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RESEARCH MEMORANDUM

for the

Air Material Command, U. S. Air Forces

PRELIMINARY TRANSIENT PERFORMANCE DATA ON THE J73 TURBOJET ENGINE

II - ALTITUDE, 35,000 FEET

By Robert J. Lubick and Adam E. Sobolewski

Lewis Flight Propulsion Laboratory
Cleveland, Ohio

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
WASHINGTON
JUL 16 1953

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SUMMARY

A program was undertaken to determine the J73 turbojet engine compressor stall and surge characteristics and combustor blow-out limits encountered during transient engine operation. Data were obtained in the form of oscillograph traces showing the time history of several engine performance parameters with changes in engine fuel flow. The data presented in this report are for step changes in fuel flow at an altitude of 35,000 feet, at flight Mach numbers of 0.3, 0.8, and 1.2, and at several engine-inlet temperatures.

INTRODUCTION

One phase of the altitude-performance investigation of the J73 turbojet engine conducted at the NACA Lewis laboratory consisted in determining the compressor stall and surge characteristics and the combustor blow-out limits encountered during and immediately following rapid changes in engine fuel flow.

The data were obtained on oscillograph traces which showed the time history of several engine parameters following a change in fuel flow. The preliminary data presented herein were obtained at an altitude of 35,000 feet, at flight Mach numbers of 0.3, 0.8, and 1.2, and at several engine-inlet temperatures. Similar data are presented in preliminary form in references 1 and 2 for altitudes of sea level, 15,000, and 45,000 feet at several flight Mach numbers.

The preliminary data which appear in this report consist of reproductions of oscillograph traces obtained at various operating conditions. A check on the accuracy of the calibration values listed on the oscillograph traces has been made but no analysis of the data is presented.

APPARATUS

Engine and Installation

The J73 turbojet engine used in this investigation has a thrust of approximately 9000 pounds, a rated engine speed of 7950 rpm, and an exhaust-gas temperature of 1185° F (1645° R). The engine is normally equipped with an hydraulic control system which was inoperative during this phase of the investigation. For these tests, the fuel system was so modified that fuel flow was a function of fuel-valve position only. Other engine components are a 12-stage axial-flow compressor with variable inlet guide vanes, an annular-type combustor with 10-cannular-type chambers, a two-stage axial-flow turbine, and a fixed-area exhaust nozzle.

The engine was mounted in a 14-foot diameter altitude chamber. A group of automatic throttle valves was incorporated at both inlet and exhaust ends of the test chamber to provide control of simulated altitude and ram-pressure ratio.

Instrumentation

The transient responses of the engine variables were recorded on a multiple channel, direct-inking, magnetic motor oscillograph. The oscillograph chart speed was 5 units per second.

The location of the measuring stations are shown in figure 1. The sensing devices used for indicating variations in the performance parameters are given in table I. Inasmuch as the total-pressure profile at the engine inlet was flat, it was possible to select almost any total- or static-pressure sensor to record on an oscillograph trace or its corresponding calibration gage without introducing errors. In the case of compressor-outlet total pressure, the sensor selected for both the oscillograph and the calibration gage was approximately the average total pressure at that station, as indicated from earlier steady-state data. Appropriate correction factors were employed where necessary for gage error and sensor location.

PROCEDURE

The oscillograph traces were calibrated by operating the engine at several widely different engine operating points and recording the corresponding pen deflections on the oscillograph trace. Fuel step changes were introduced over a range of initial engine speeds at the conditions shown in the following table:

Altitude, ft	Flight Mach number	Inlet guide vane position	Engine-inlet temperature, °F
35,000	0.3	Open	0, 35
	.3	Closed	-5
	.8	Open	-10, 35, 160
	.8	Closed	10, 160
	1.2	Open	35
	1.2	Closed	35

The variable inlet guide vanes, which normally moved from closed to open position at an engine speed of 6800 rpm as speed was increased, were maintained in a fixed closed or open position during all transients of this phase of the investigation.

The size of the fuel step change was increased until limited by either compressor surge or combustor blow-out or until it was felt that large steps in fuel flow would expose the engine to excessively high temperature. Only the traces which were considered pertinent in determining an operating limit are presented. Thus, in general, at any given initial engine speed two traces are shown. One gives the maximum step change in fuel flow obtained without encountering compressor surge or stall. The other gives the minimum step change in fuel flow which produced compressor surge or stall.

During the period of transient engine operation, both the engine-inlet total pressure and the exhaust pressure varied from the initial value. However, the engine operating limit usually occurred before the engine-inlet total pressure or the exhaust pressure changed appreciably. The time history of the behavior of the engine-inlet total pressure during transient engine operation is shown on the oscillograph traces, but the variation of exhaust pressure is not shown. In general, the maximum increase in exhaust pressure was 7 percent of the initial value.

DISCUSSION

The conditions for each oscillograph trace (figs. 2 to 152) presented herein are given in table II. On each set of oscillograph traces the figure legend specifies the engine conditions at the beginning of the change in fuel flow. Each trace is identified by a label below which is given the calibration factor for the trace. As indicated by the calibration factor, all traces are considered linear except the fuel-flow trace which follows the square-law relation. On each trace is shown the initial value of the engine variable. In the case of fuel flow, one or more additional values are given. The arrows on each figure indicate the direction in which the variable is increasing.

Caution should be used in applying the calibration factors to the traces. Although the horizontal or time scale is linear, the vertical scale on all traces is a circular arc. In obtaining the rate of change of any variable or in calculating elapsed time, this curvature must be considered.

Lewis Flight Propulsion Laboratory
National Advisory Committee for Aeronautics
Cleveland, Ohio, July 1, 1953

REFERENCES

1. Sobolewski, Adam E., and Lubick, Robert J.: Preliminary Transient Performance Data on the J73 Turbojet Engine. I - Altitude, Sea Level and 15,000 Feet. NACA RM SE53F22, 1953.

