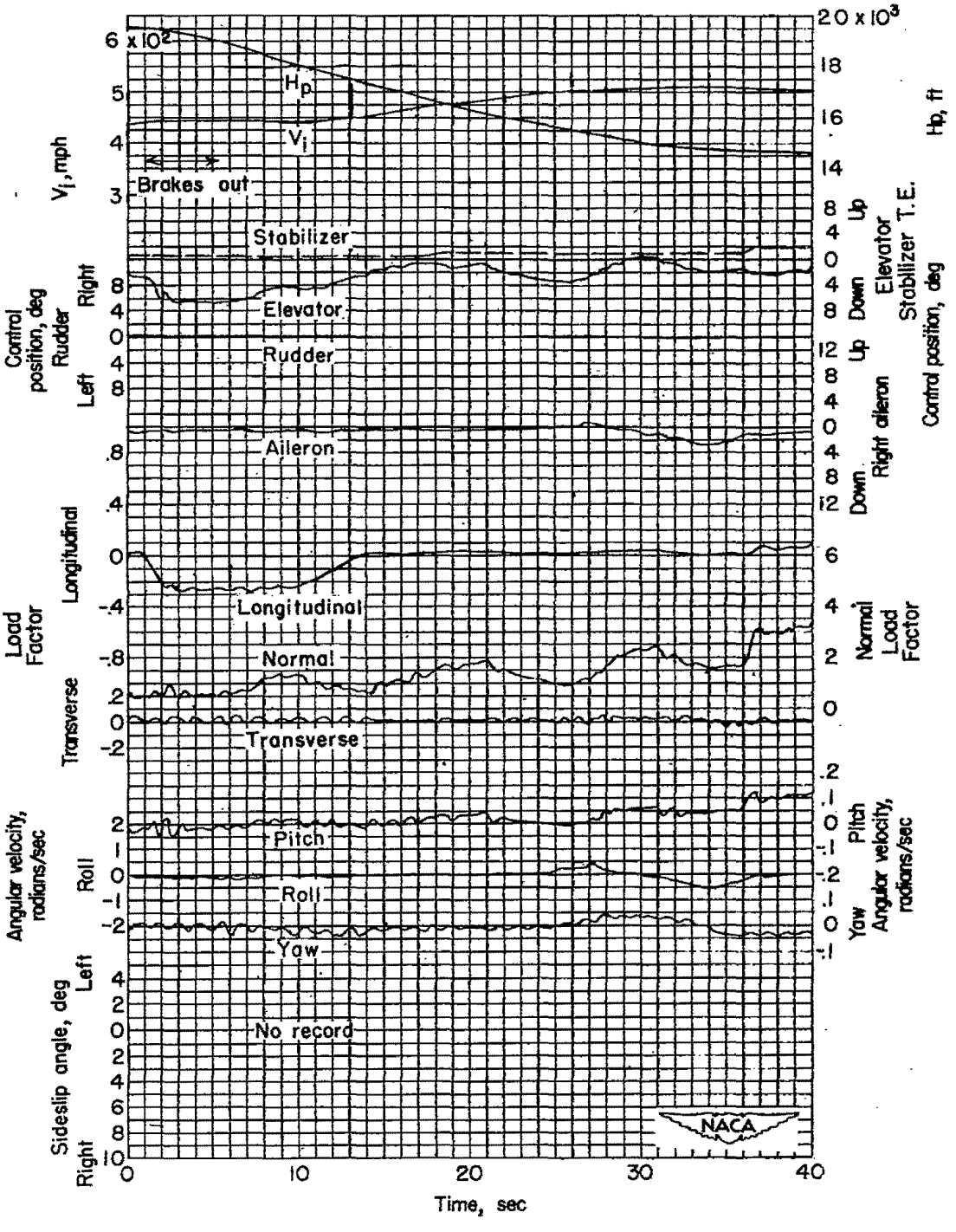


Figure 194.- Sharp right and left diving turns. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

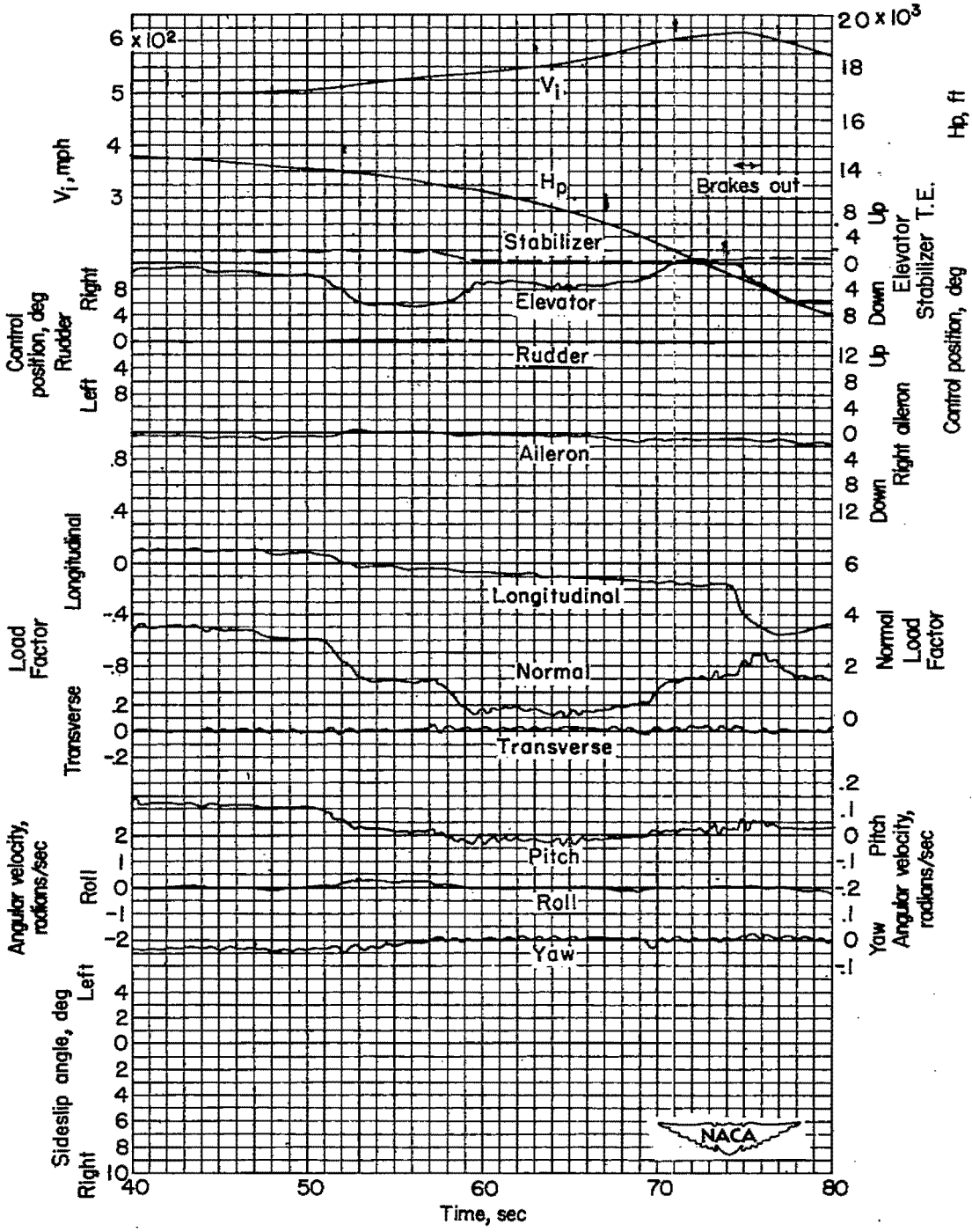


Figure 194.- Continued.

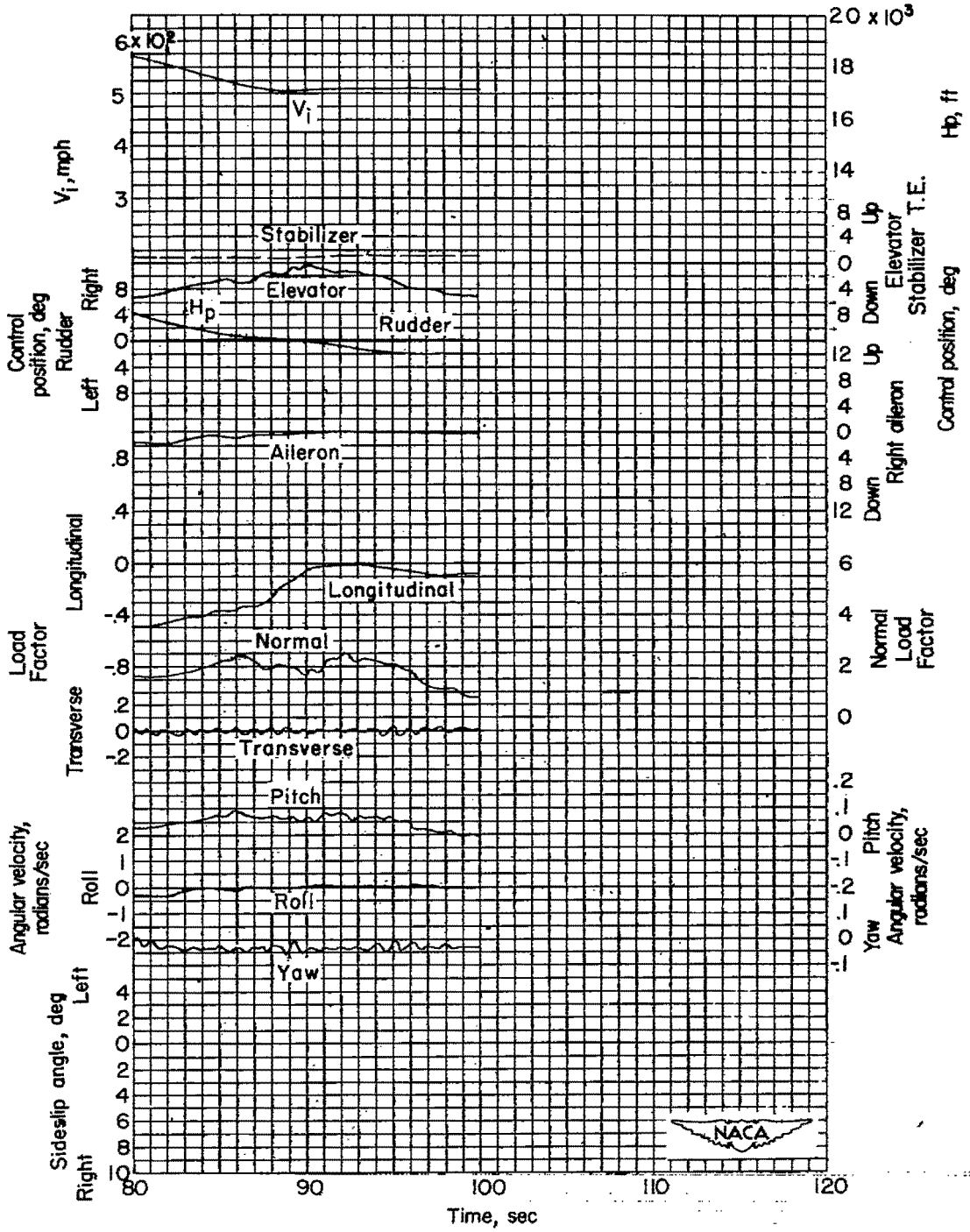


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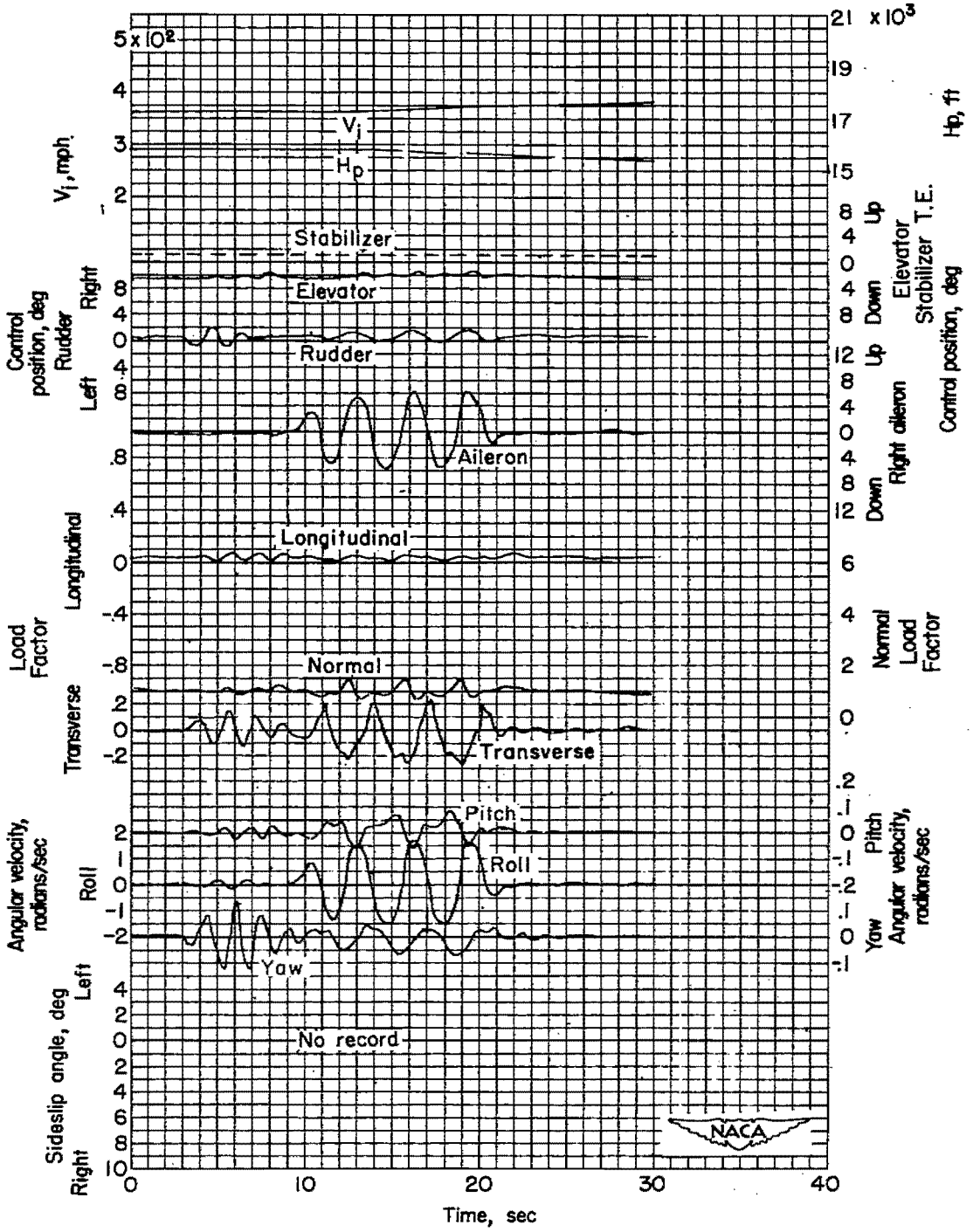


Figure 195.- Fishtail followed by banks without turns. Airplane weight, 12,300 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

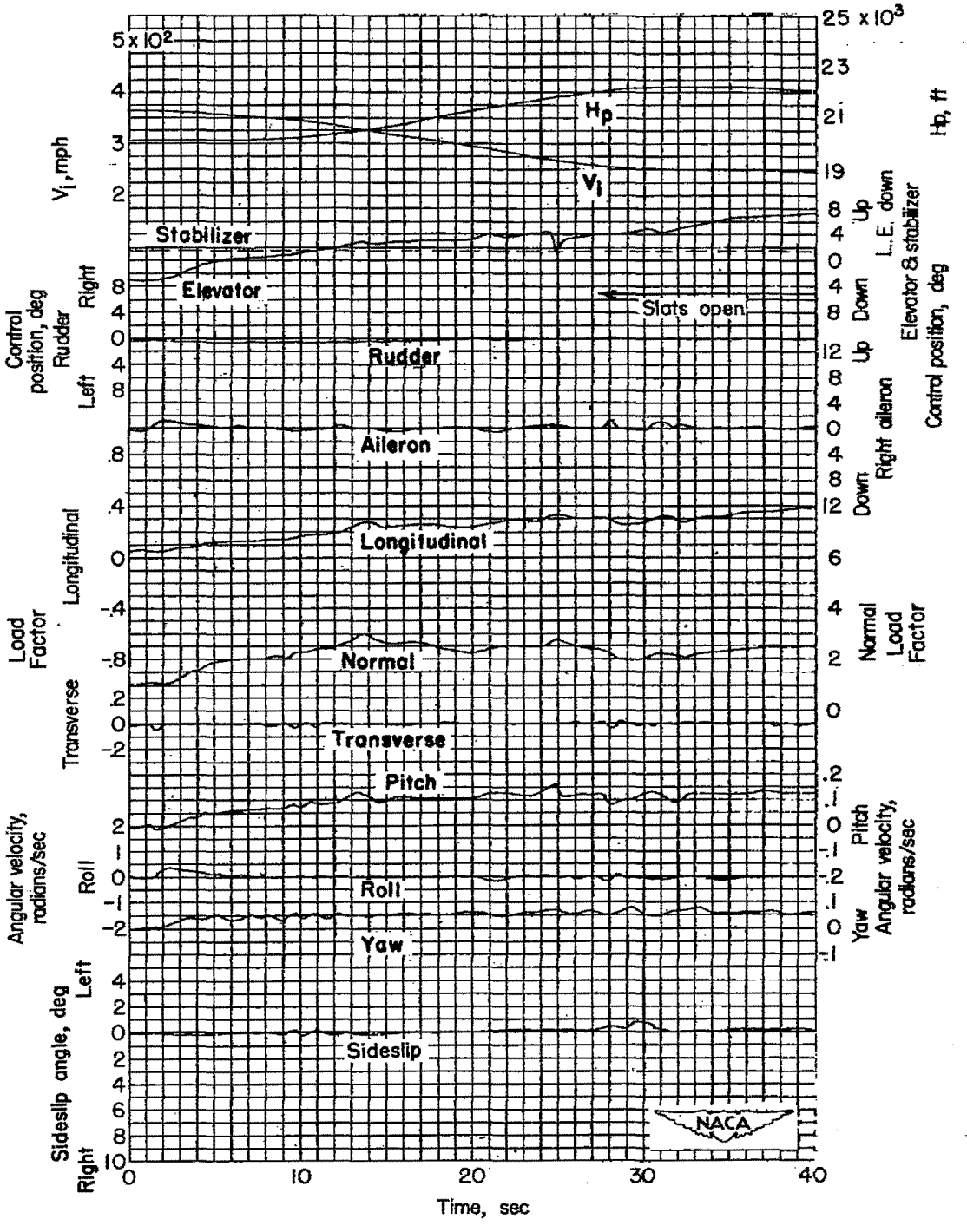


Figure 196.- Approach to the stall. Airplane weight, 13,550 pounds, center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

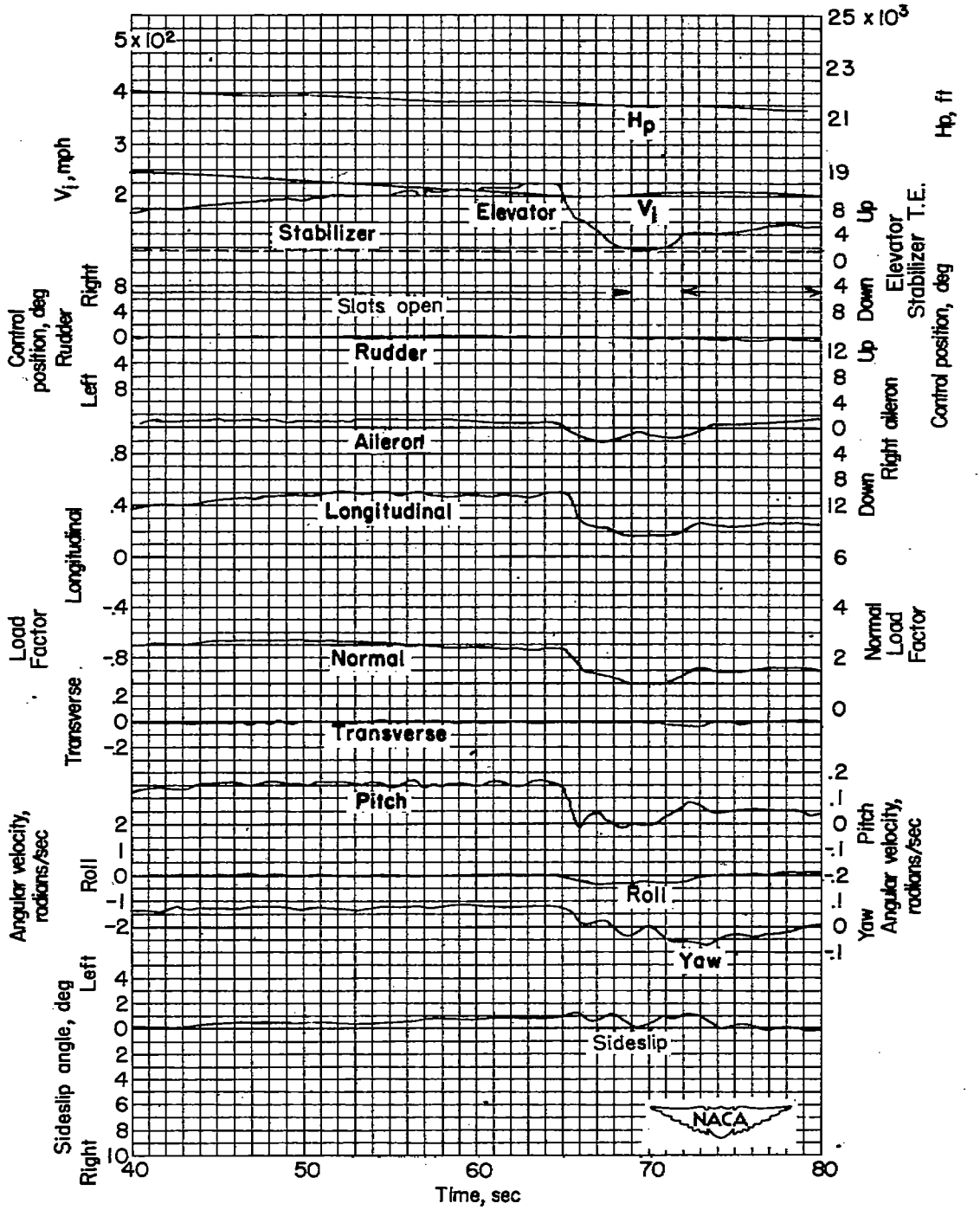


Figure 196.- Concluded.