2. McAulay, John E., and Wallner, Lewis E.:. Preliminary Transient Performance Data on the J73 Turbojet Engine. III - Altitude, 45,000 Feet. NACA RM SE53F30, 1953.

TABLE I. - INSTRUMENTATION

Measured quantity	Engine station	Steady-state instrumentation	Transient instrumentation	
			Sensor	Range over which frequency response is essentially flat, cps
Fuel flow	-	Rotameter	Aneroid-type pressure sensor, with strain-gage element, connected to measure pressure drop across variable orifice in fuel line	Undetermined
Dynamic pressure at engine inlet	1	Bourdon-type gage	Aneroid-type pressure sensor with strain-gage element	0-10 At sea-level static
Engine-inlet total pressure	1	Bourdon-type gage	Aneroid-type pressure sensor with strain-gage element	0-10 At sea-level static
Compressor-outlet total pressure	2	Bourdon-type gage	Aneroid-type pressure sensor with strain-gage element	0-10 At sea-level static
Compensated exhaust-gas temperature	3	Five paralleled thermocouples connected to self-balancing potentiometer recorder	Six paralleled 20-gage, chromel-alumel, butt-welded thermocouples and electric network to compensate for thermocouple lag	0-30 At sea-level static when used with properly adjusted compensator
Uncompensated exhaust-gas temperature	3	Five paralleled thermocouples connected to self-balancing potentiometer recorder	Six paralleled 20-gage, chromel-alumel, butt-welded thermocouples	0-1 At sea-level static
Engine speed	-	Chronometric tachometer	Direct-current generator with output proportional to engine speed	0-5

TABLE II - OSCILLOGRAPH-TRACE CONDITIONS

Figure	Altitude, ft	Flight Mach number	Inlet guide vane position	Engine-inlet temperature, °F		Initial engine speed, rpm		Figure	Altitude, ft	Flight Mach number	Inlet guide vane position	Engine-inlet temperature, °F		Initial engine speed, rpm	
				Nominal	Actual	Nominal	Actual					Nominal	Actual	Nominal	Actual
2	35,000	0.3	Open	0	-2	5200	5280	78	35,000	0.8	Open	35	39	7200	7300
3					-2		5210	79					38		7240
4					0	5800	5780	80					39		7240
5					0		5770	81					39		7240
6					2	6200	6210	82					39	7500	7530
7					2		6200	83					39		7550
8					0		6130	84				160	150	5000	5020
9					3	6800	6810	85					147		4960
10					3		6825	86					150		4920
11					1	7500	7480	87					152		4935
12				35	38	5600	5610	88					152		4920
13					38	5800	5810	89					152		4920
14					38		5800	90					161	5500	5490
15					37	6000	5950	91					161		5510
16					37		5950	92					161		5450
17					38	6100	6060	93					161		5505
18					38		6060	94					163	6000	6010
19					37	6200	6180	95					163		6025
20					37		6200	96					164	6500	6500
21					37	6500	6460	97					165		6520
22					38		6480	98					165		6570
23					37		6500	99					164		6500
24					38		6490	100					164		6500
25					37		6460	101					163	6800	6815
26					37	6600	6620	102					166	7000	6990
27					36	7000	7050	103					166		6970
28					36		6940	104					166		7030
29					37	7100	7090	105					165		7040
30					37		7090	106					165		7030
31					36	7500	7510	107			Closed	10	17	5100	5150
32					36		7440	108					17		5175
33					37	7800	7605	109					17		5125
34					36		7600	110					-2	5400	5420
35					36		7600	111					-3		5400
36			Closed	-5	-6	5000	5040	112					-2	5500	5470
37					-6		5060	113					14		5560
38					-5	5500	5520	114					14		5500
39					-3		5480	115					11	6000	6050
40					-5		5490	116					14		6025
41					-3		5440	117					9	6700	6750
42					-1	6300	6330	118					9		6725
43					-1		6350	119				160	167	5400	5415
44					-2	6800	6850	120					167		5415
45					-2		6770	121					167		5415
46		0.8	Open	-10	-10	5200	5180	122					163	6000	6020
47					-10		5175	123					163		6020
48					-10		5180	124					164	6500	6505
49					-8	5500	5473	125					164		6505
50					-8		5473	126					163		6490
51					-6	6000	6030	127					163		6490
52					-6		6030	128					163	7000	7035
53					-6	6500	6520	129					163		7070
54					-6		6475	130		1.2	Open	35	32	5500	5500
55					-8	7100	7085	131					32		5500
56					-8		7085	132					34	6000	6020
57					-9	7500	7470	133					42		6020
58					-10		7530	134					34		6020
59					-10		7530	135					42		5980
60				35	30	6000	5970	136					35	6500	6470
61					28		5970	137					35		6500
62					28		5950	138					42	6600	6570
63					30		6050	139					42		6600
64					28		5995	140					35	7500	7470
65					28		6020	141					35		7500
66					30		5900	142			Closed		30	5500	5500
67					30	6600	6600	143					30		5440
68					30		6600	144					30	6000	6020
69					30		6540	145					29		6020
70					30		6600	146					30		5955
71					38	7000	7050	147					30	6500	6535
72					38		7030	148					40		6530
73					30		6980	149					30		6535
74					39		7050	150					40		6540
75					30		7038	151					30	7100	7115
76					30		6960	152					30		7050
77					39	7200	7250								

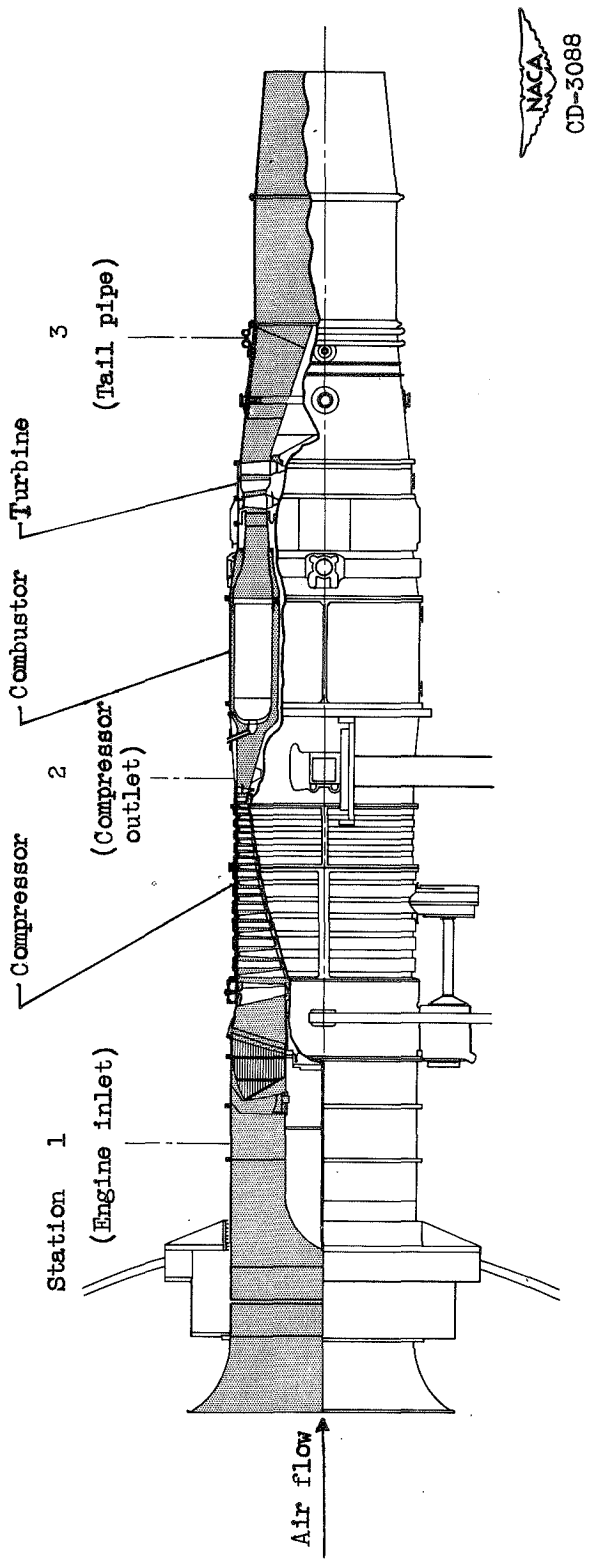

Figure 1. - Side view of turbojet engine installation showing stations at which instrumentation was installed.