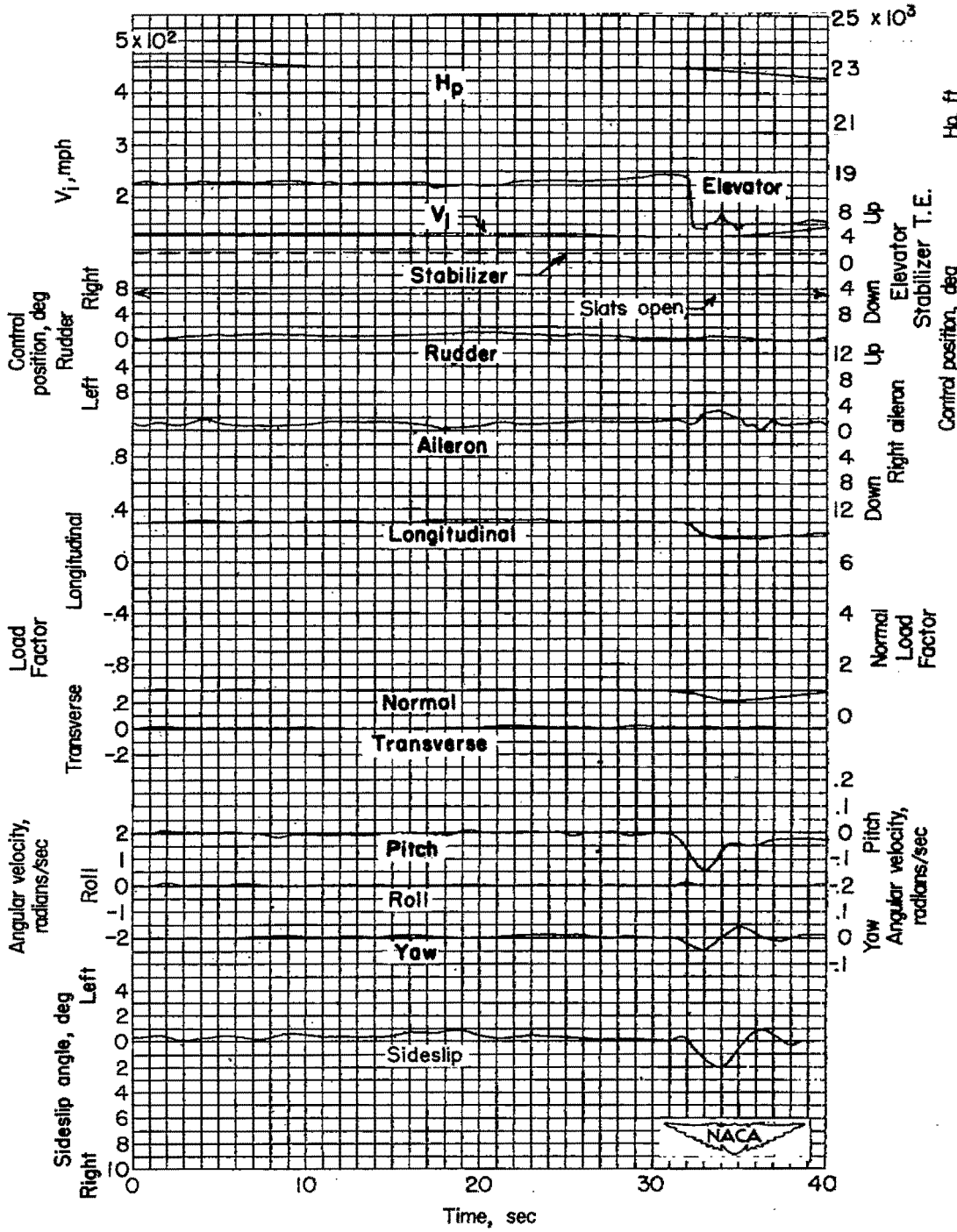


Figure 197.- Approach to the stall. Airplane weight, 13,400 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

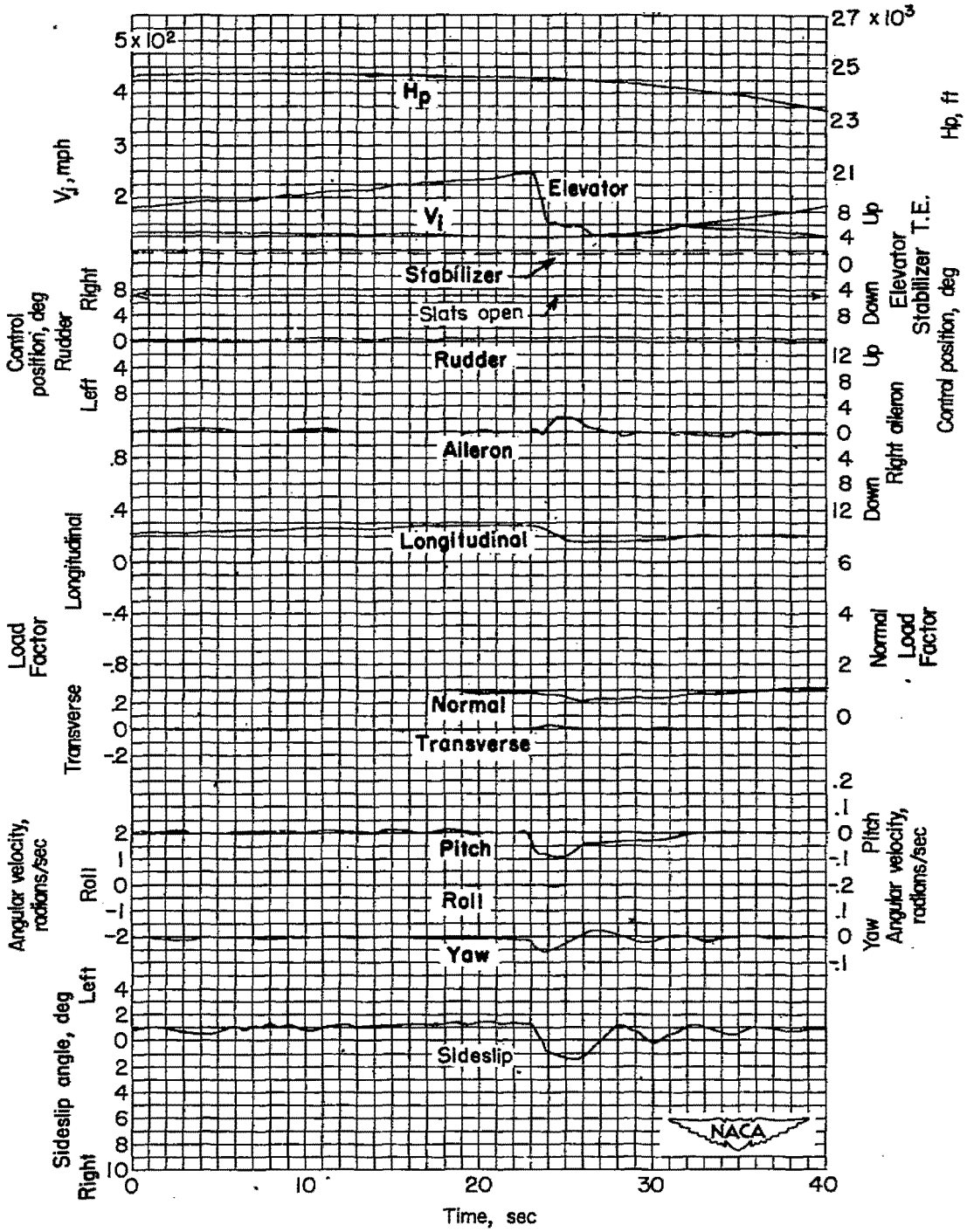


Figure 198.- Approach to the stall. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

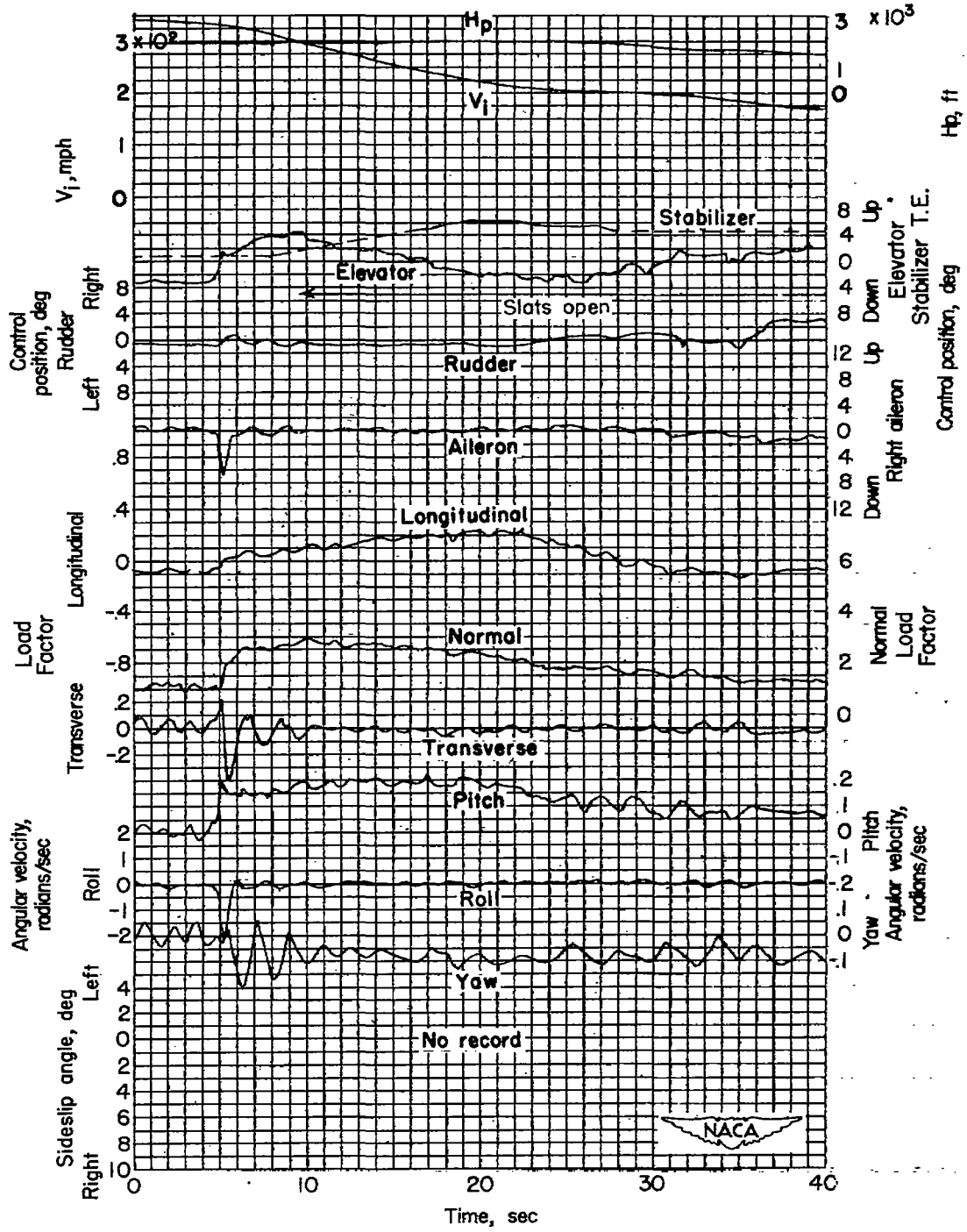


Figure 199.- Landing. Airplane weight, 12,200 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

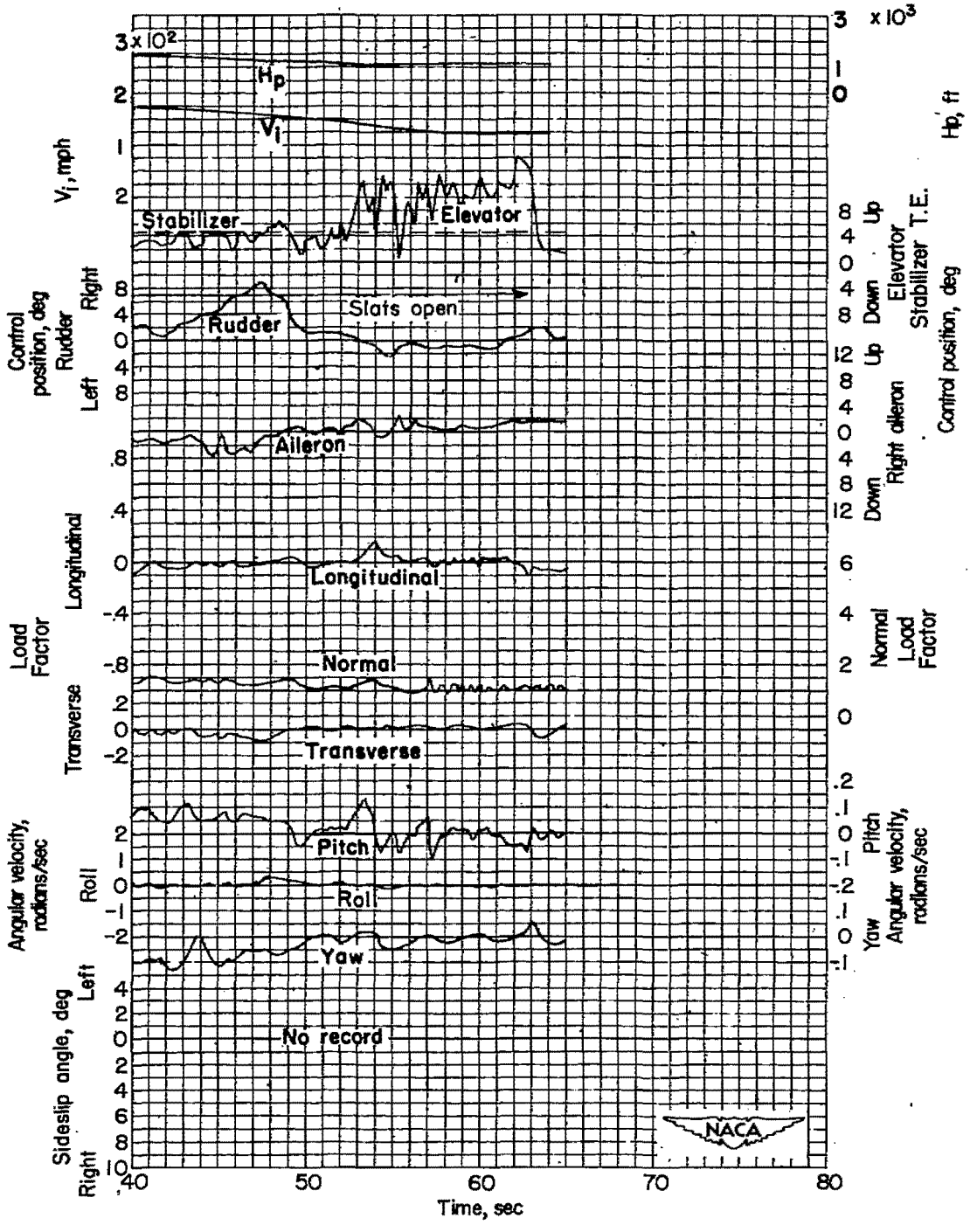


Figure 199.- Concluded.

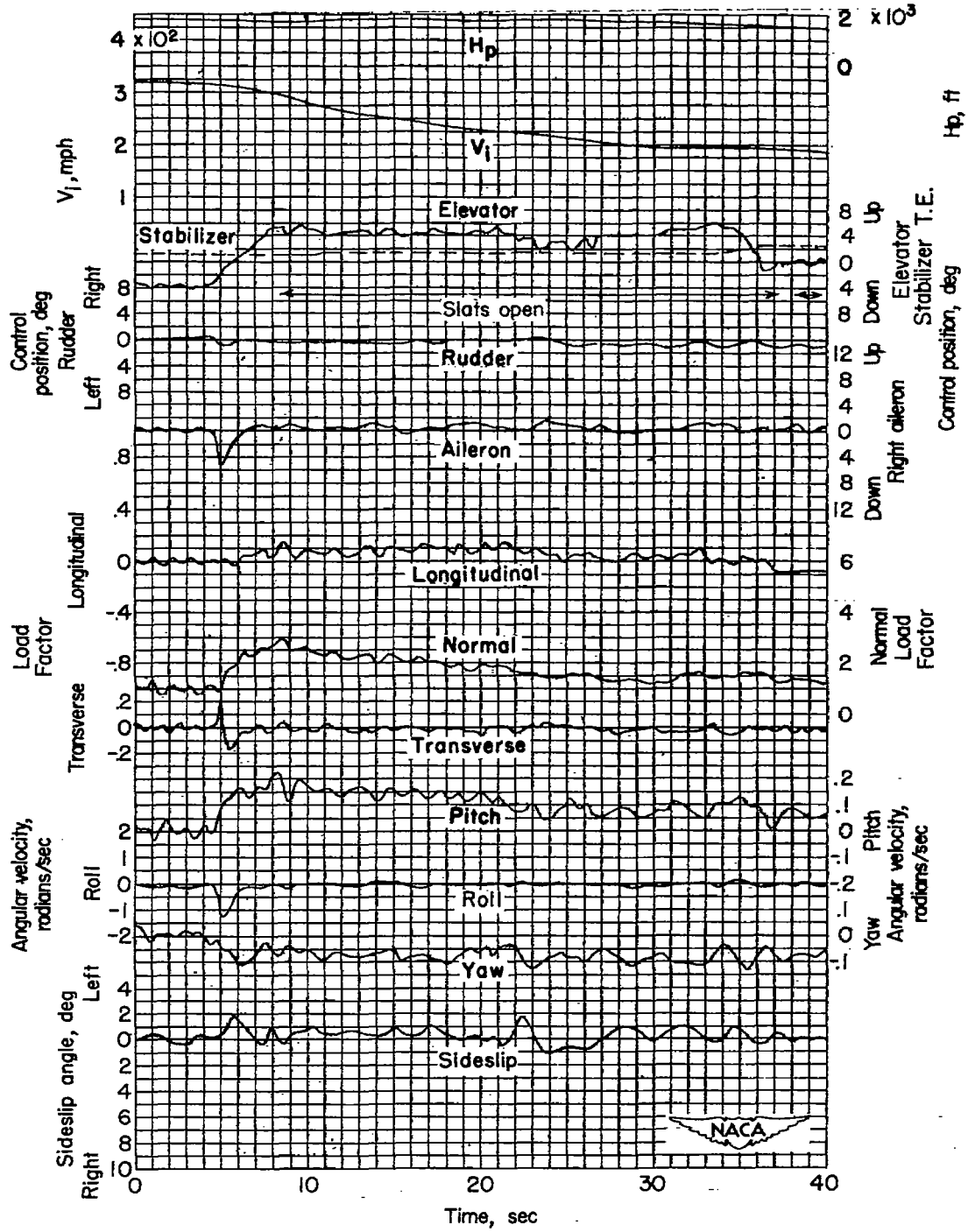


Figure 200.- Landing. Airplane weight, 12,100 pounds; center-of-gravity location, 21.2 percent of the mean aerodynamic chord.

[redacted]

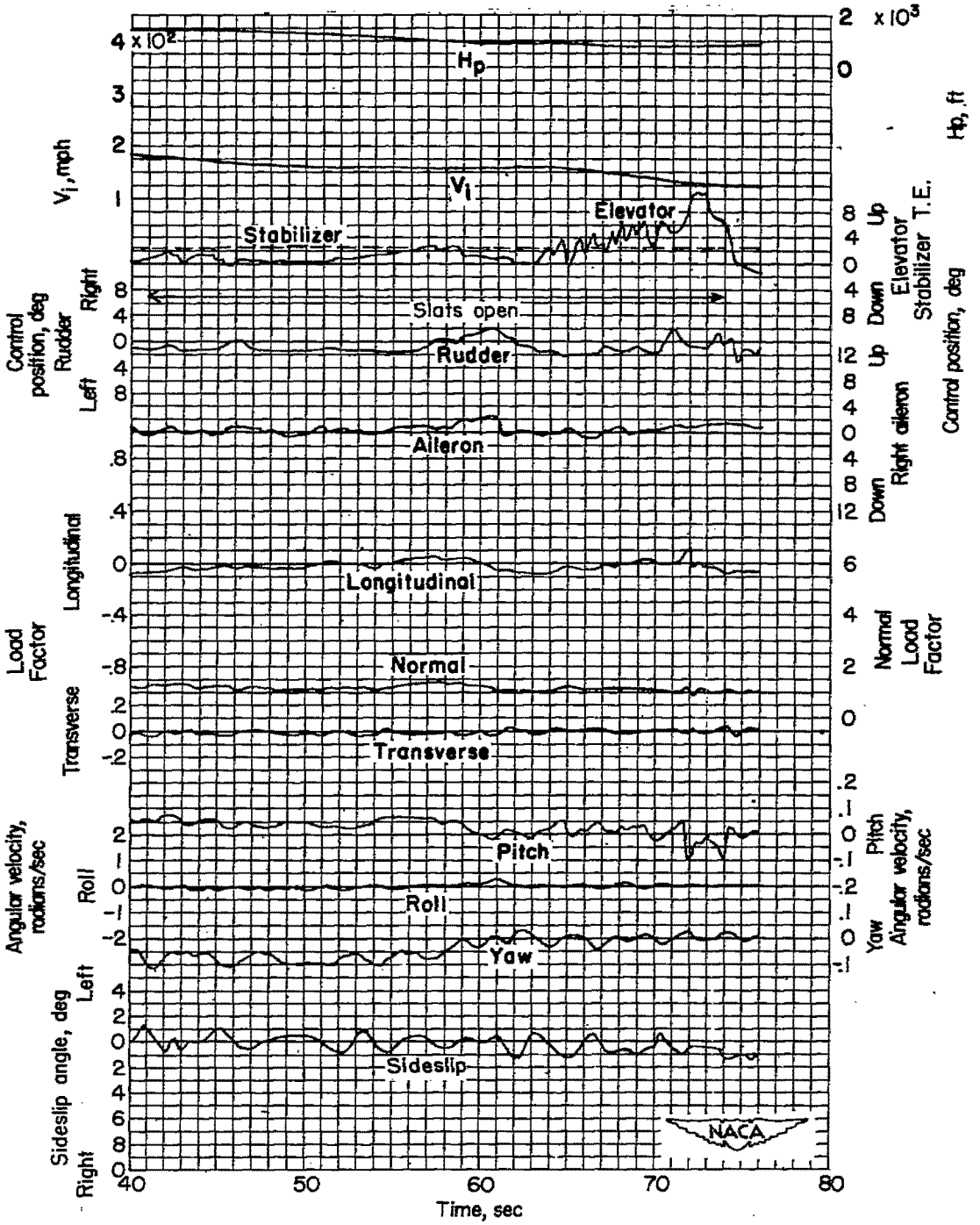


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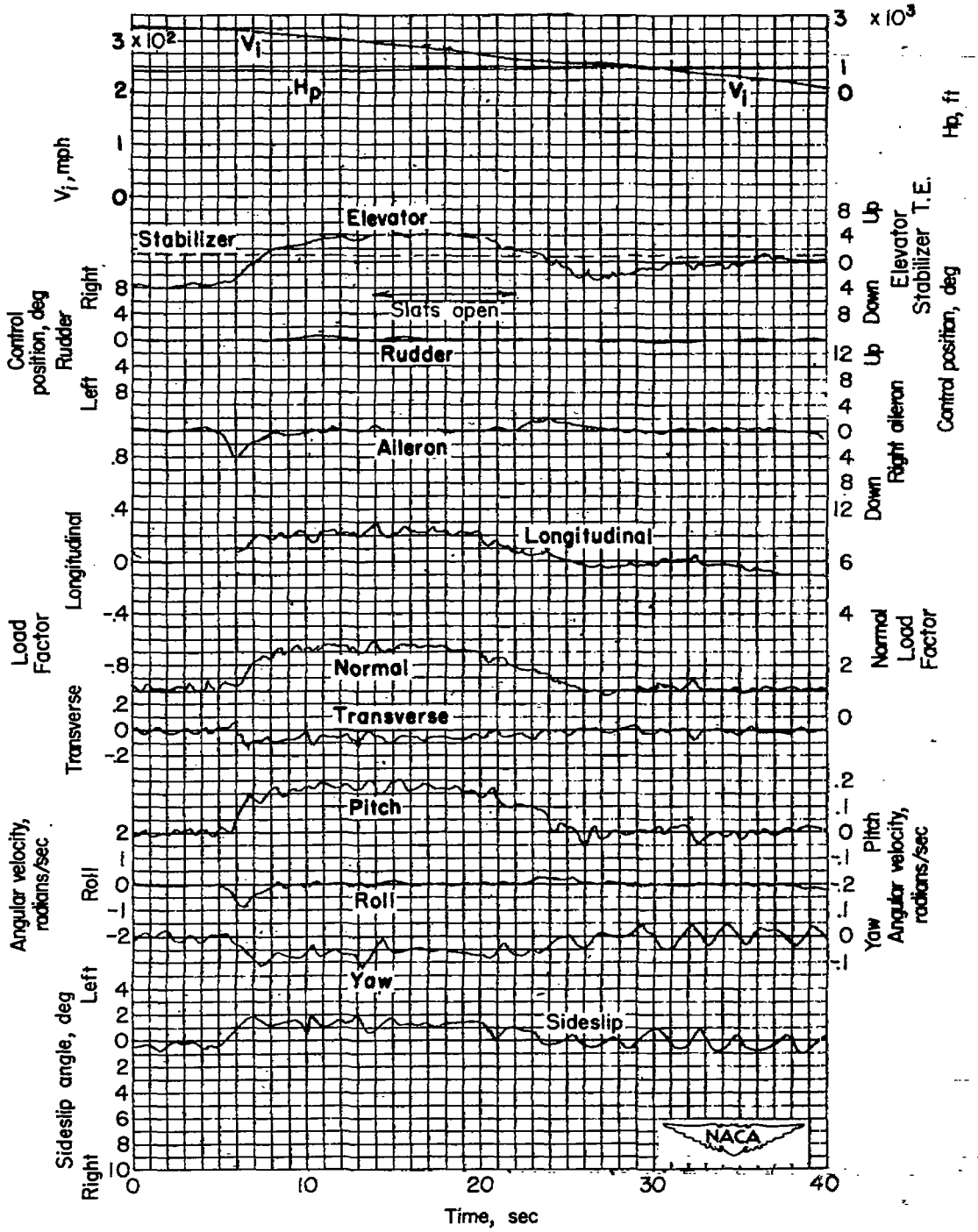