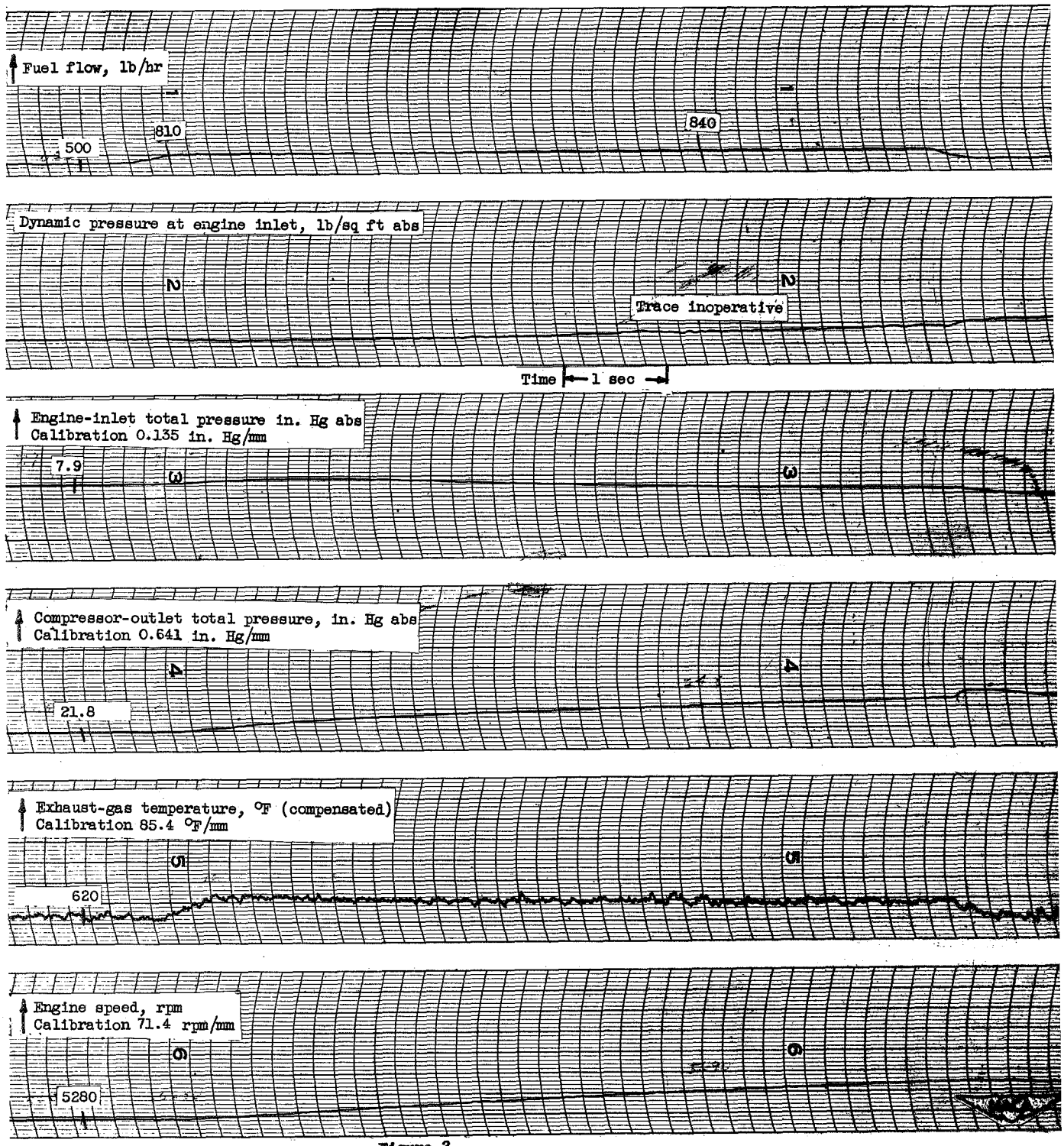

Figure 2

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -2 °F; inlet guide vanes position, open.

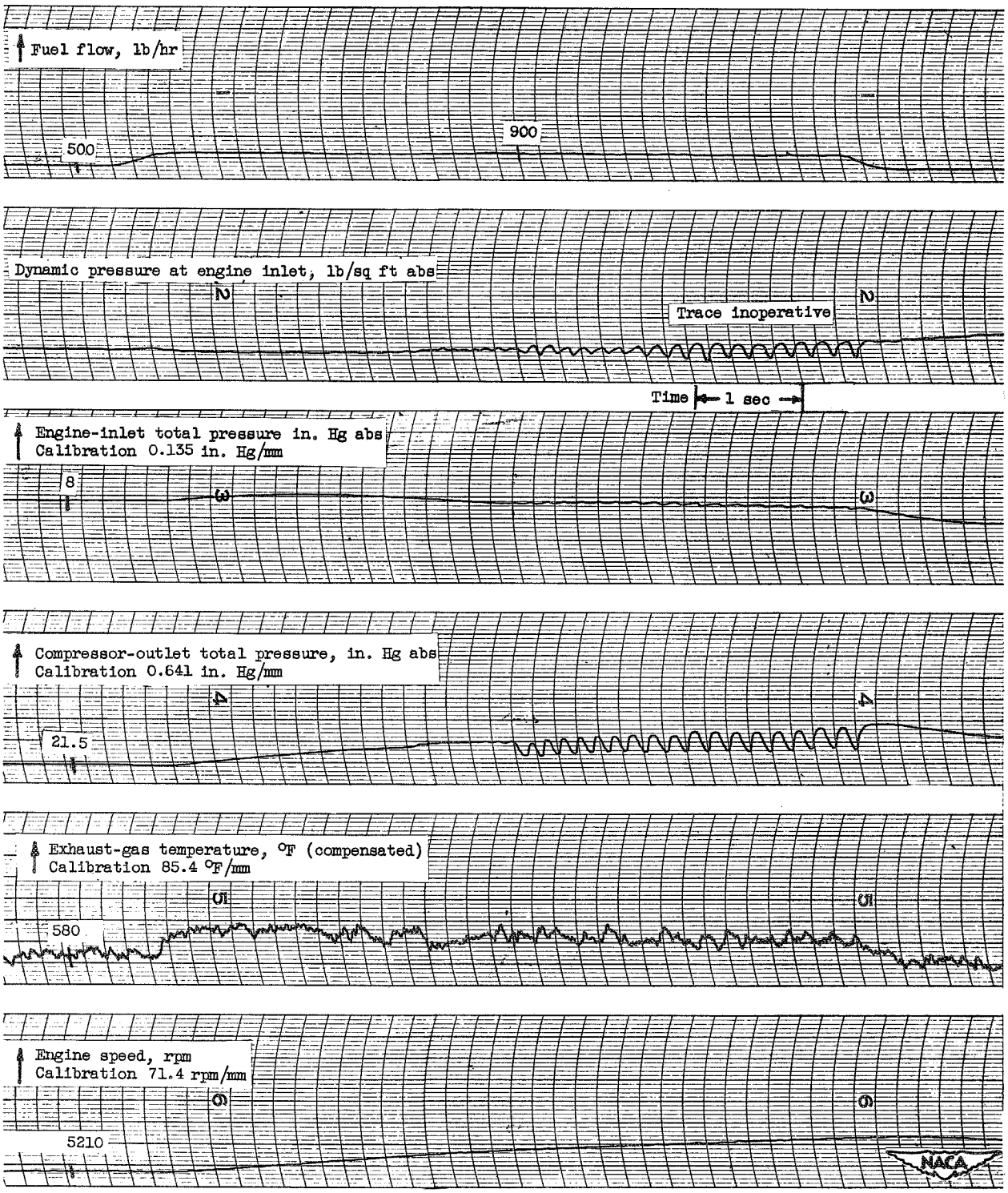

Figure 3

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -2 °F; inlet guide vanes position, open.

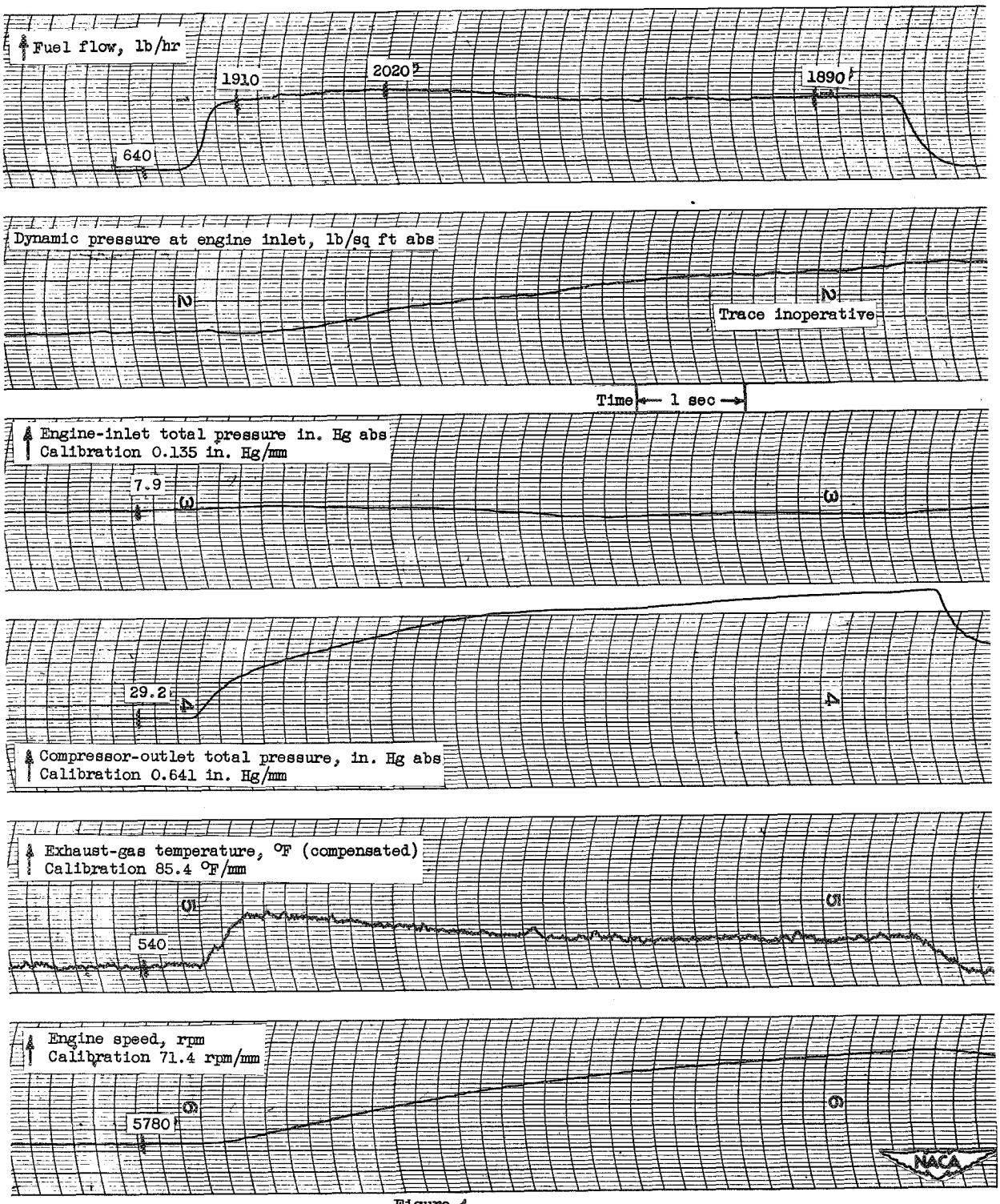

Figure 4

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 0 °F; inlet guide vanes position, open.