Figure 201.- Landing. Airplane weight, 12,650 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

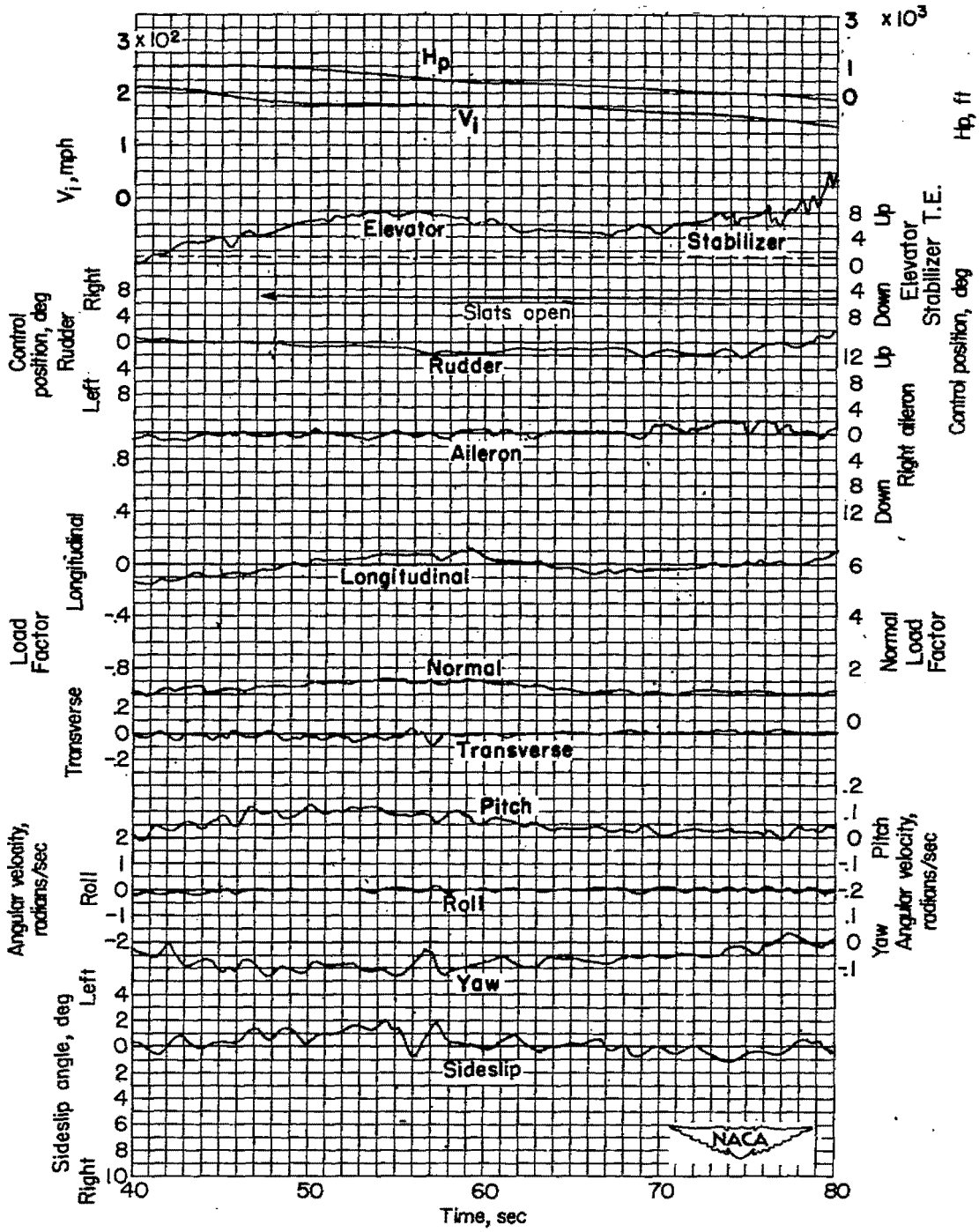


Figure 201.- Continued.

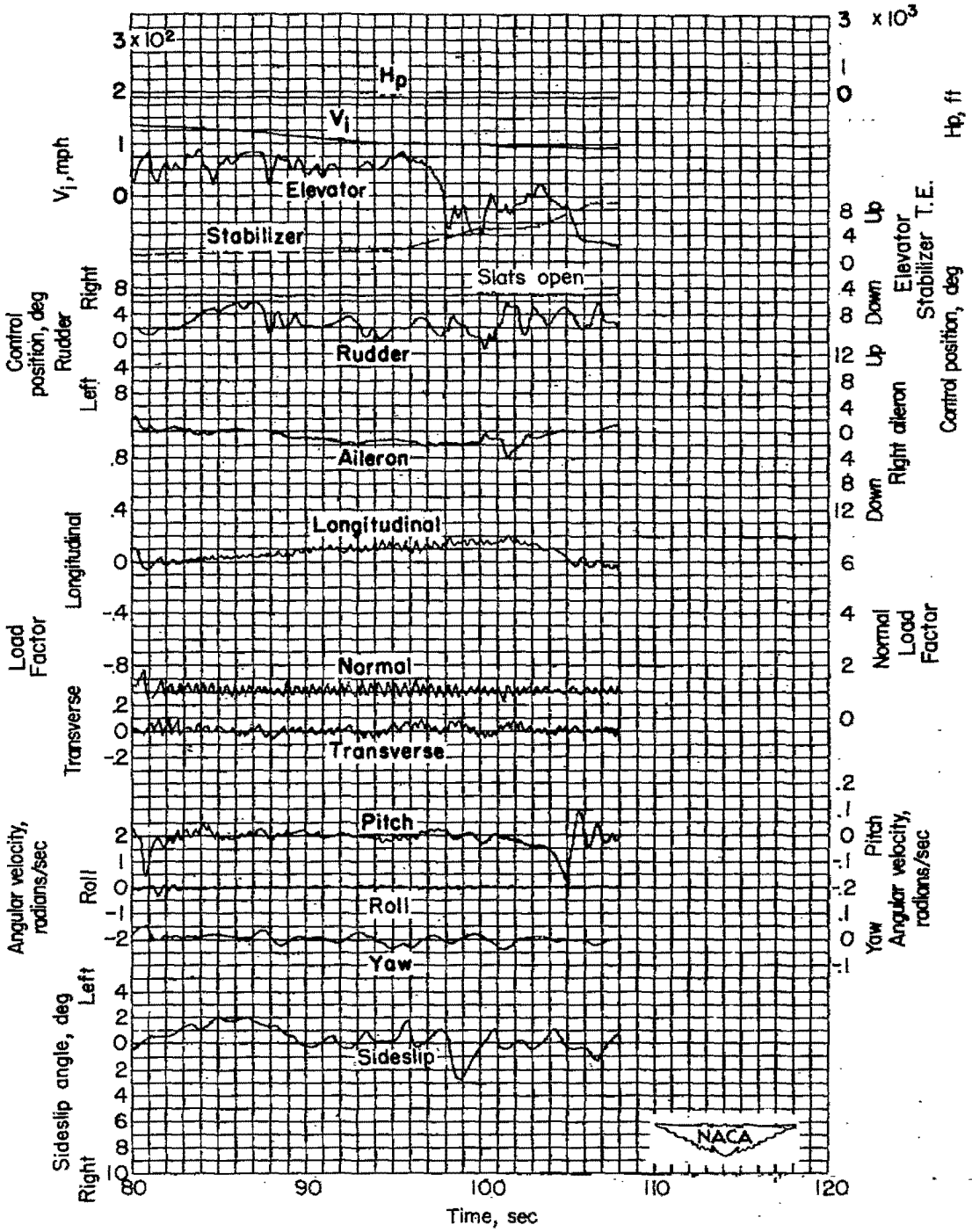


Figure 201.- Concluded.

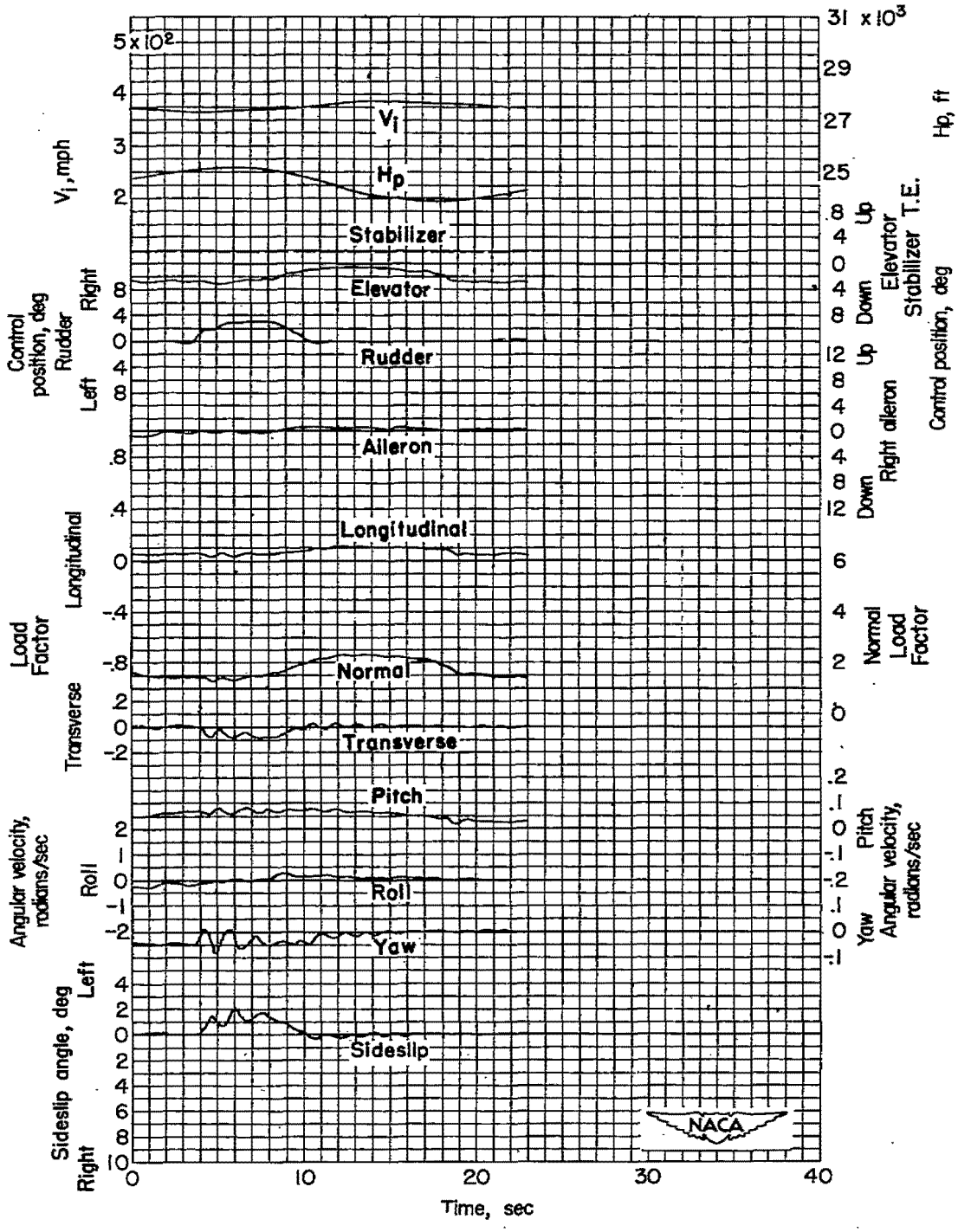


Figure 202.- Left sideslip followed by a dive and pull-out. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

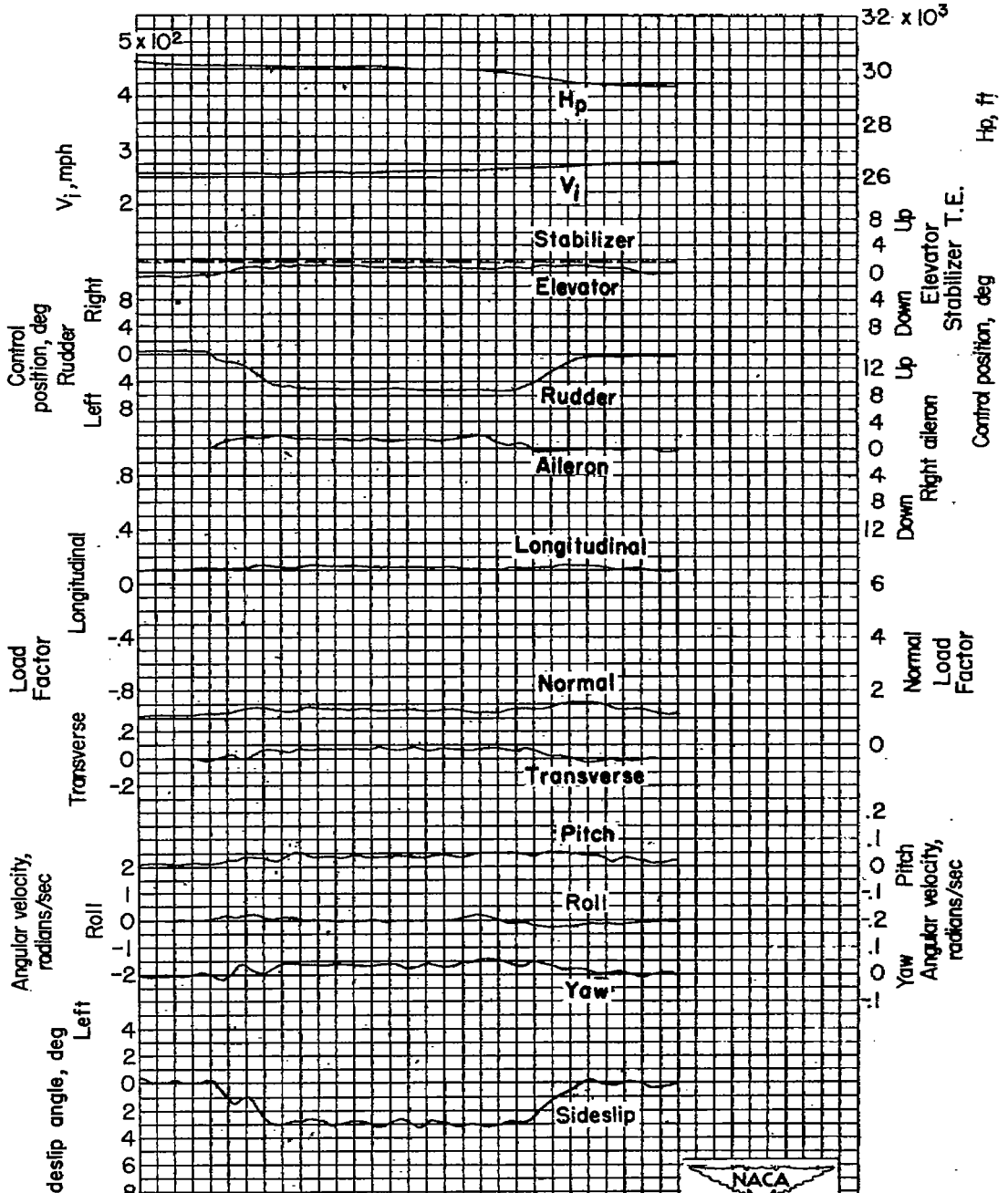


Figure 203.- Right sideslip. Airplane weight, 13,650 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

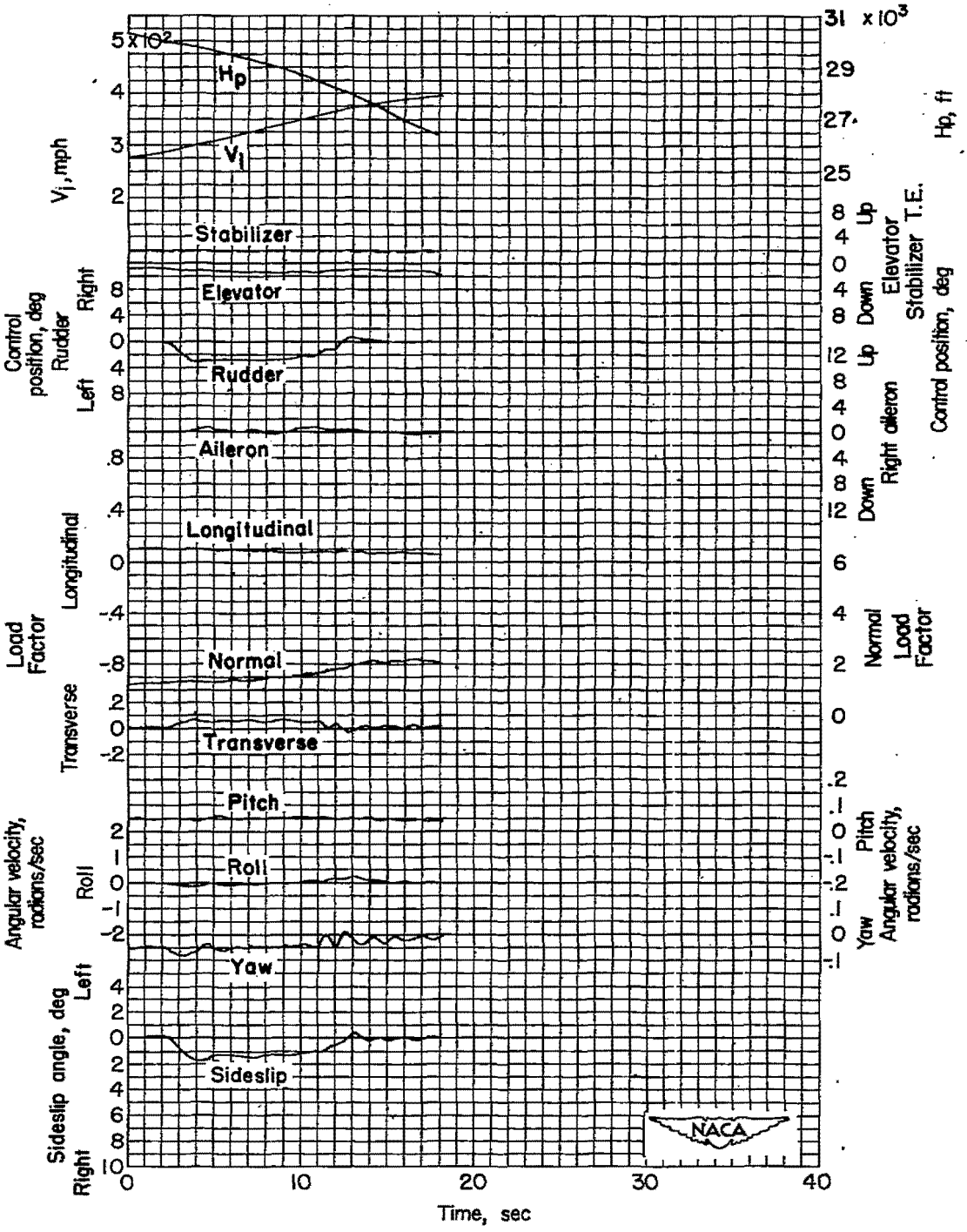


Figure 204.- Right diving sideslip. Airplane weight, 13,320 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