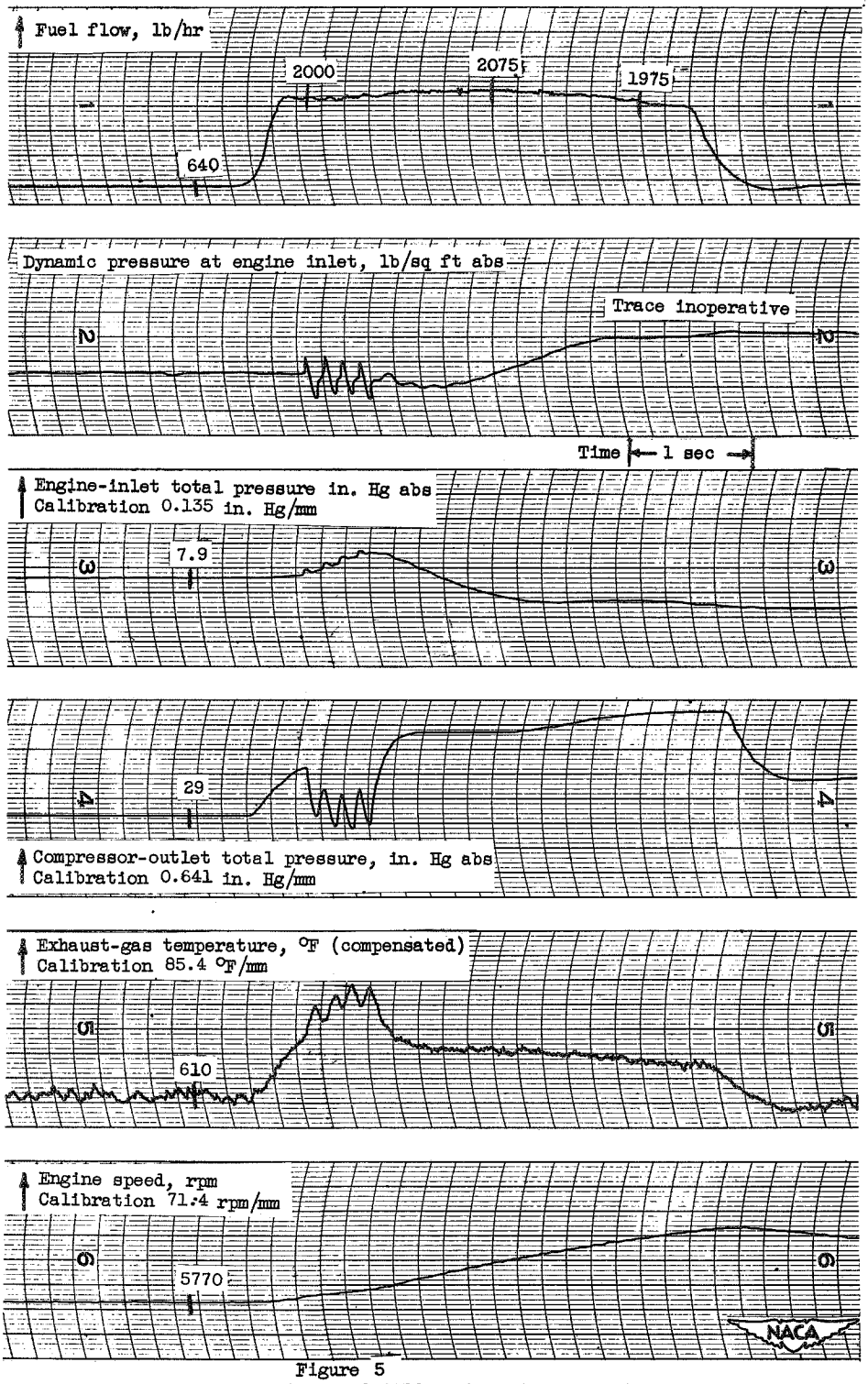

Figure 5

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 0 °F; inlet guide vanes position, open.

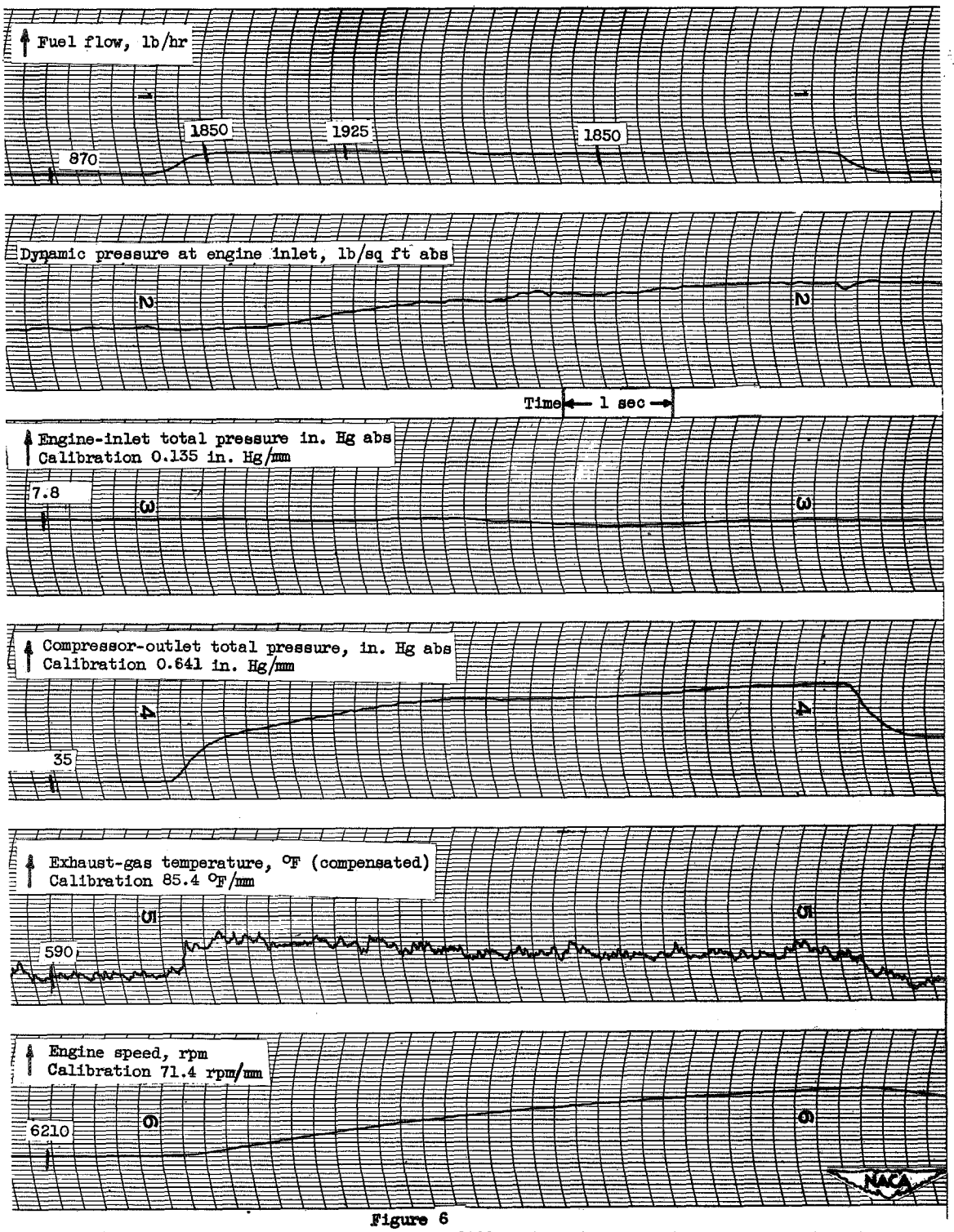

Figure 6

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 2 °F; inlet guide vanes position, open.