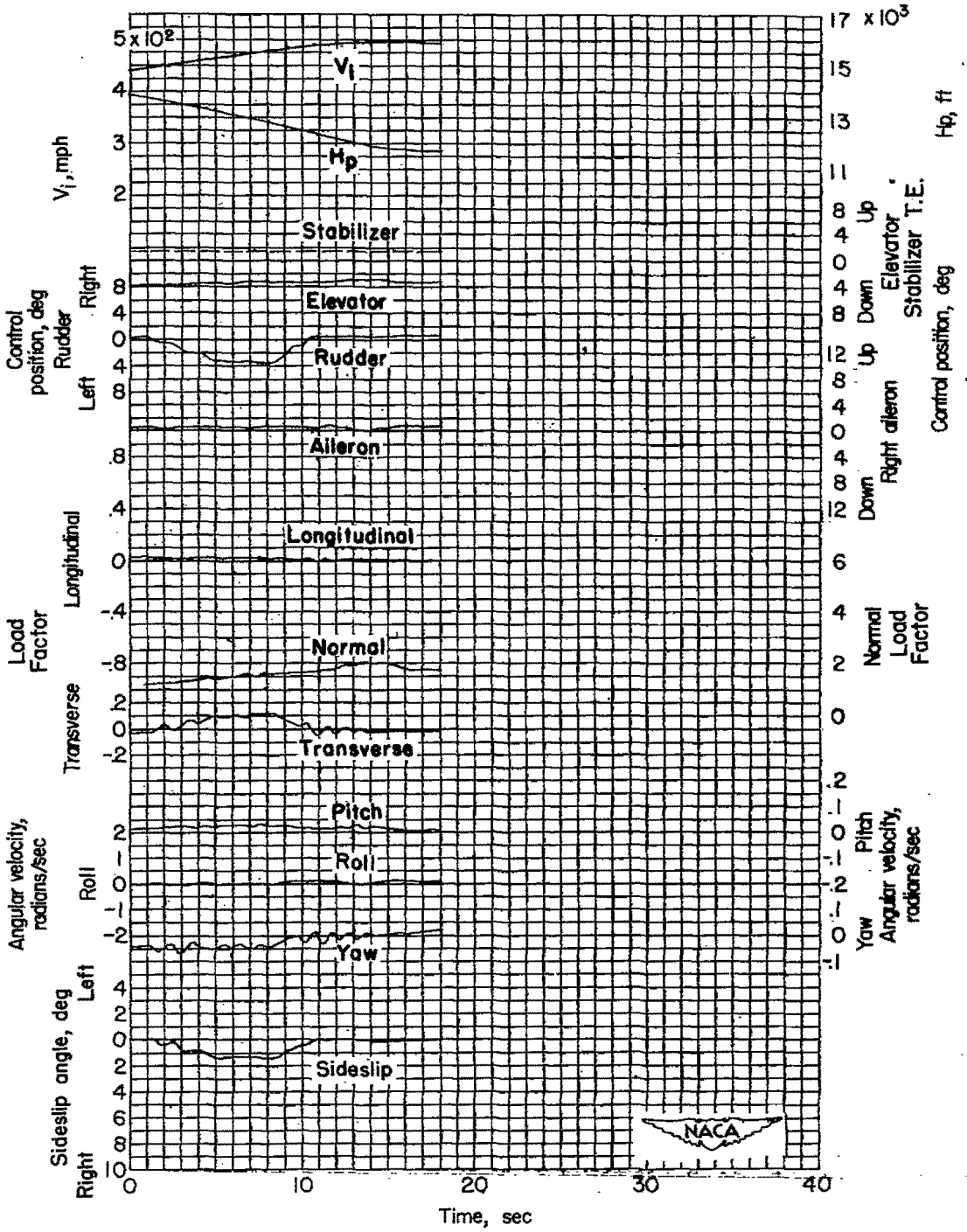


Figure 205.- Right sideslip. Airplane weight, 12,350 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

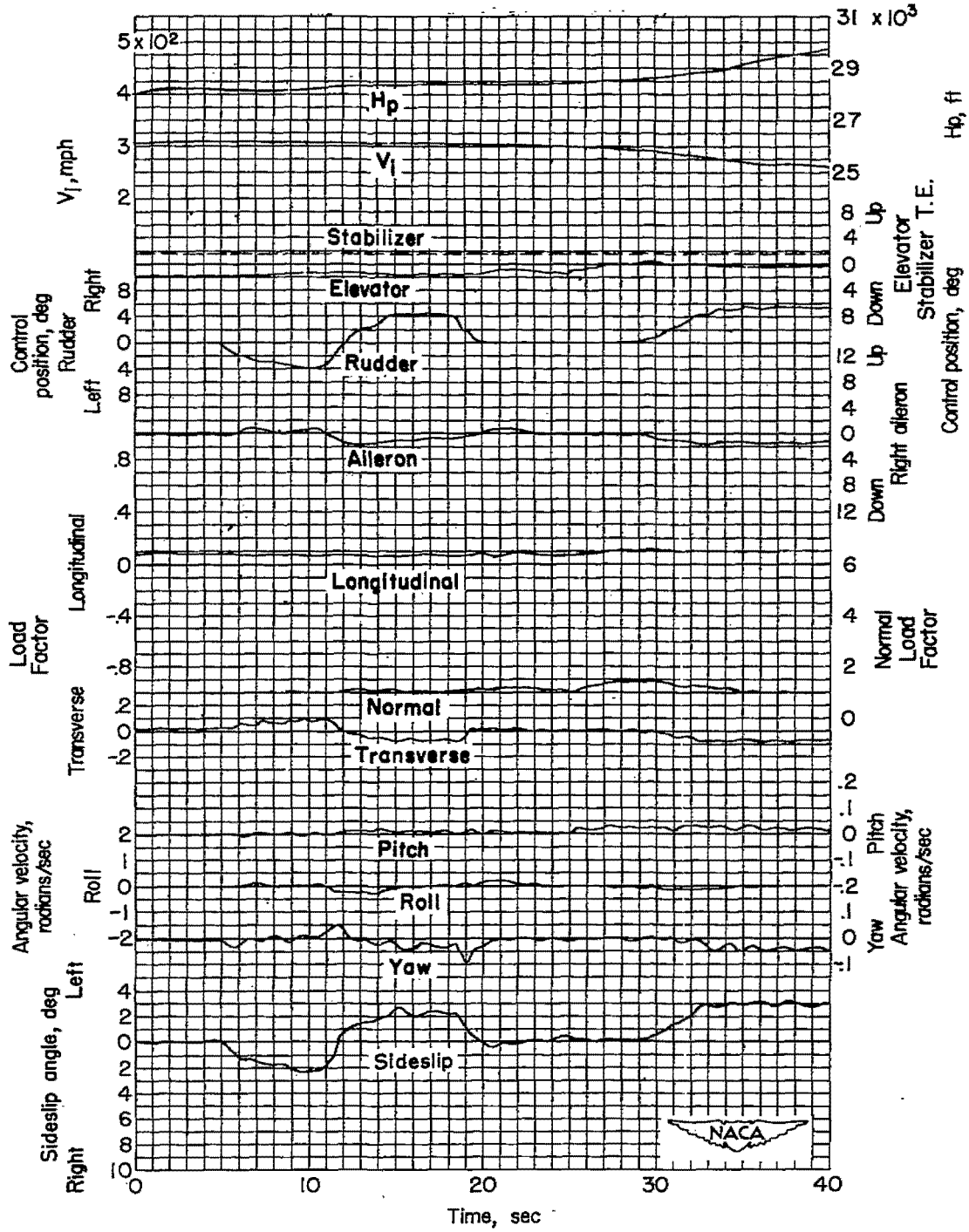


Figure 206.- Left and right sideslips. Airplane weight, 13,700 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

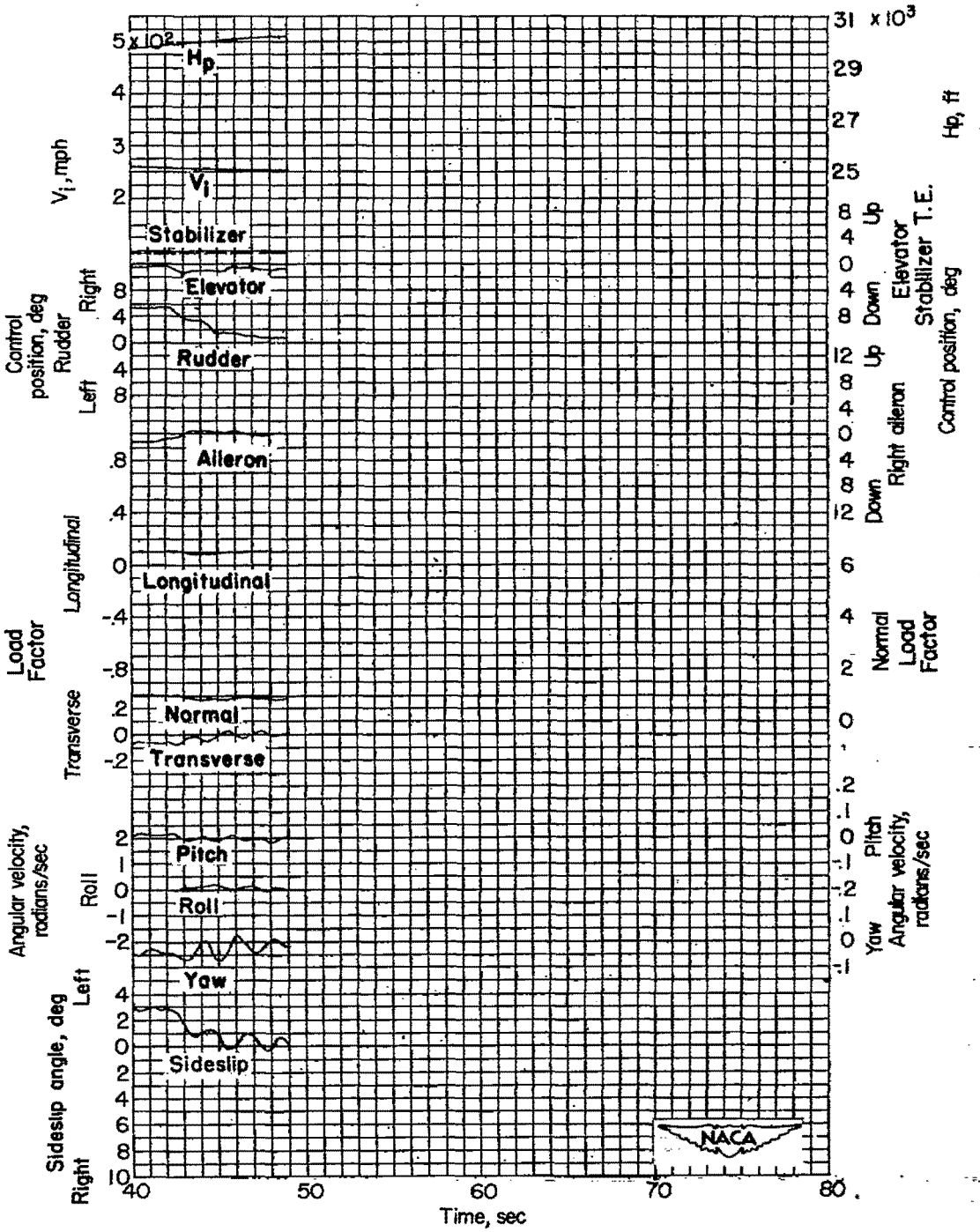


Figure 206.- Concluded.

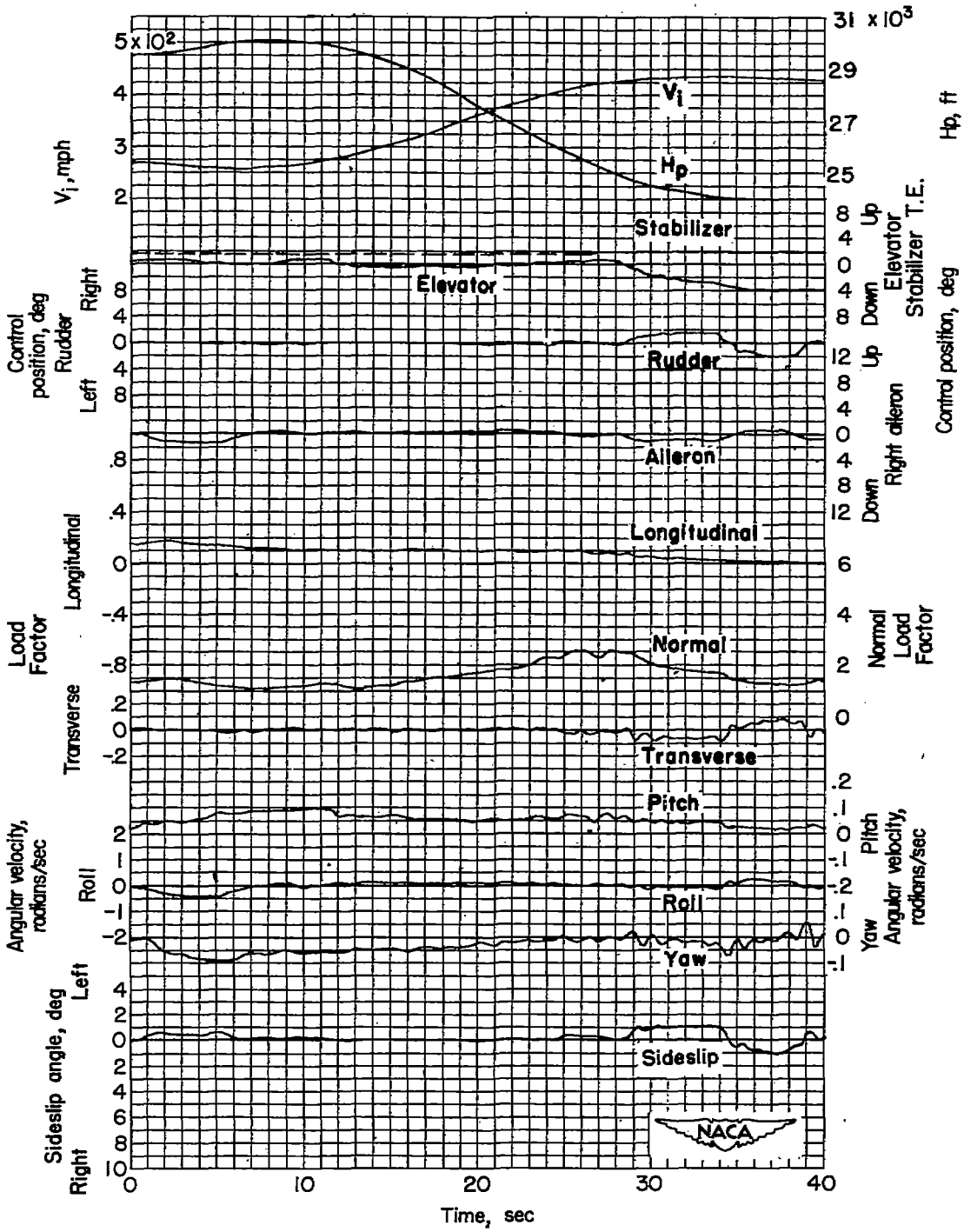


Figure 207.- Left diving turn, steady left and right sideslips followed by a right climbing turn. Airplane weight, 13,600 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

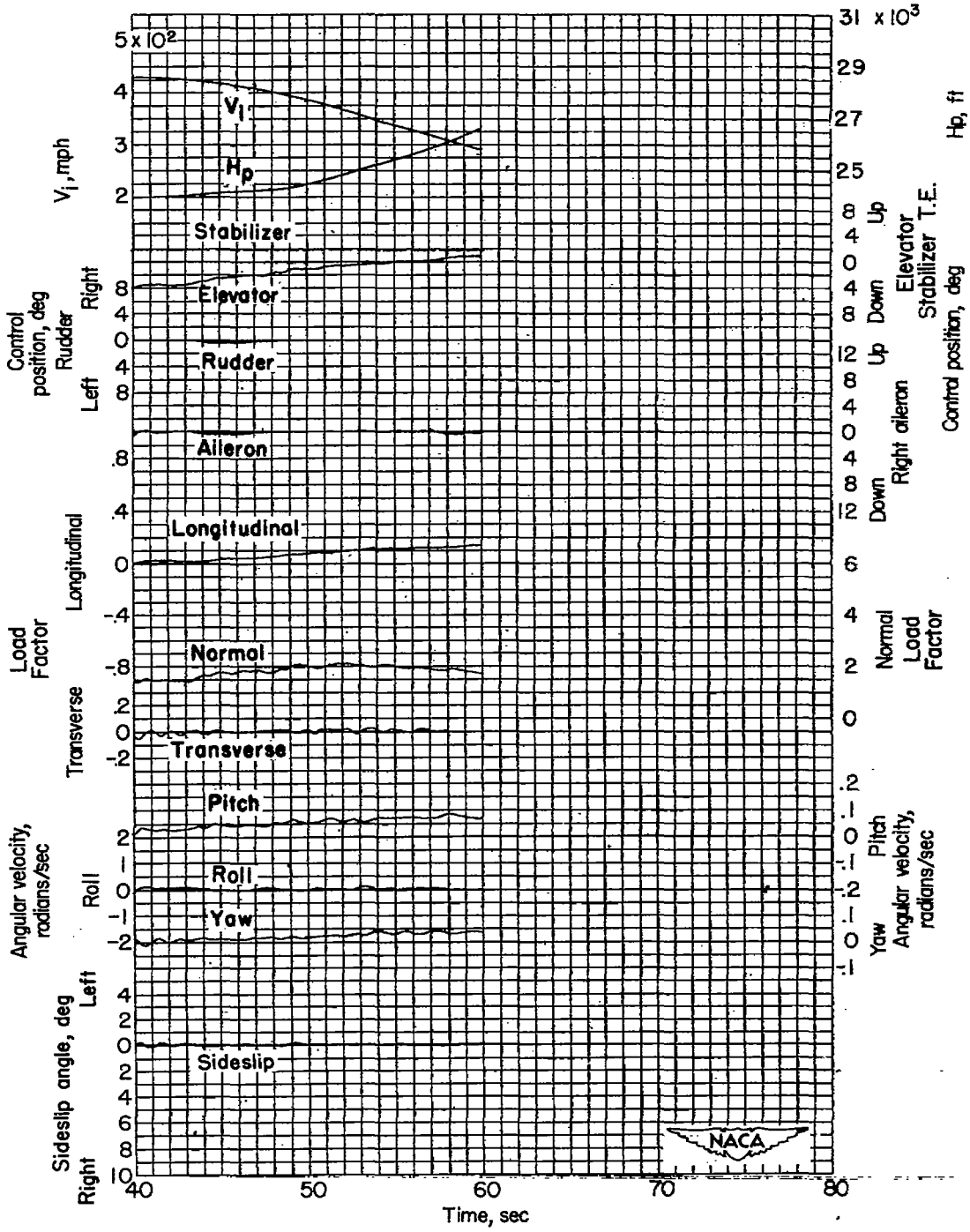


Figure 207.- Concluded.

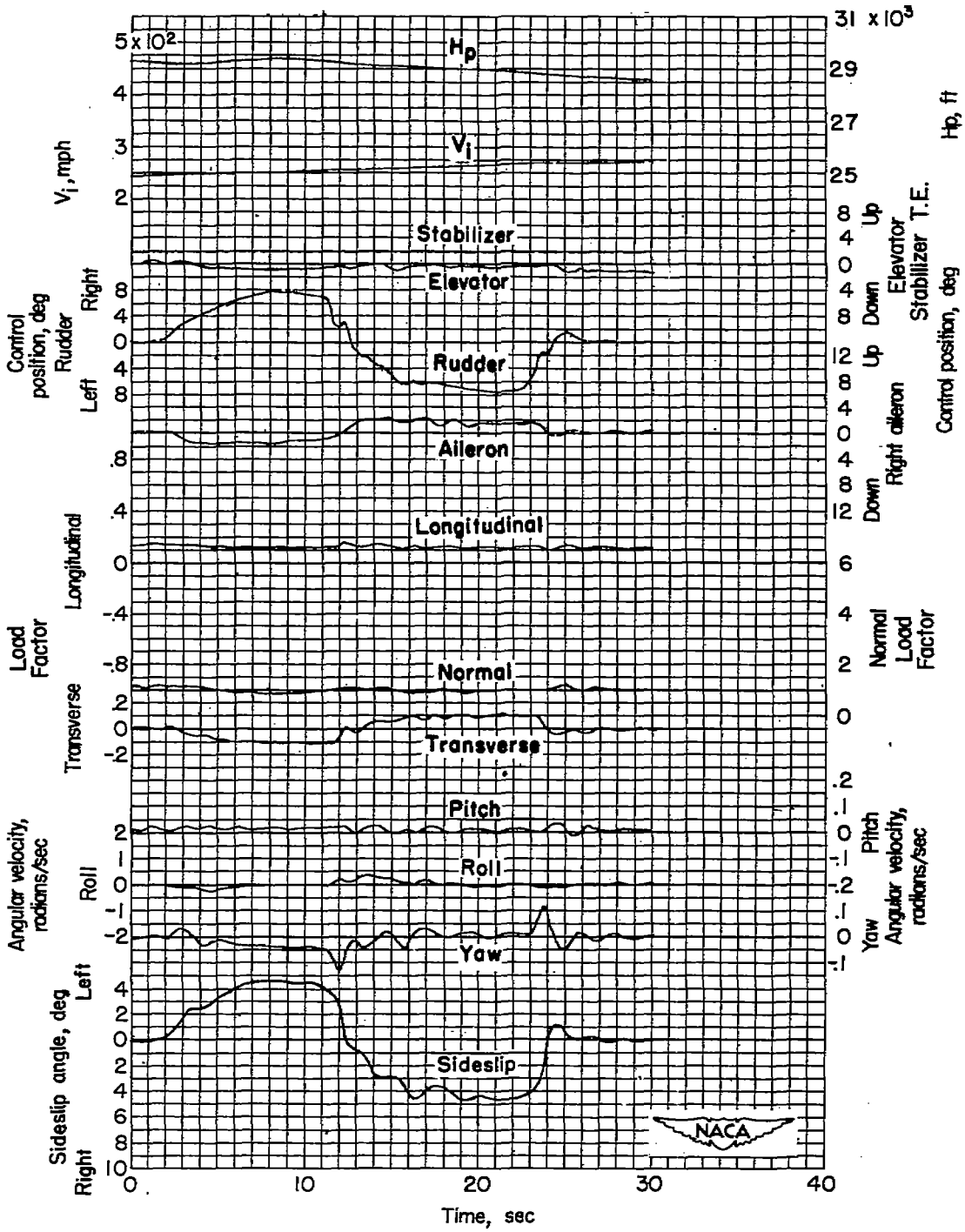


Figure 208.- Left and right sideslips. Airplane weight, 13,550 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