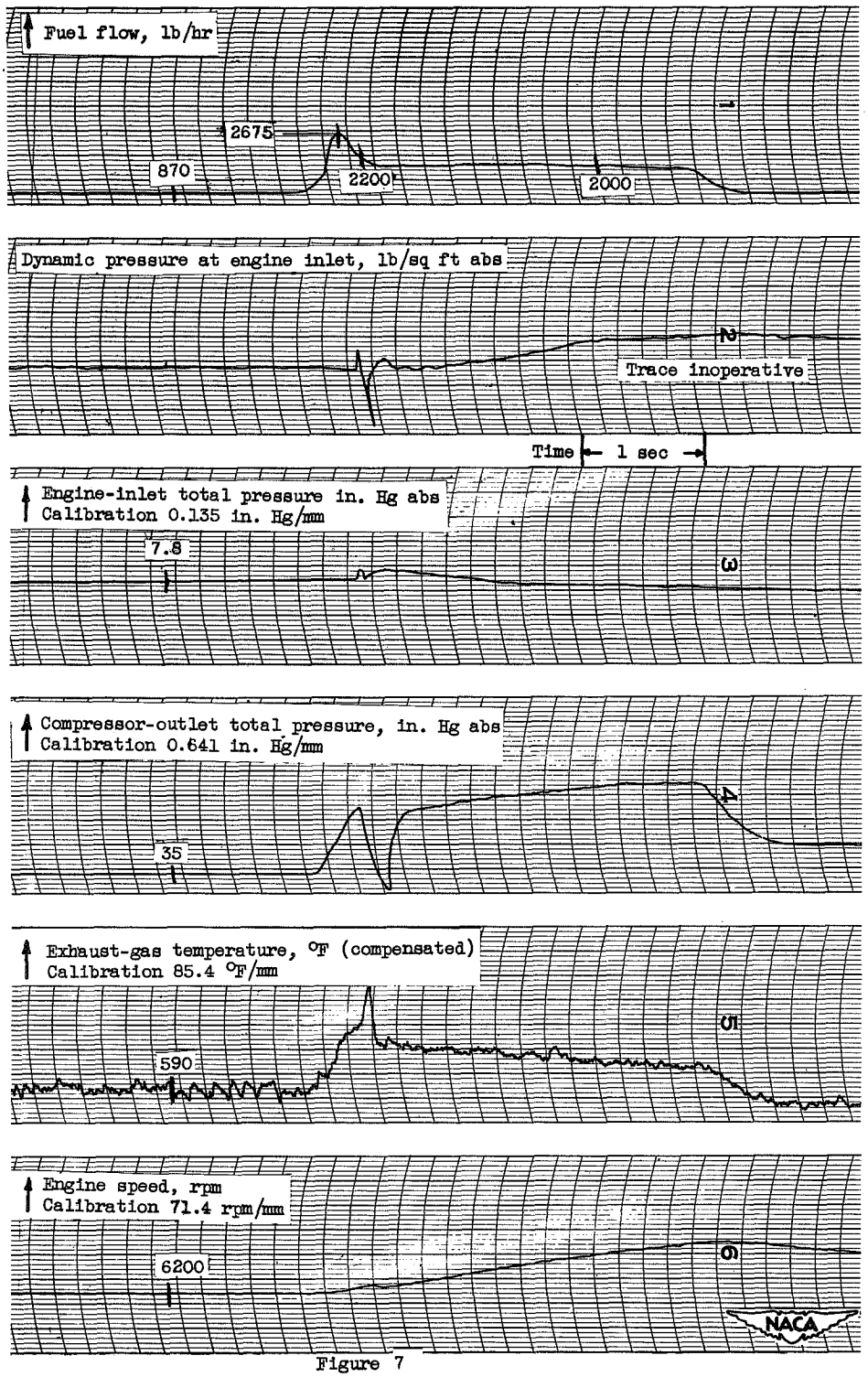

Figure 7

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 2° F; inlet guide vanes position, open.