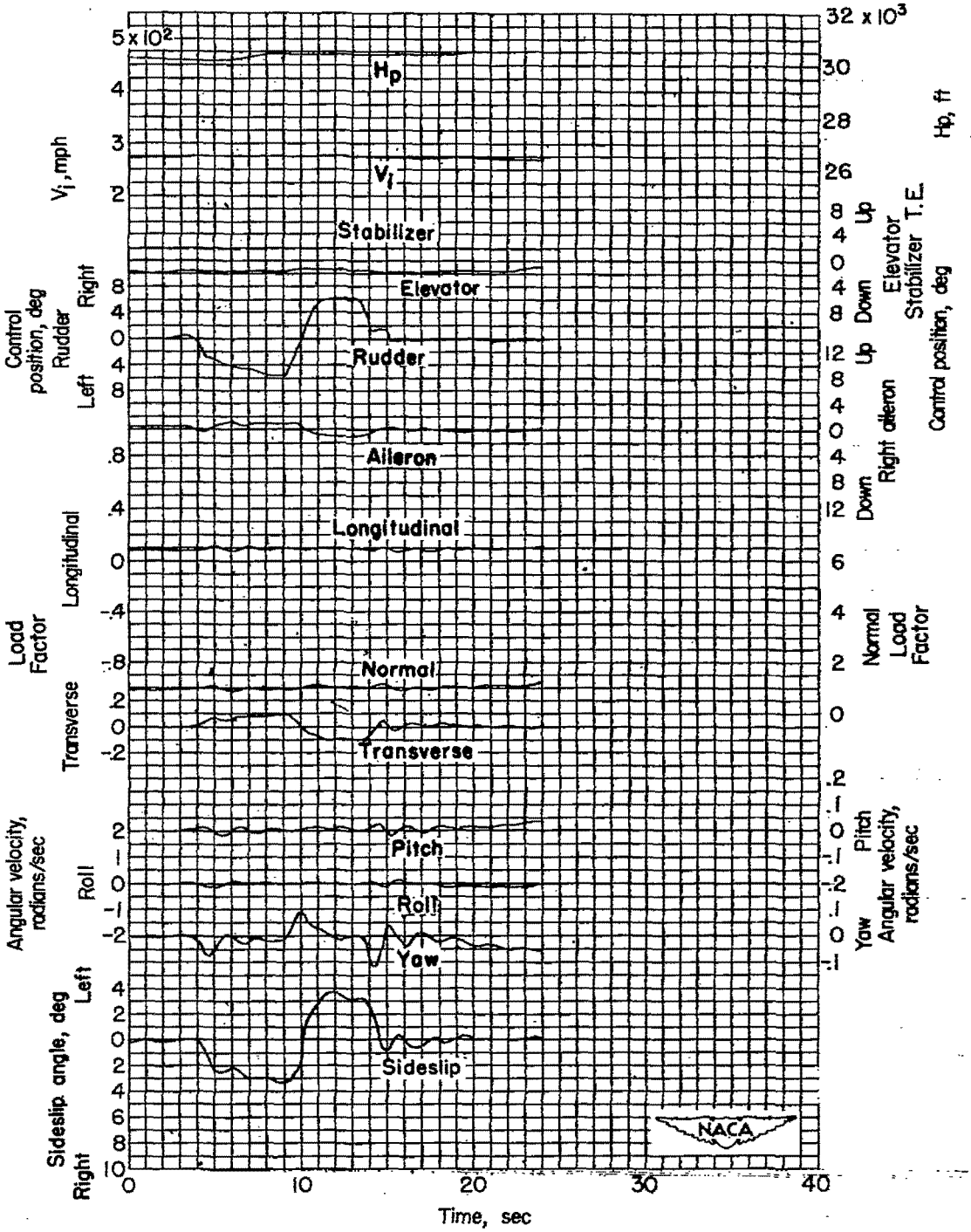


Figure 209.- Right and left sideslips. Airplane weight, 13,350 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

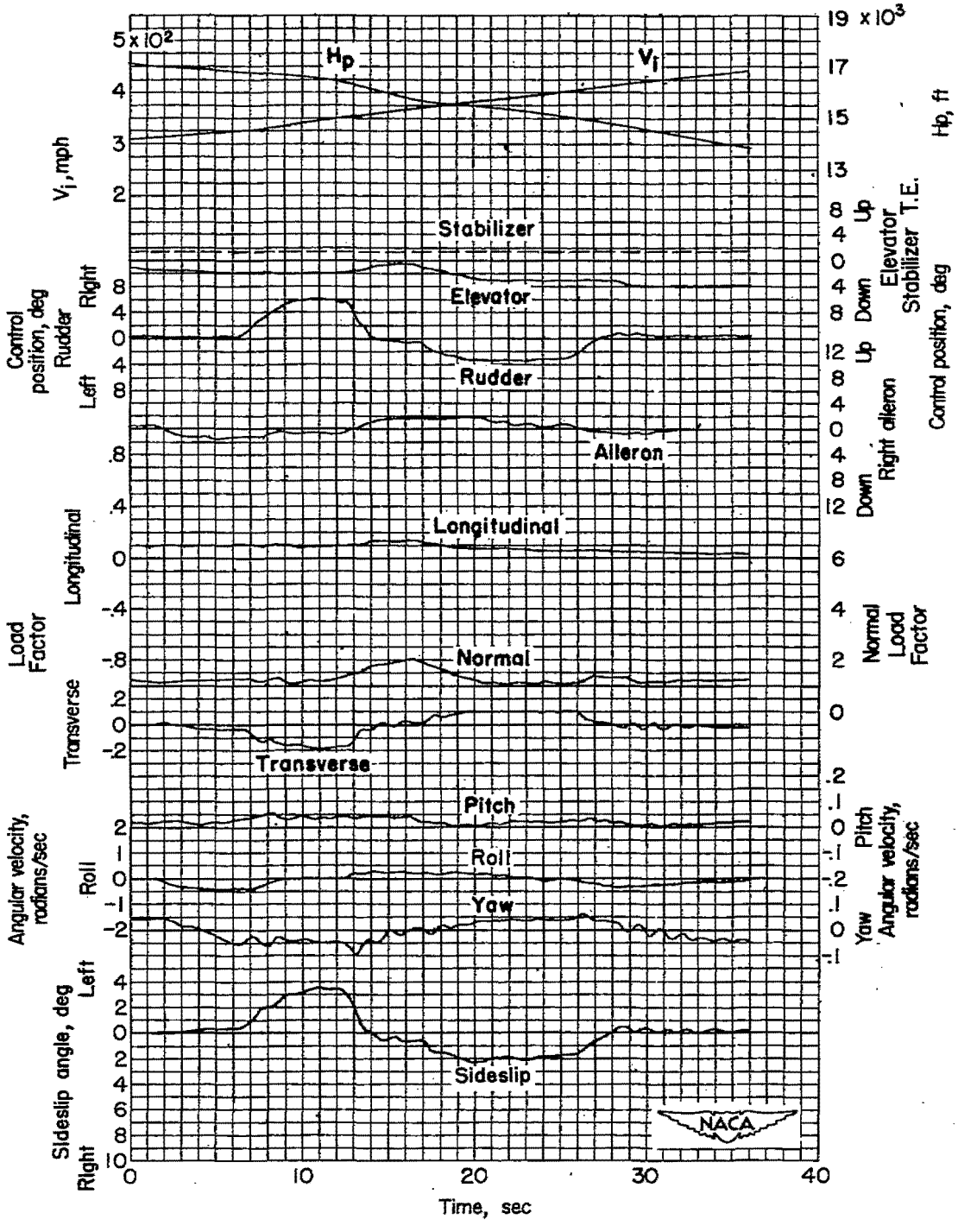


Figure 210.- Left and right sideslips. Airplane weight, 12,350 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

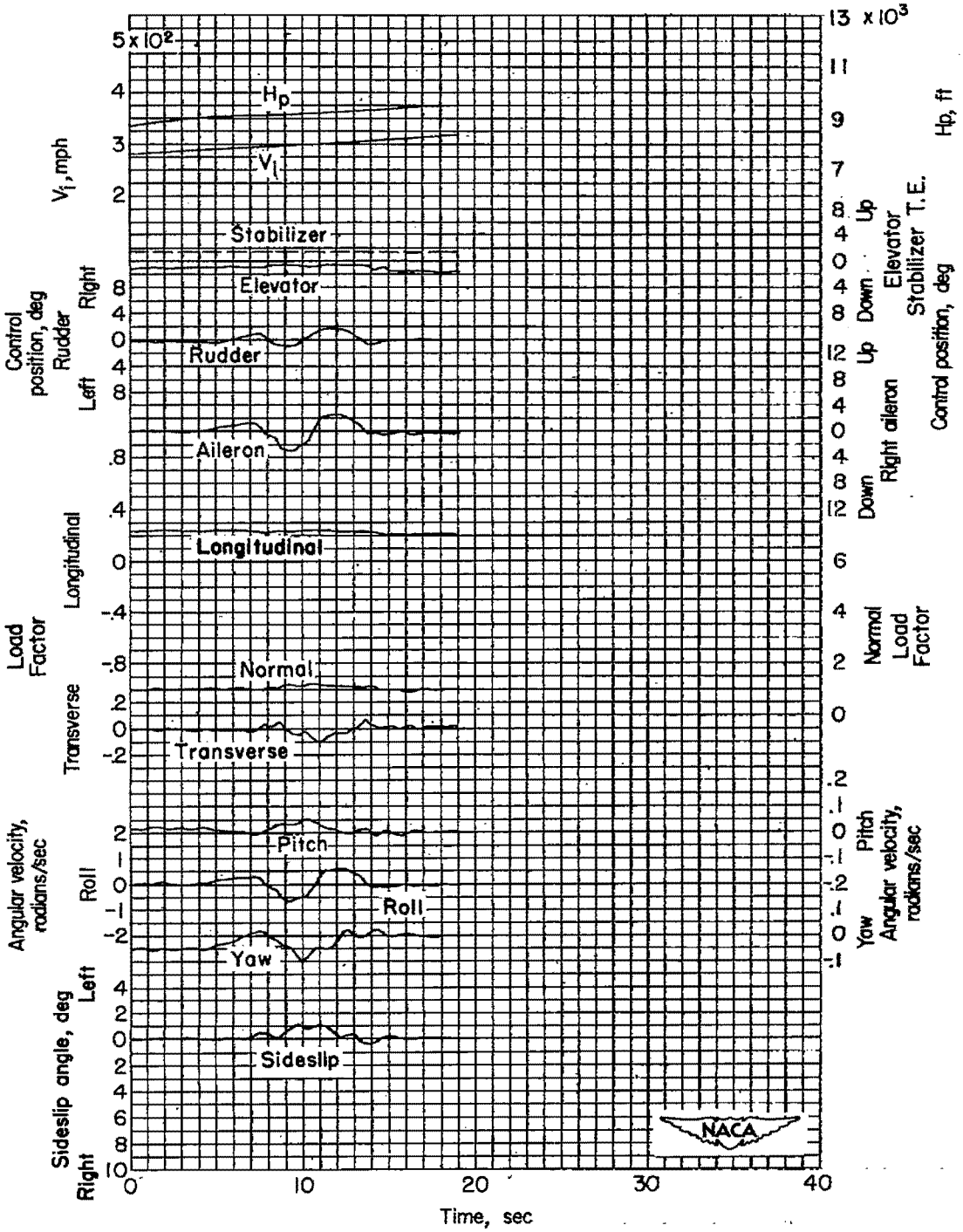


Figure 211.- Left and right sideslips. Airplane weight, 14,050 pounds; center-of-gravity location, 20.8 percent of the mean aerodynamic chord.

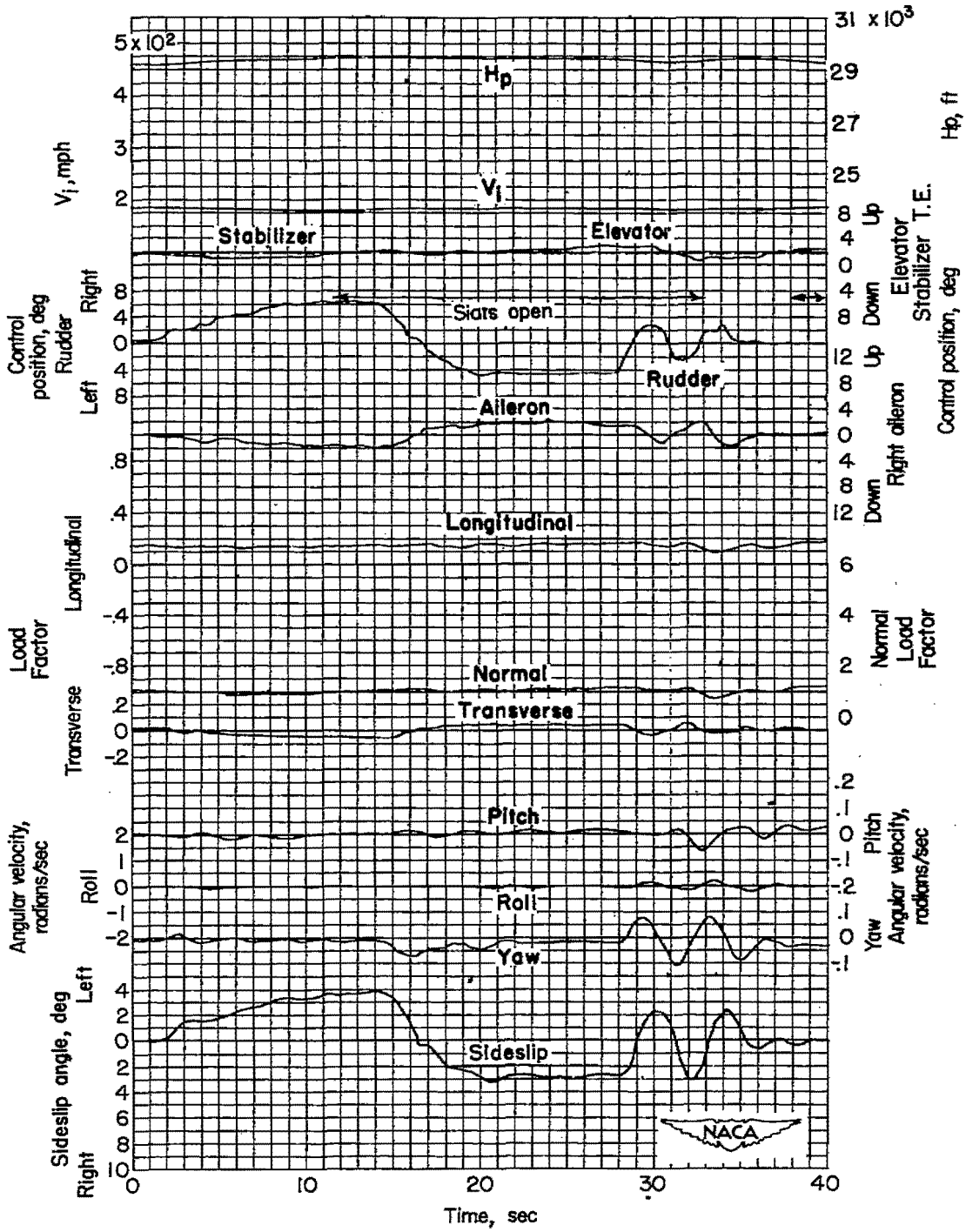


Figure 212.- Left and right sideslips followed by fishtails. Airplane weight, 13,100 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

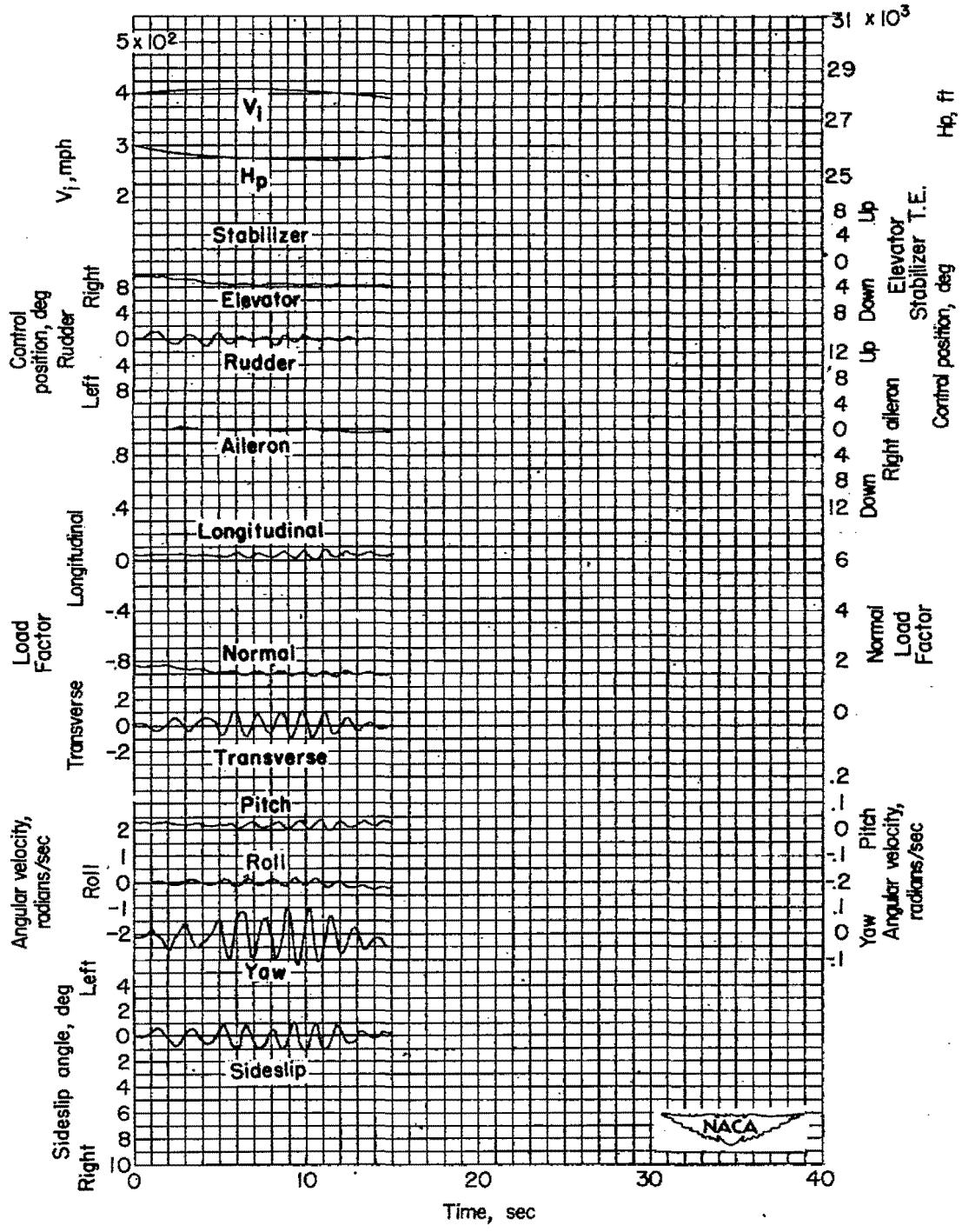


Figure 213.- Fishtails. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

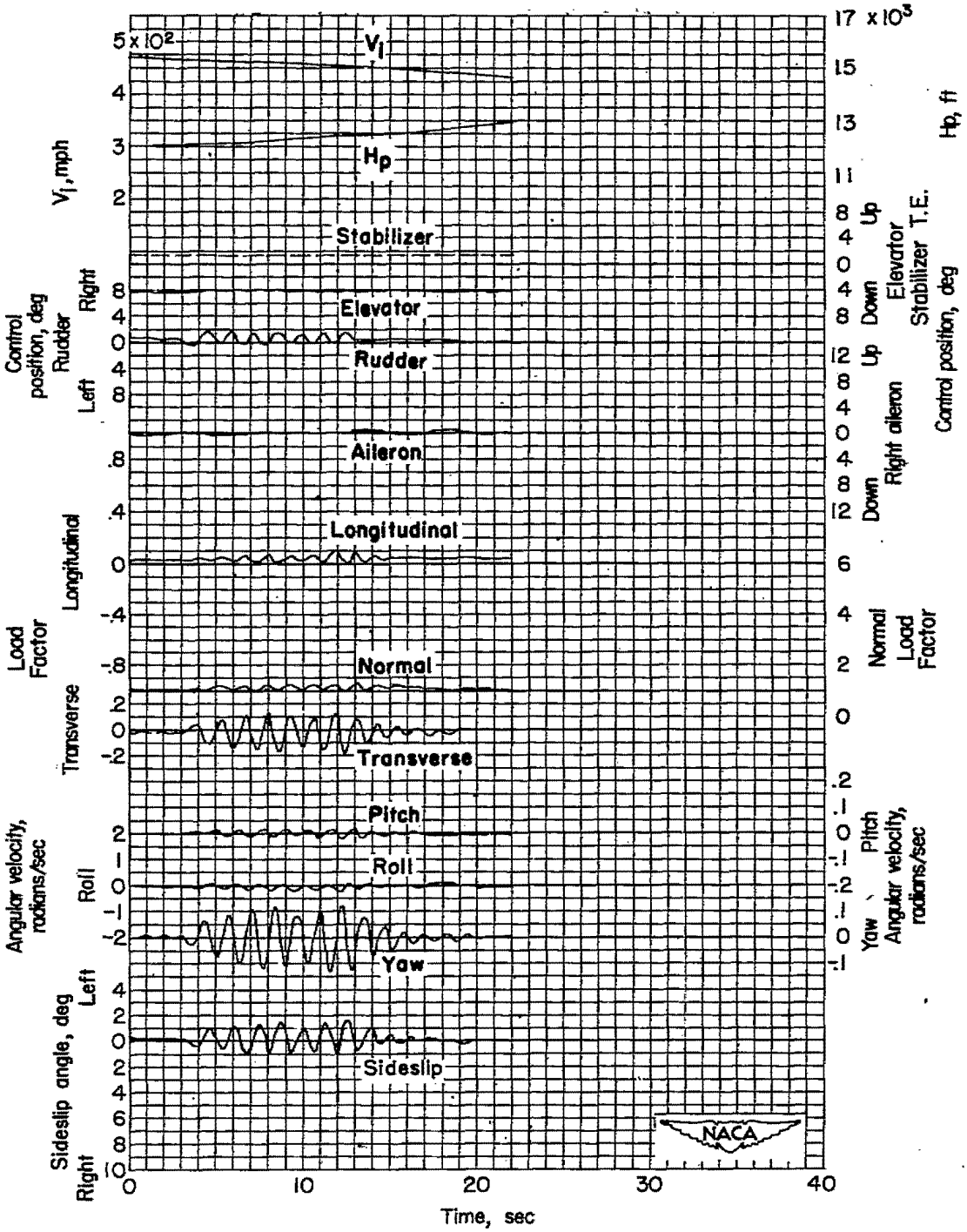


Figure 214.- Fishtails. Airplane weight, 12,300 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

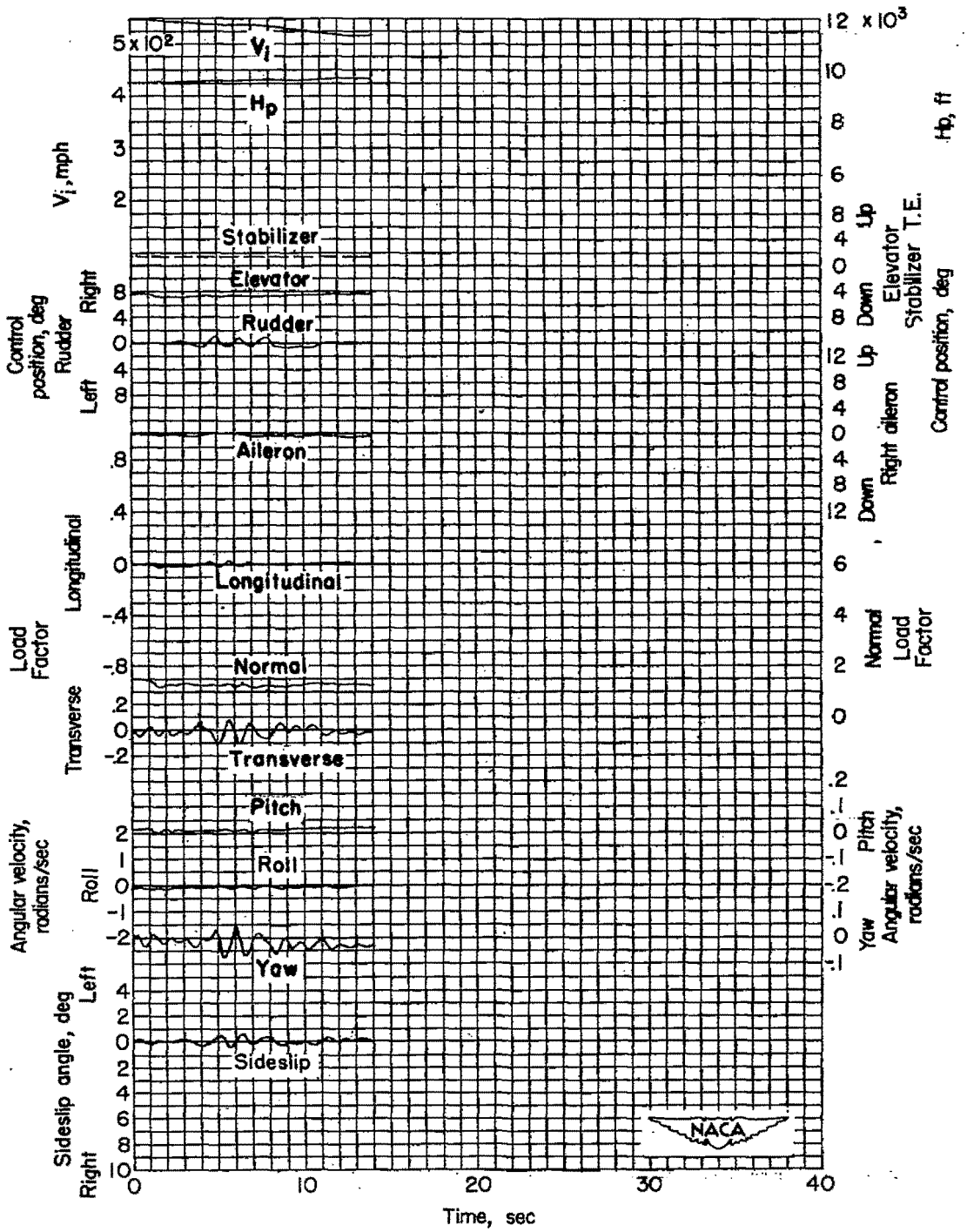


Figure 215.- Fishtails. Airplane weight, 12,250 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

[redacted]

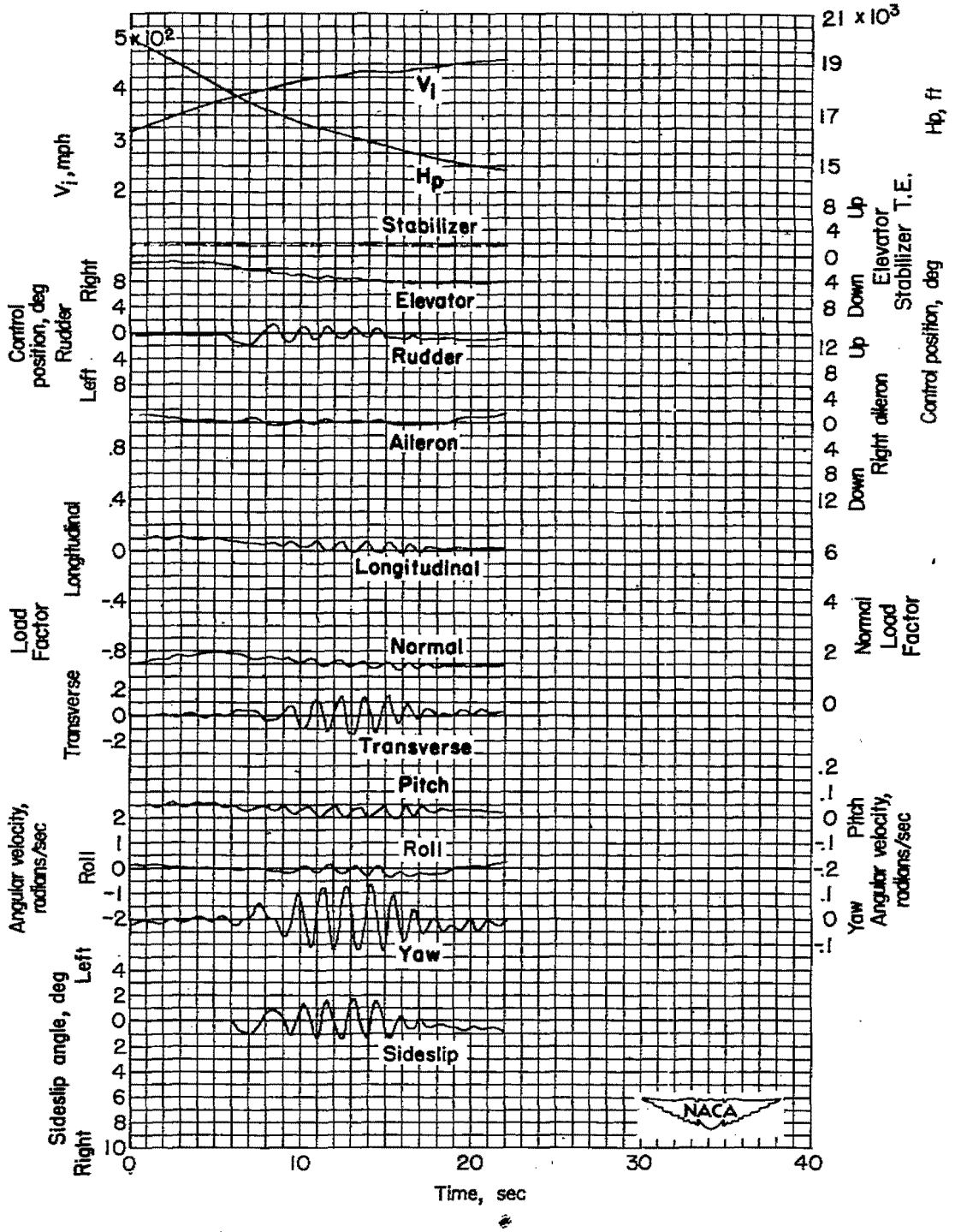


Figure 216.- Fishtails in a steep dive. Airplane weight, 12,600 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

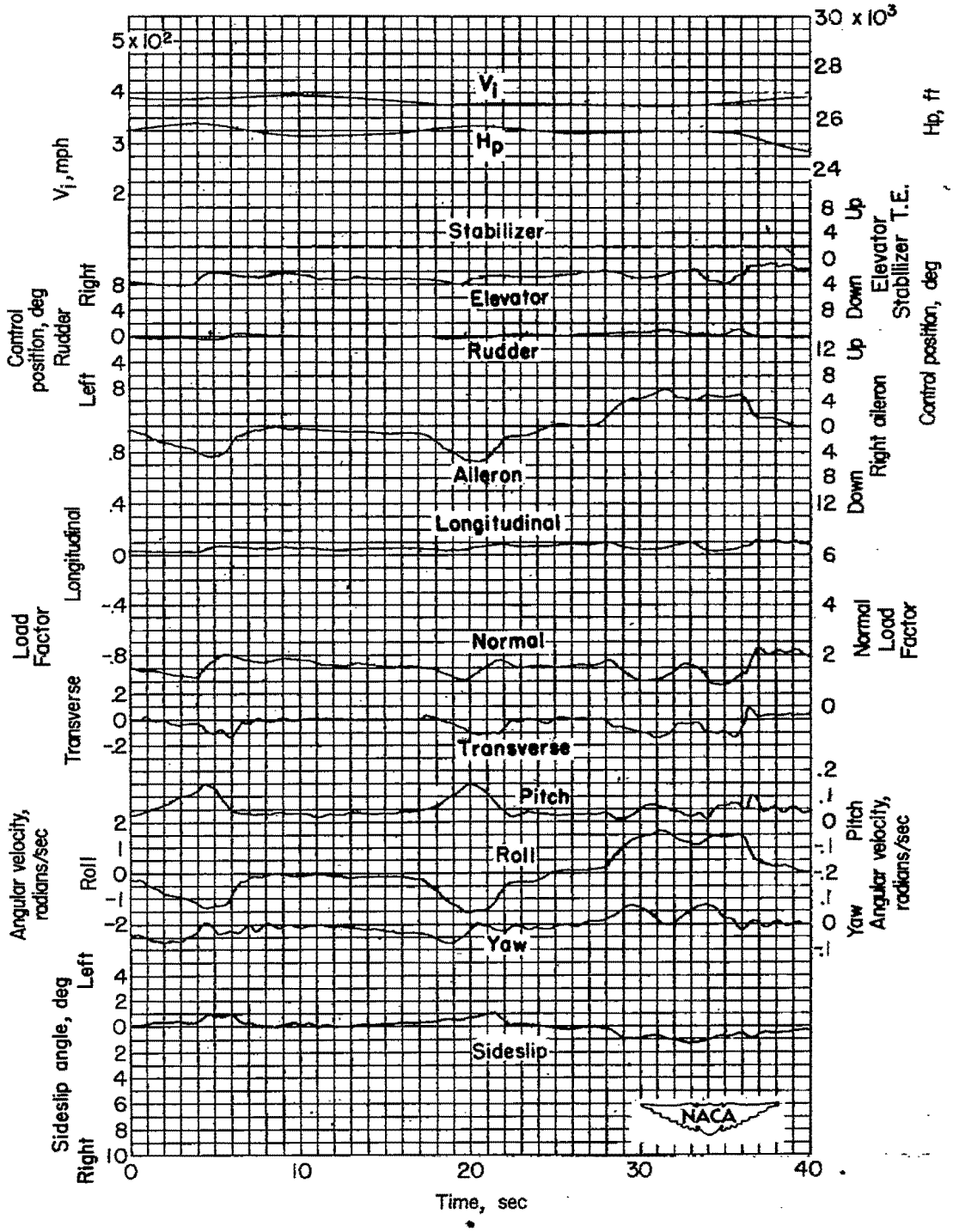


Figure 217.- Left and right barrel rolls. Airplane weight, 13,300 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

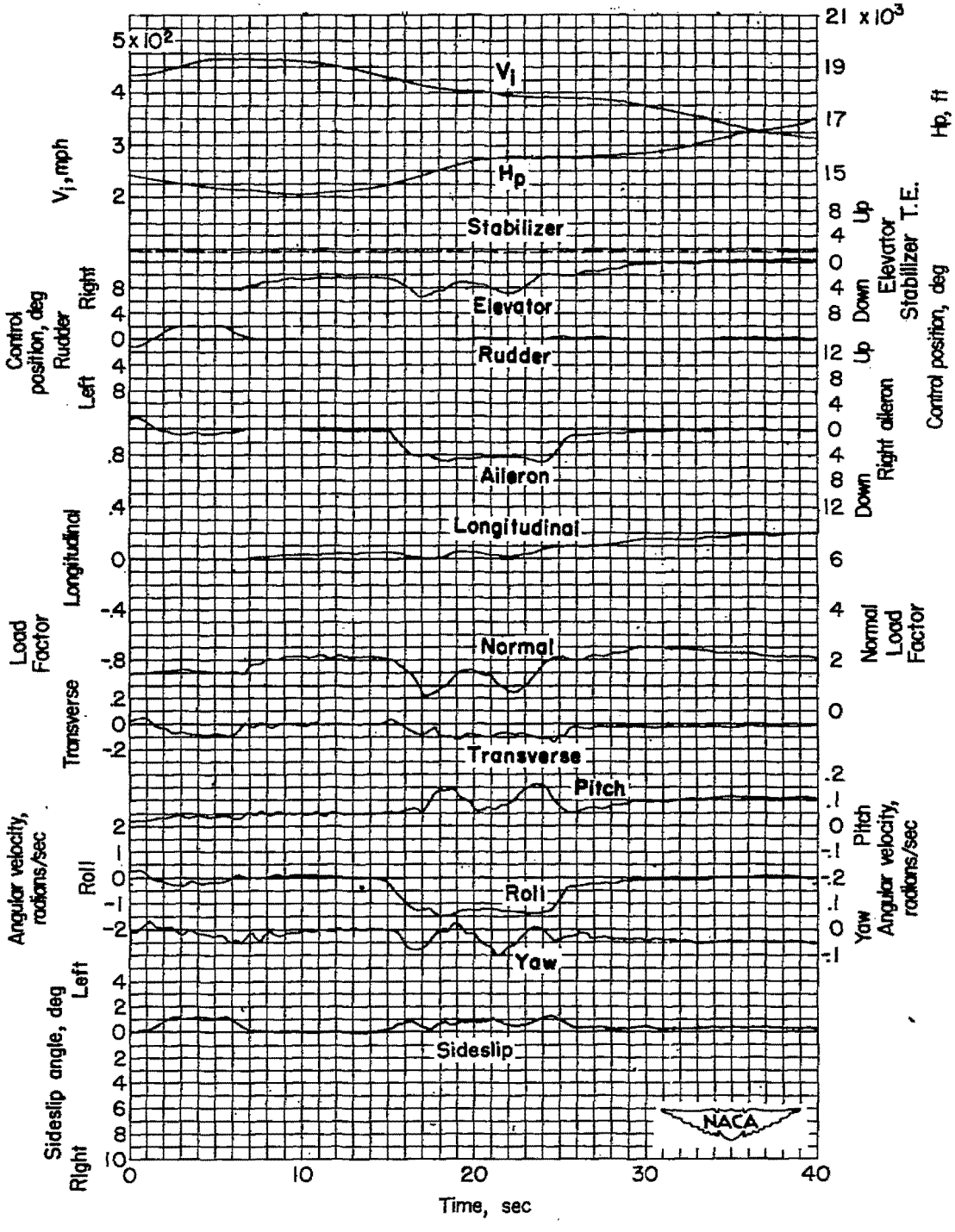


Figure 218.- Left barrel rolls. Airplane weight, 12,600 pounds; center-of-gravity location, 21.1 percent of the mean aerodynamic chord.

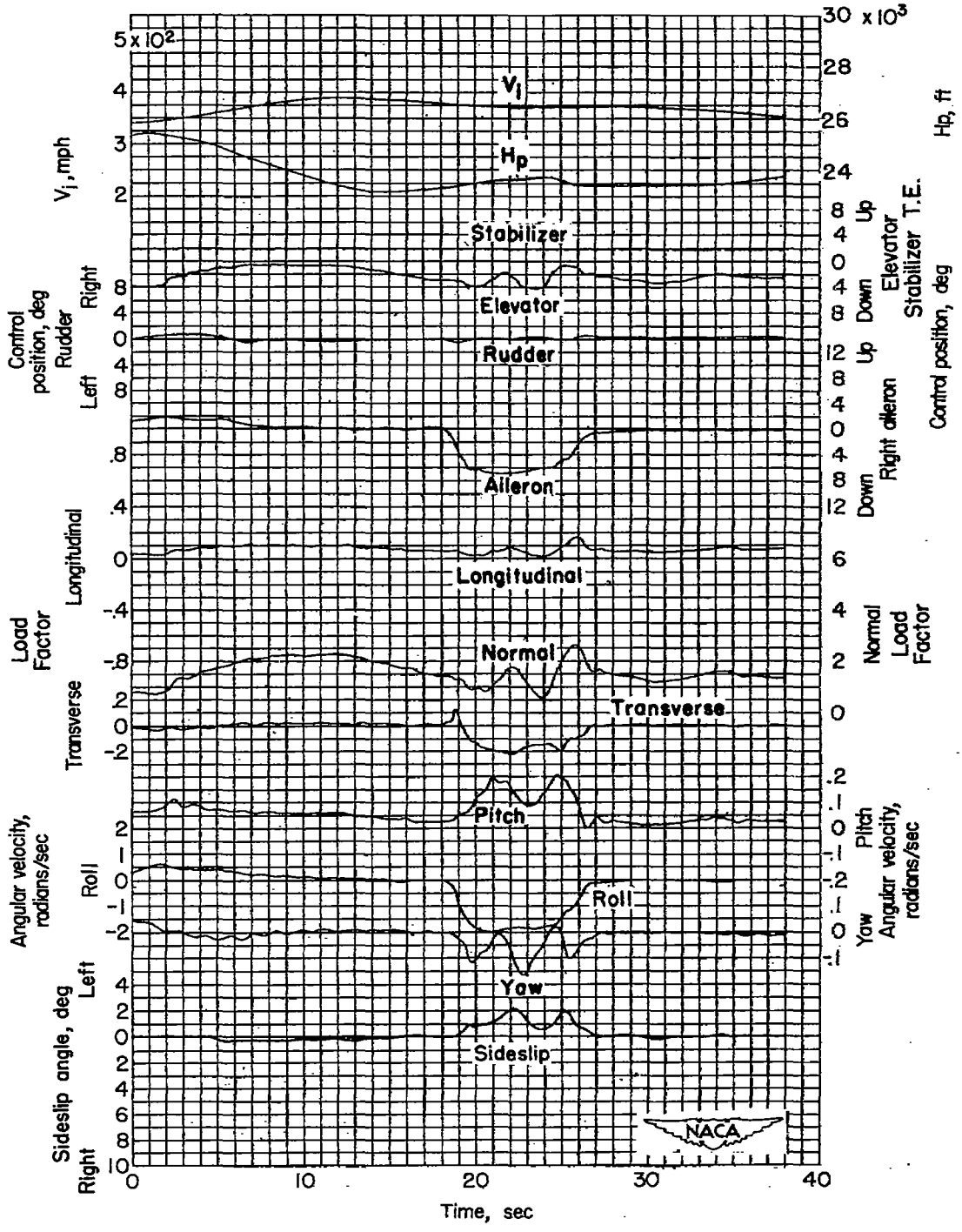


Figure 219.- Roll entry into a dive, pull-out, and left barrel roll. Airplane weight, 13,250 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

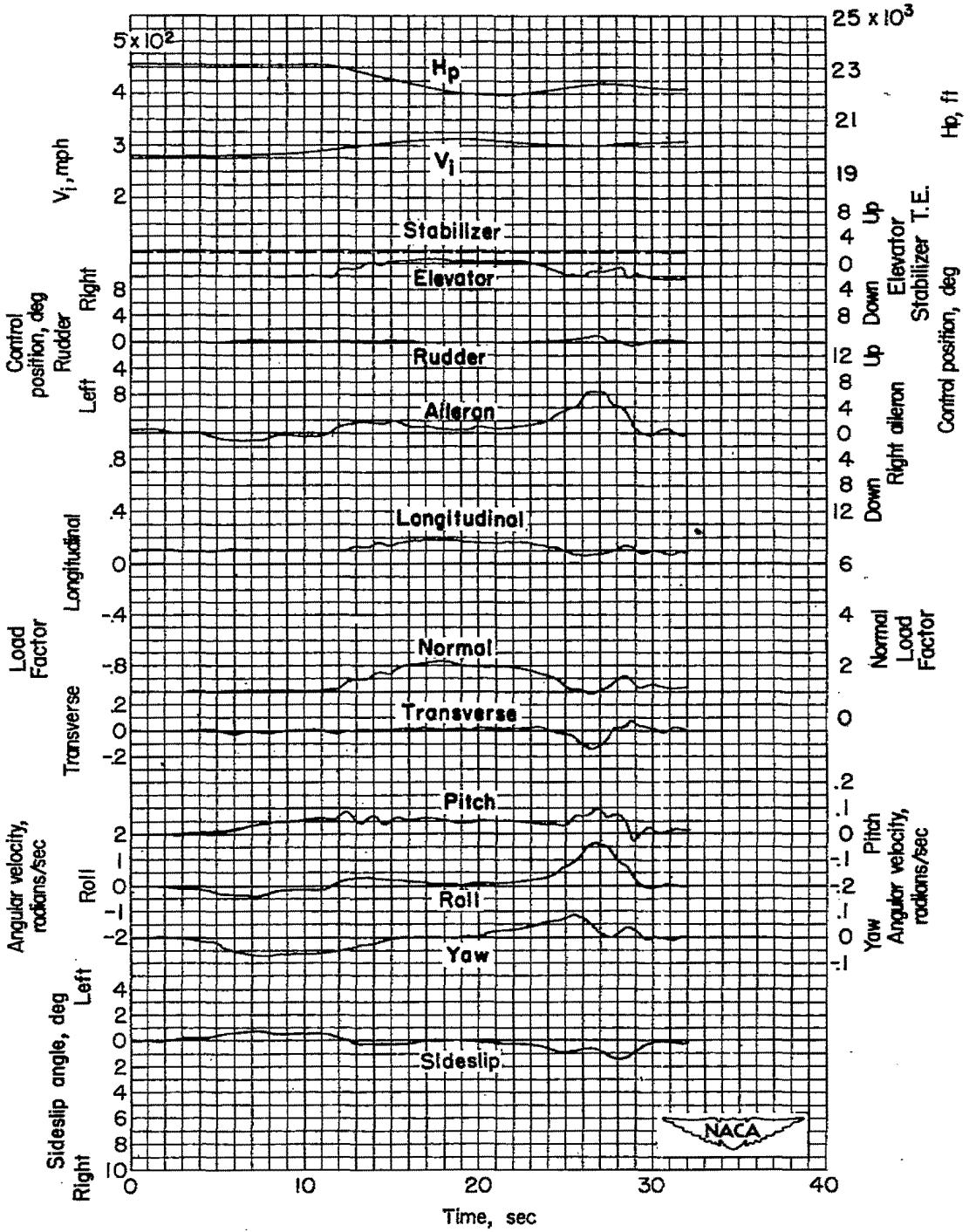


Figure 220.- Left diving turn and pull-up followed by a right barrel roll. Airplane weight, 12,850 pounds; center-of-gravity location, 21.0 pounds cent of the mean aerodynamic chord.

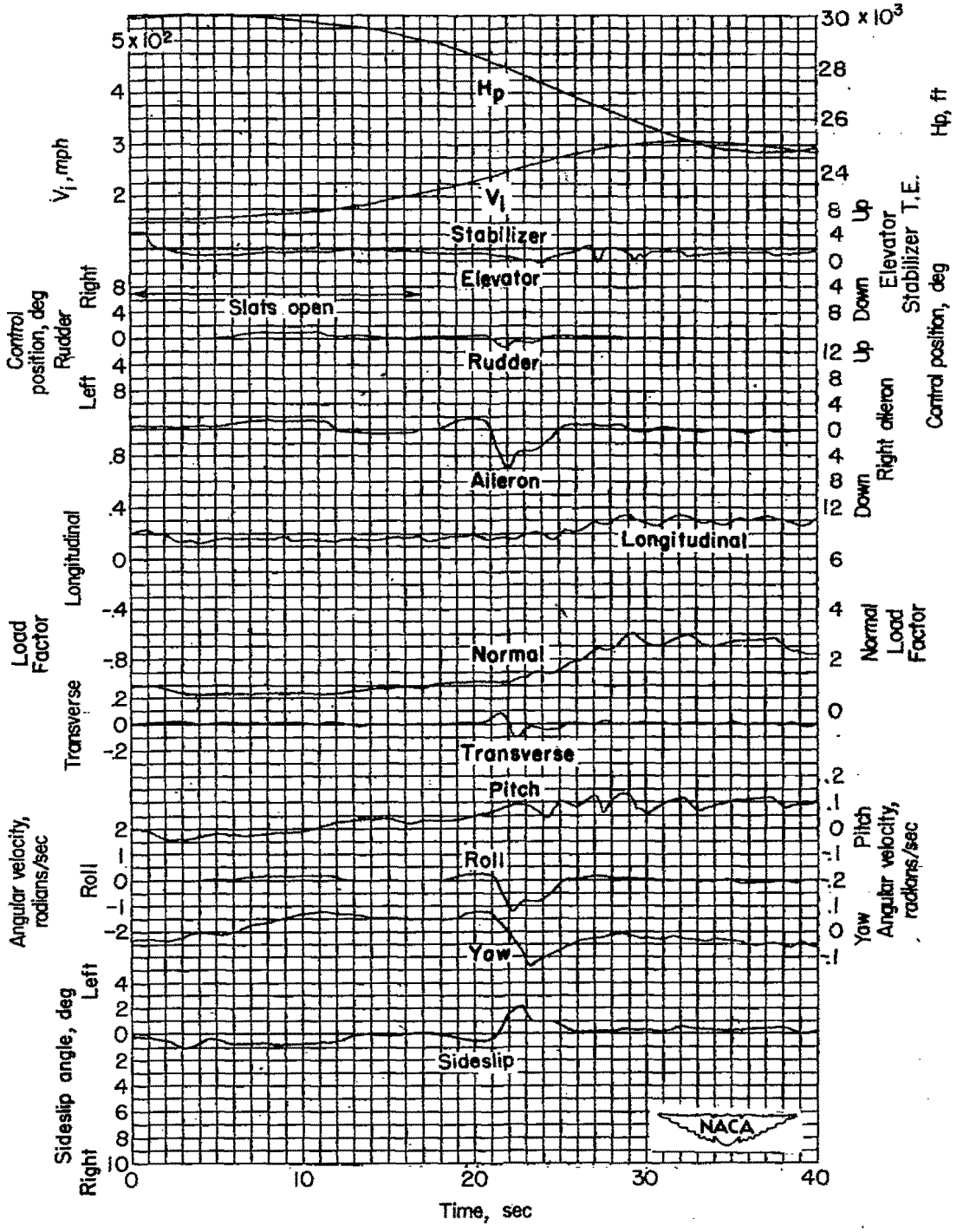


Figure 221.- Right and left diving turns followed by a left climbing turn. Airplane weight, 13,050 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

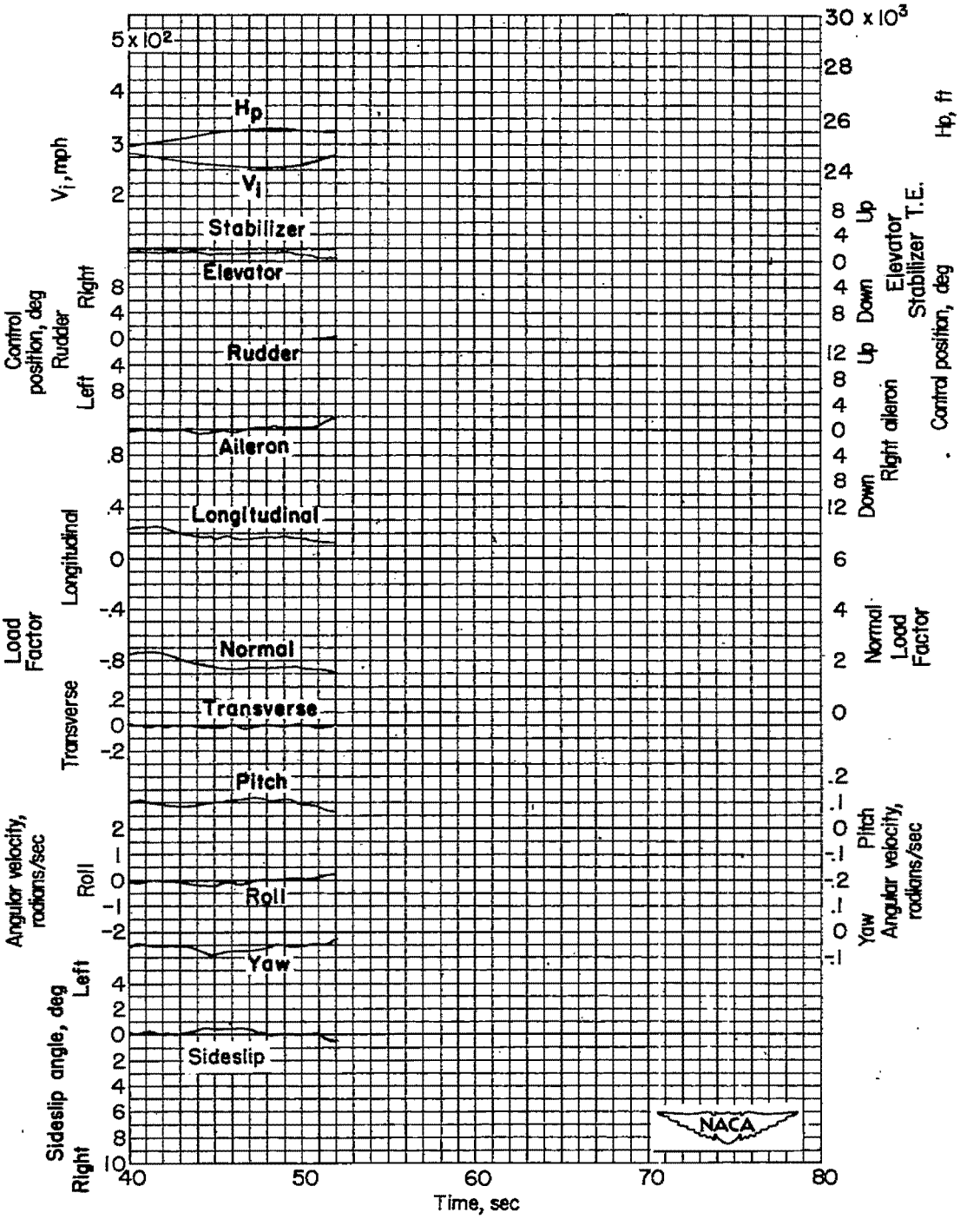


Figure 221.- Concluded.

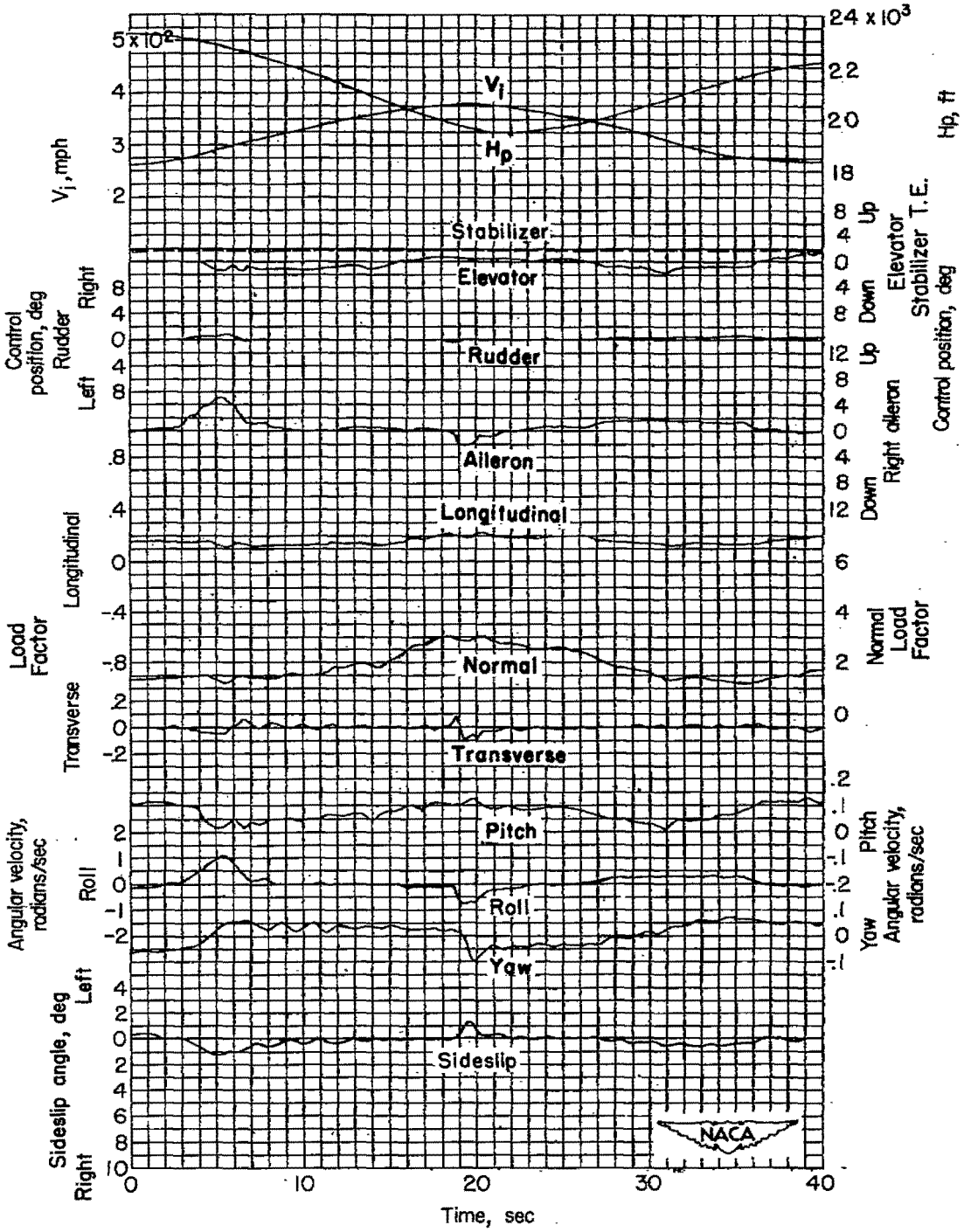


Figure 222.- Right and left diving and climbing turns. Airplane weight, 12,800 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

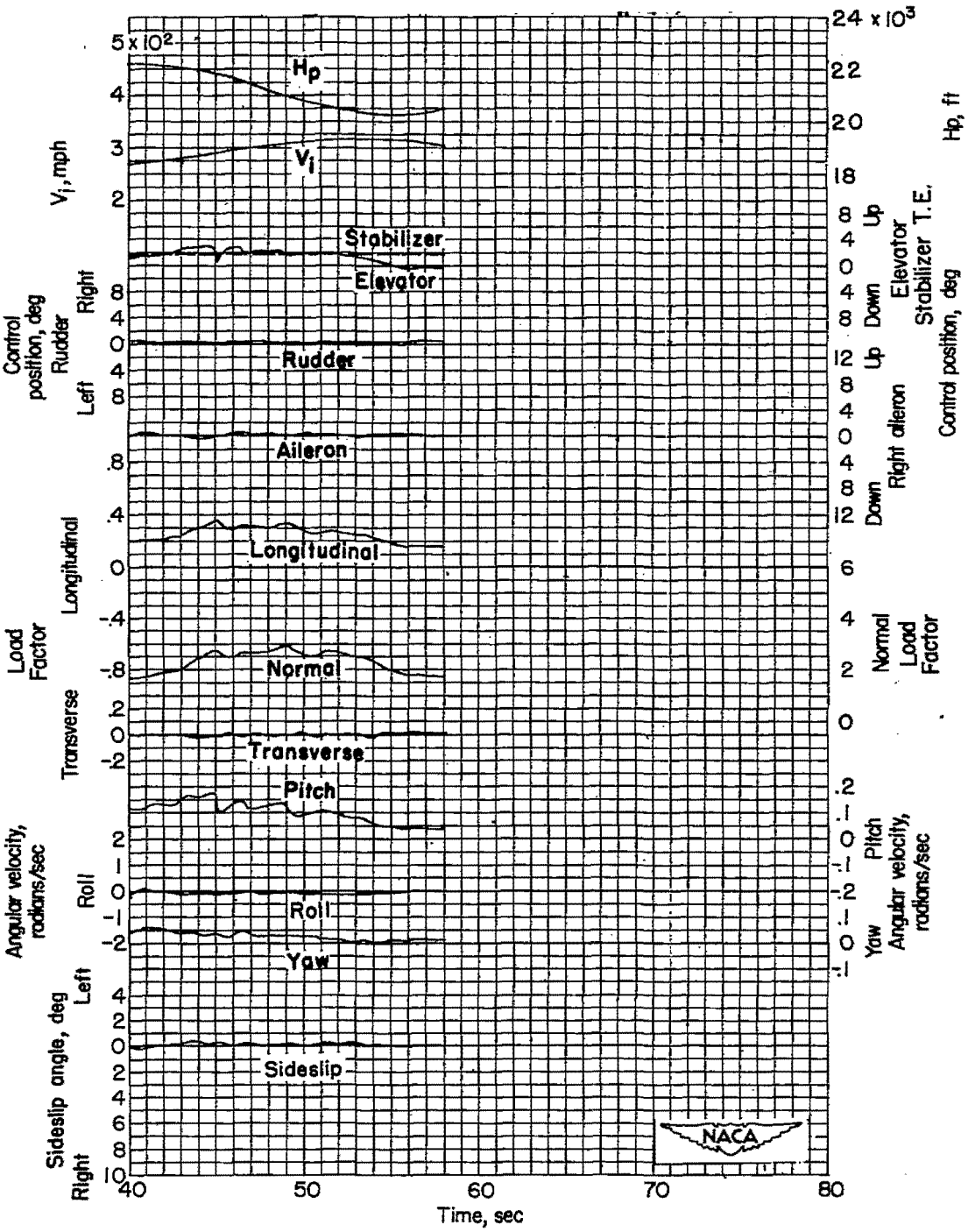


Figure 222.- Concluded.

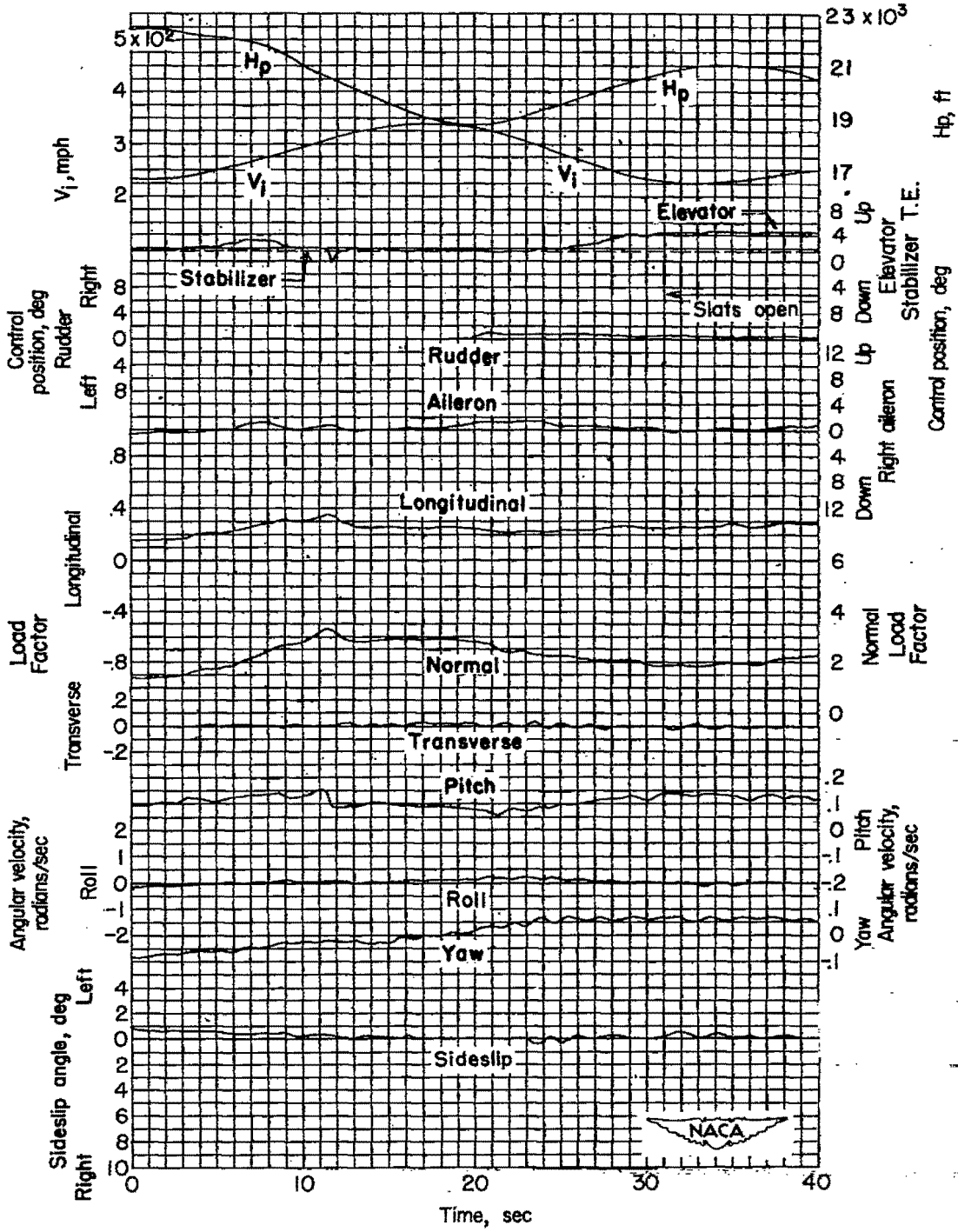


Figure 223.- Left diving turn followed by a right climbing and diving turn. Airplane weight, 12,700 pounds; center-of-gravity location, 21.0 percent of the mean aerodynamic chord.

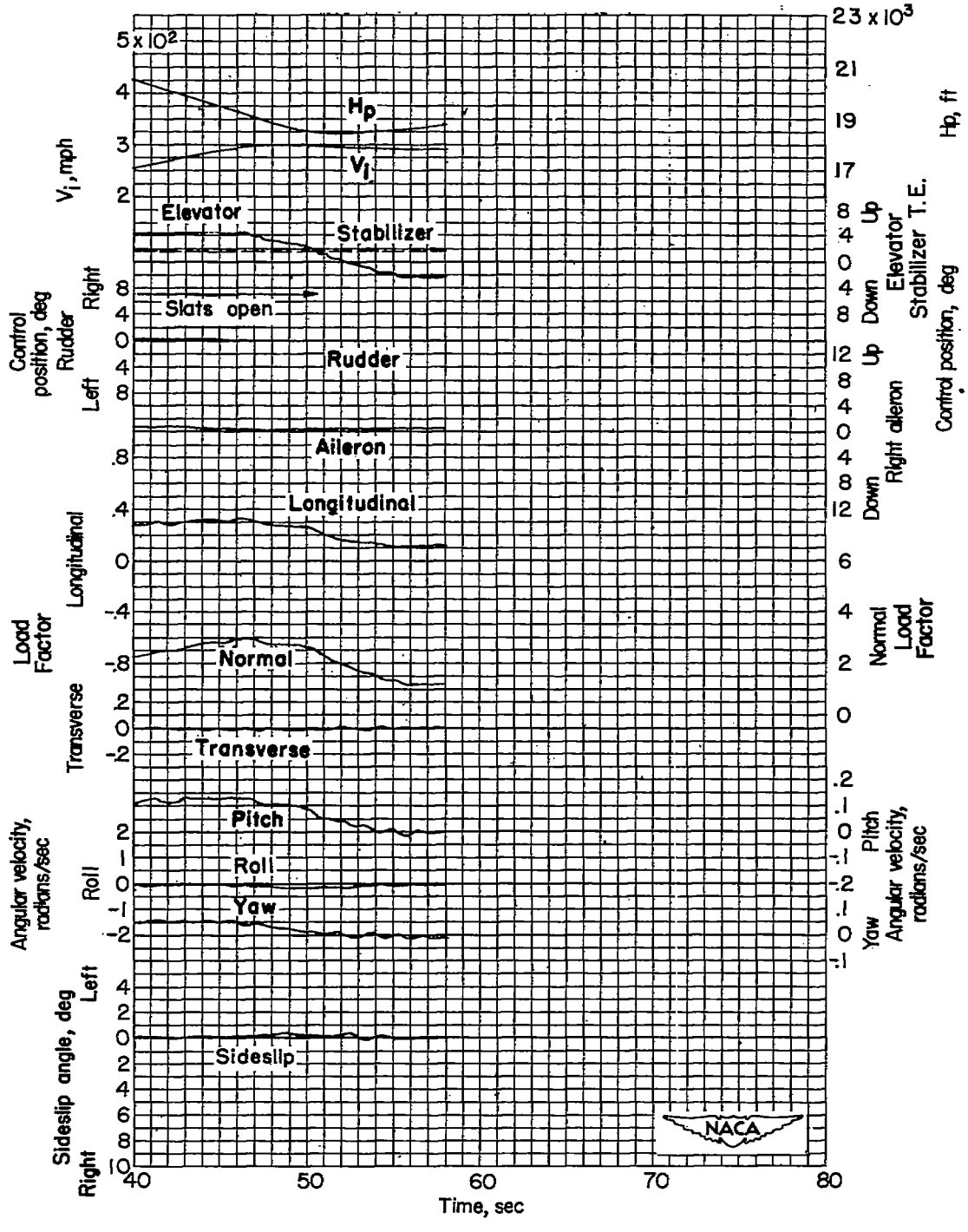


Figure 223.- Concluded.

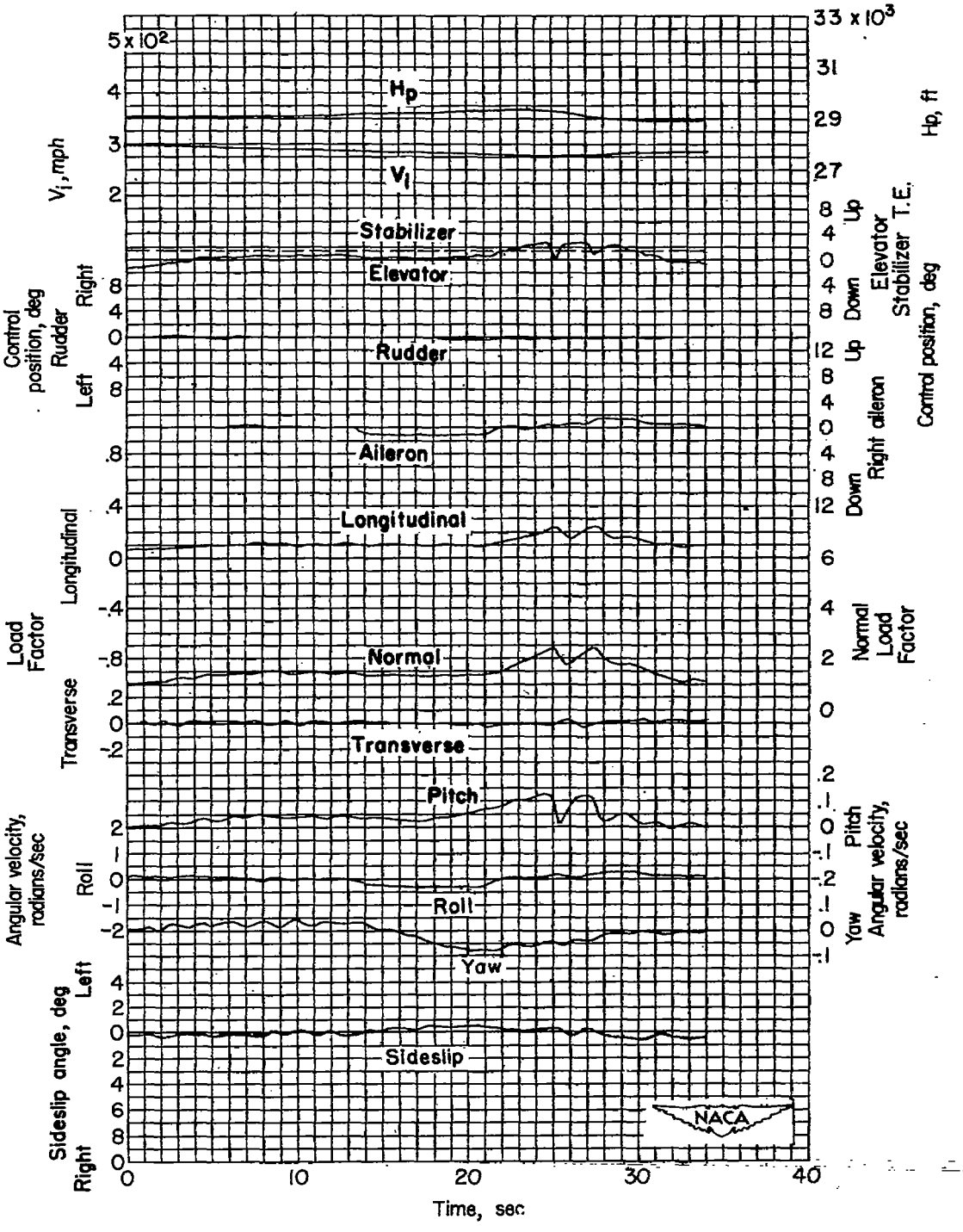


Figure 224.- Gentle right turn followed by a left turn. Airplane weight, 13,450 pounds; center-of-gravity location, 20.9 percent of the mean aerodynamic chord.

[redacted]

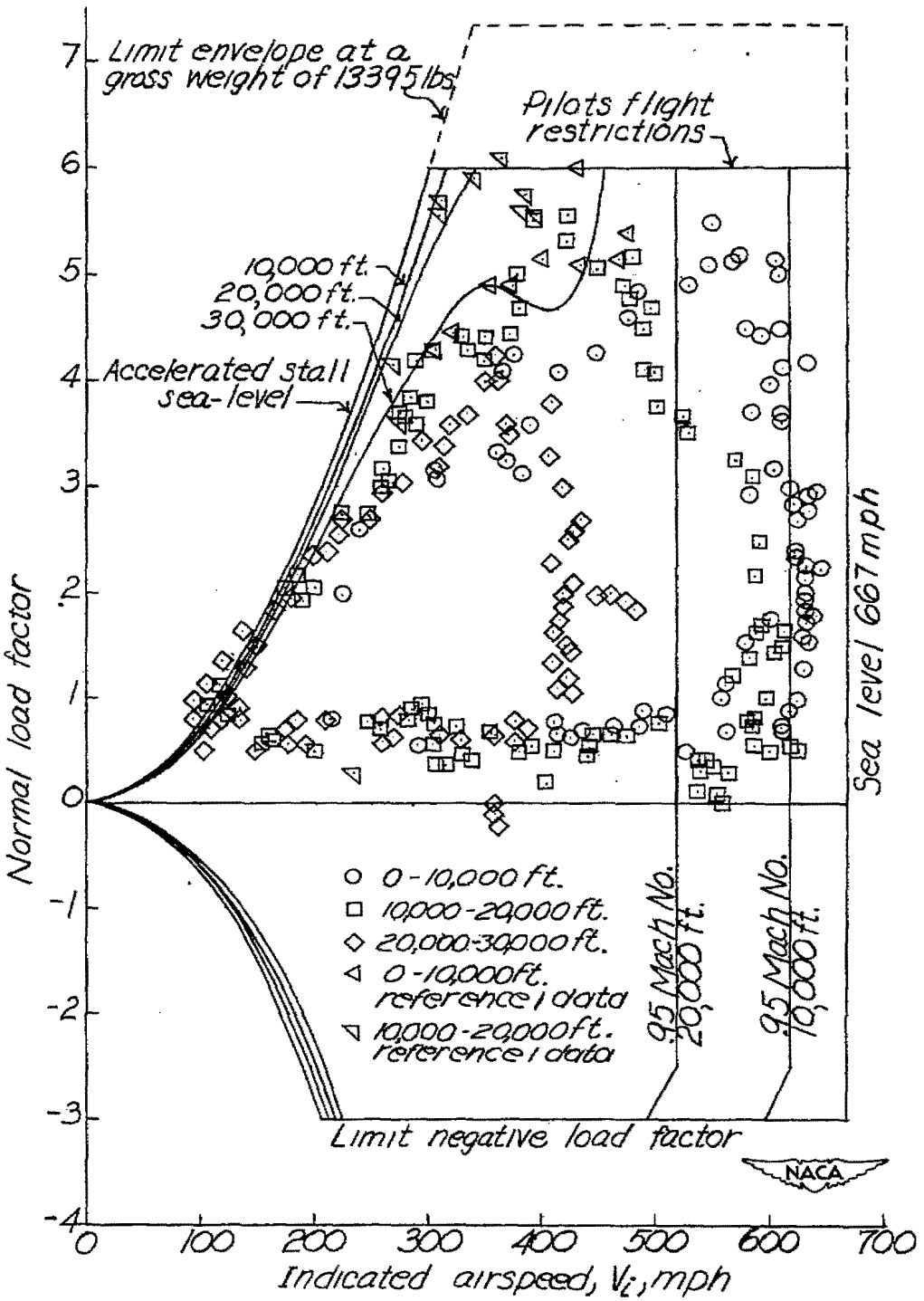


Figure 225.- Comparison of maximum measured normal load factors with the operational V-n diagram.

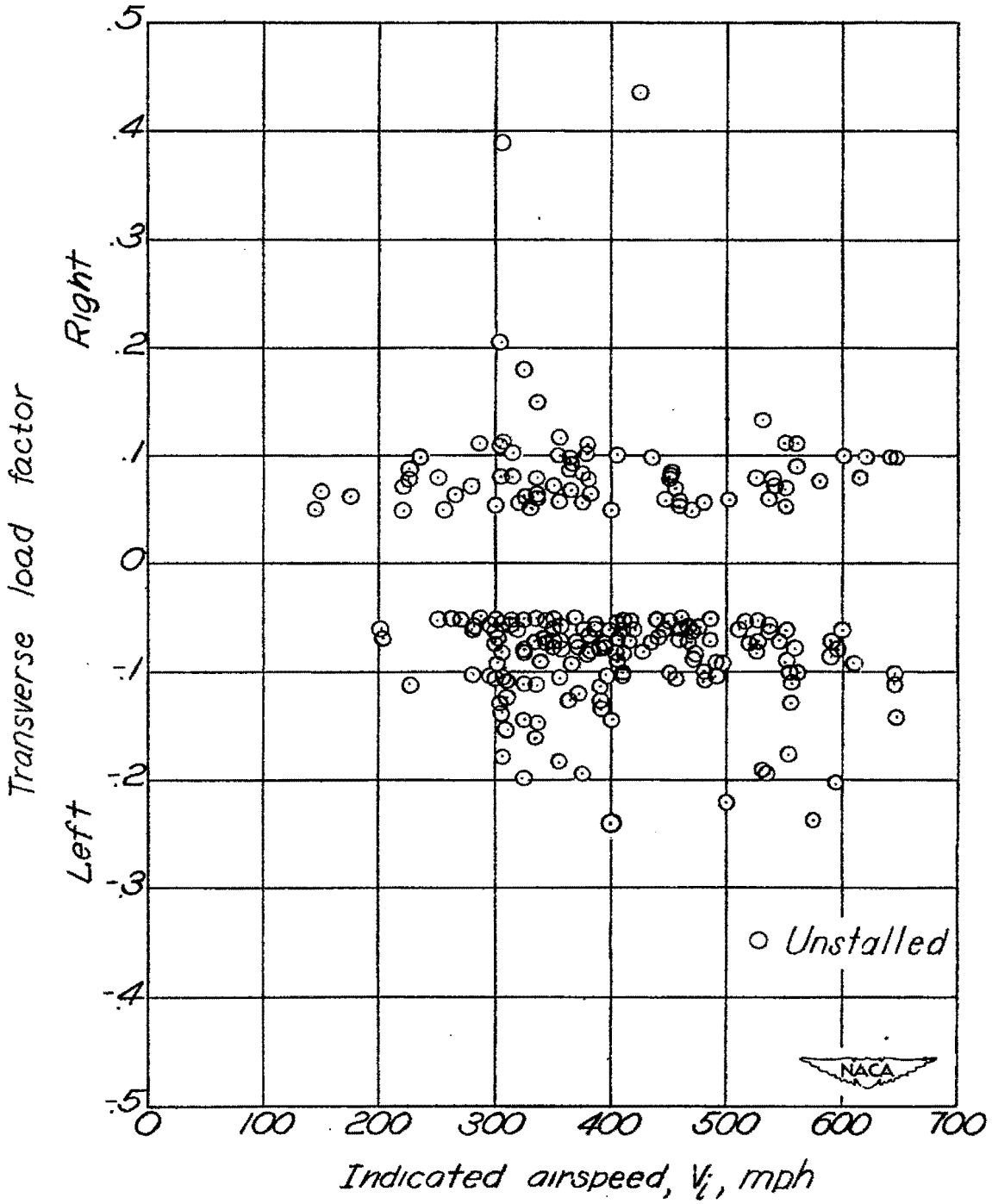


Figure 226.- Variation of maximum transverse load factor with indicated airspeed.

[redacted]

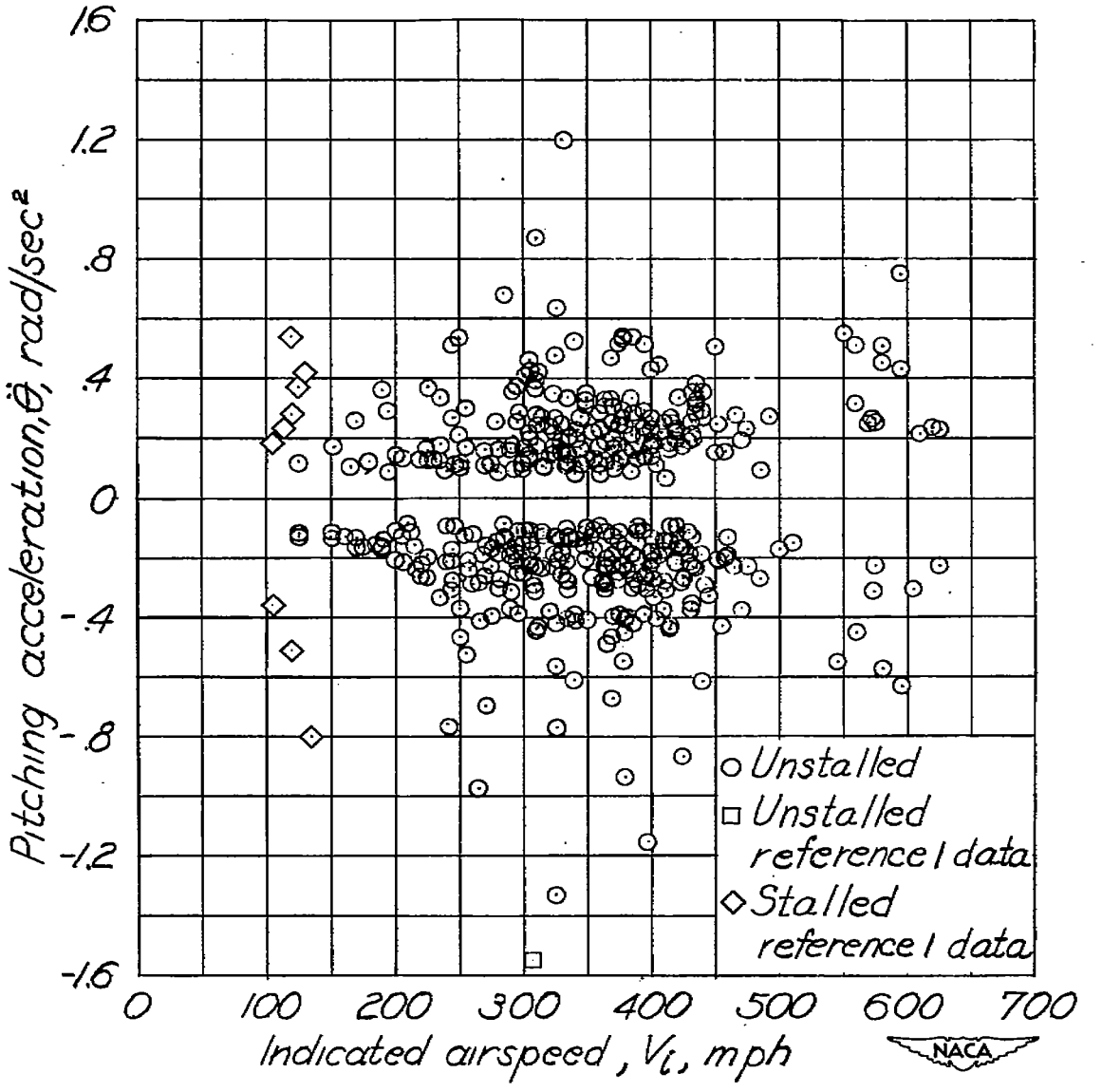


Figure 227.- Variation of maximum pitching acceleration with indicated airspeed.

[redacted]

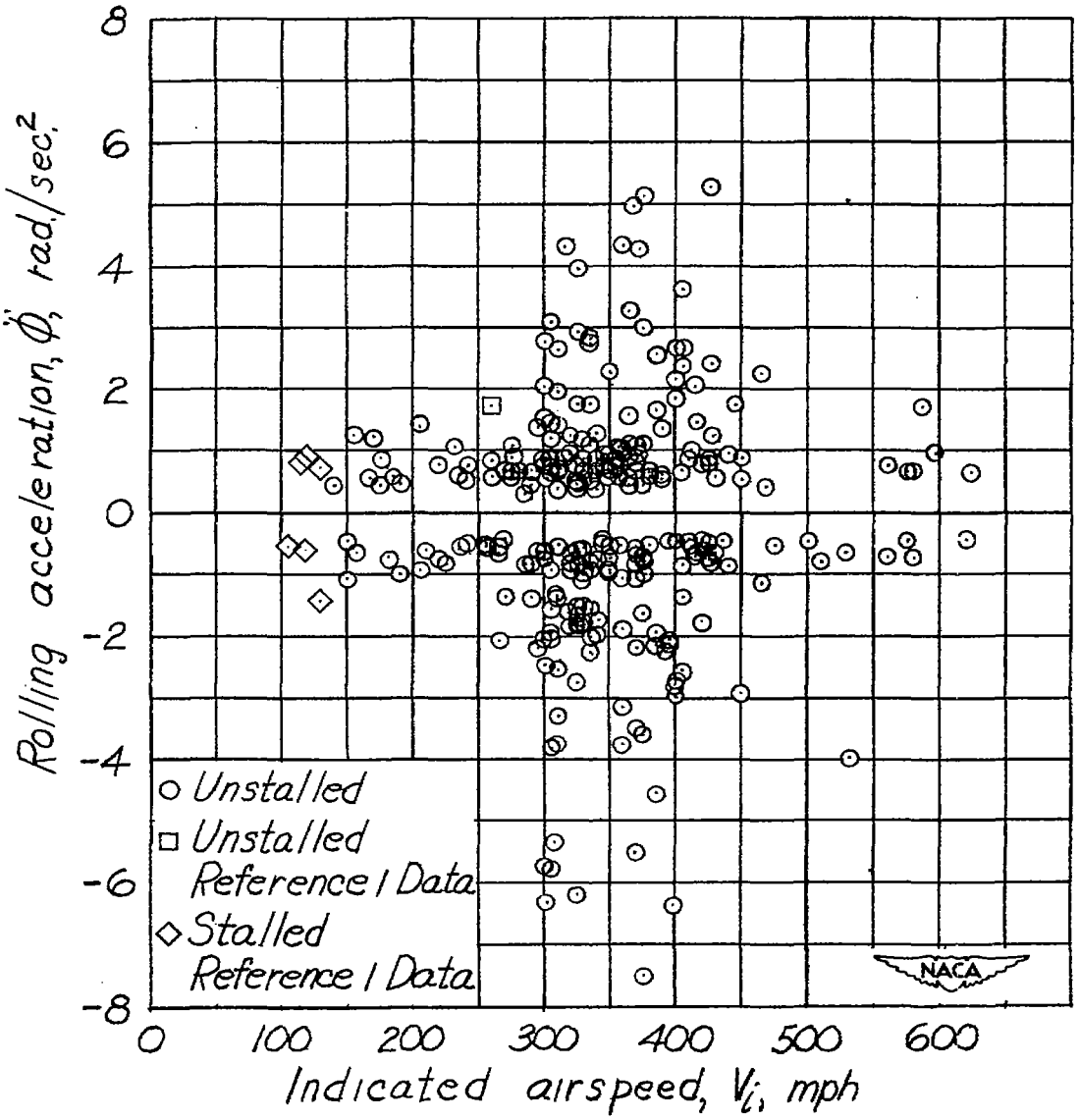


Figure 228.- Variation of maximum rolling acceleration with indicated airspeed.

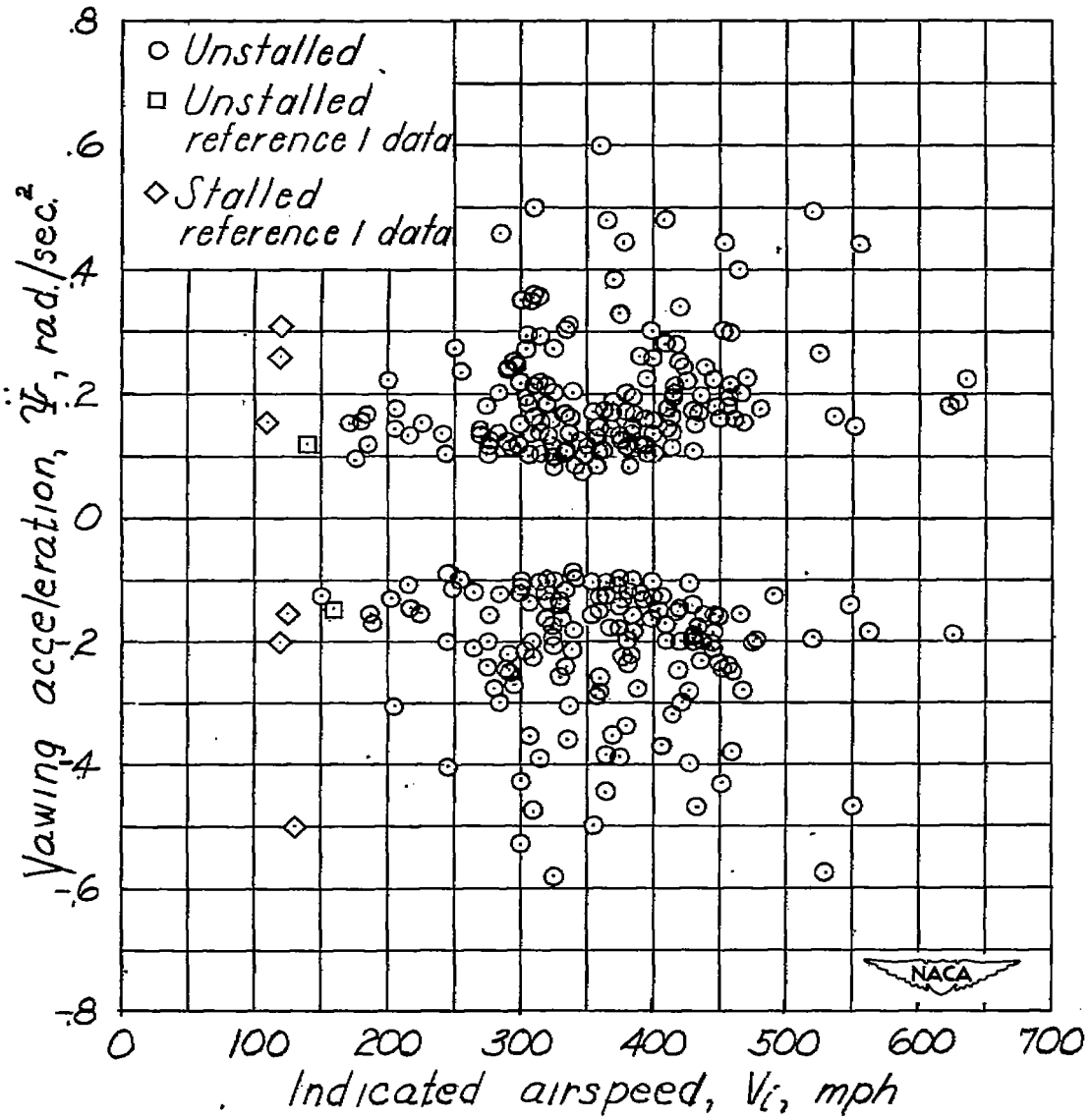


Figure 229.- Variation of maximum yawing acceleration with indicated airspeed.

Restriction/Classification Cancelled

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