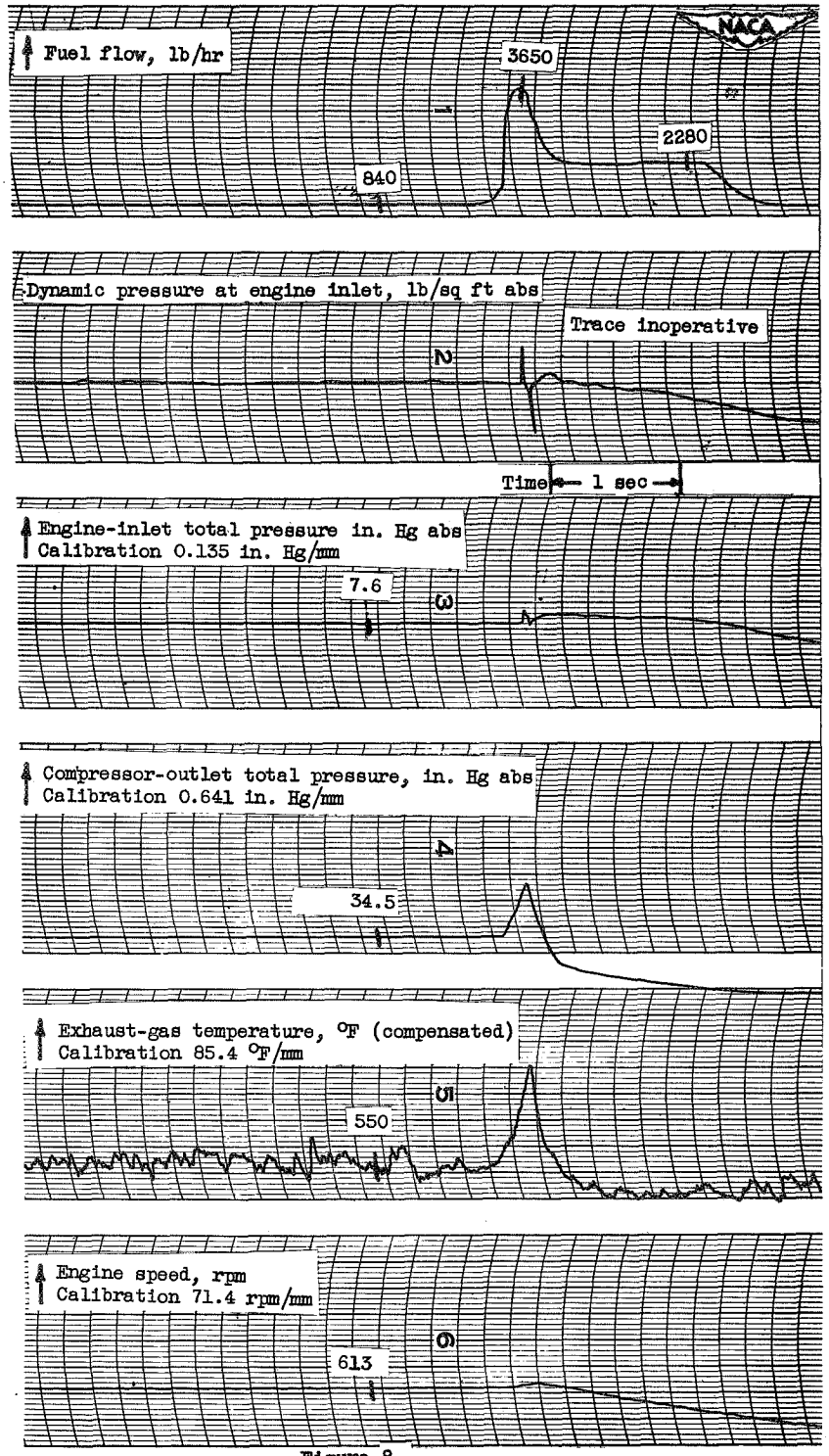

Figure 8

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3 : engine-inlet air temperature, 0 °F; inlet guide vanes position, open.

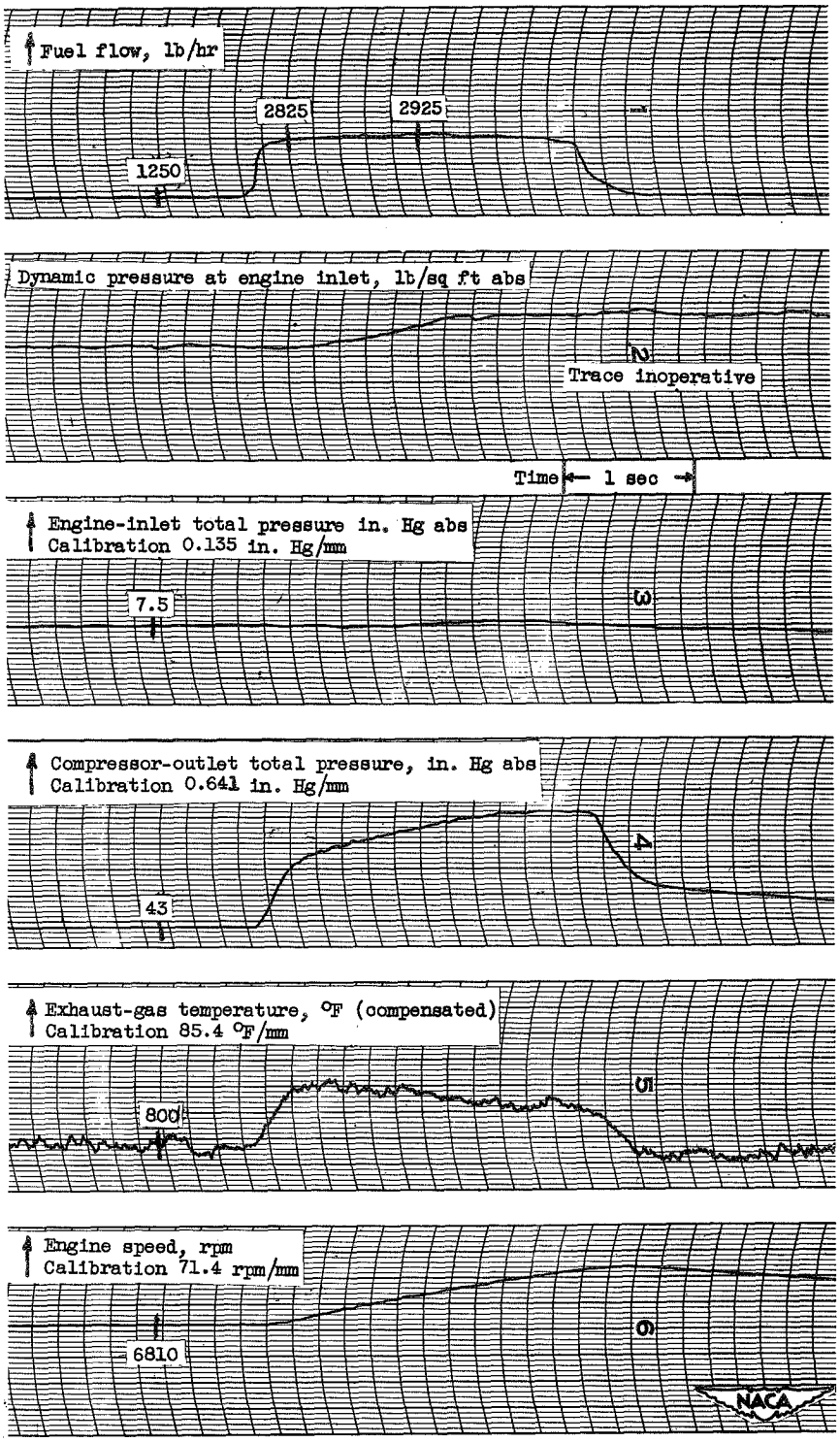

Figure 9

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 5° F; inlet guide vanes position, open.

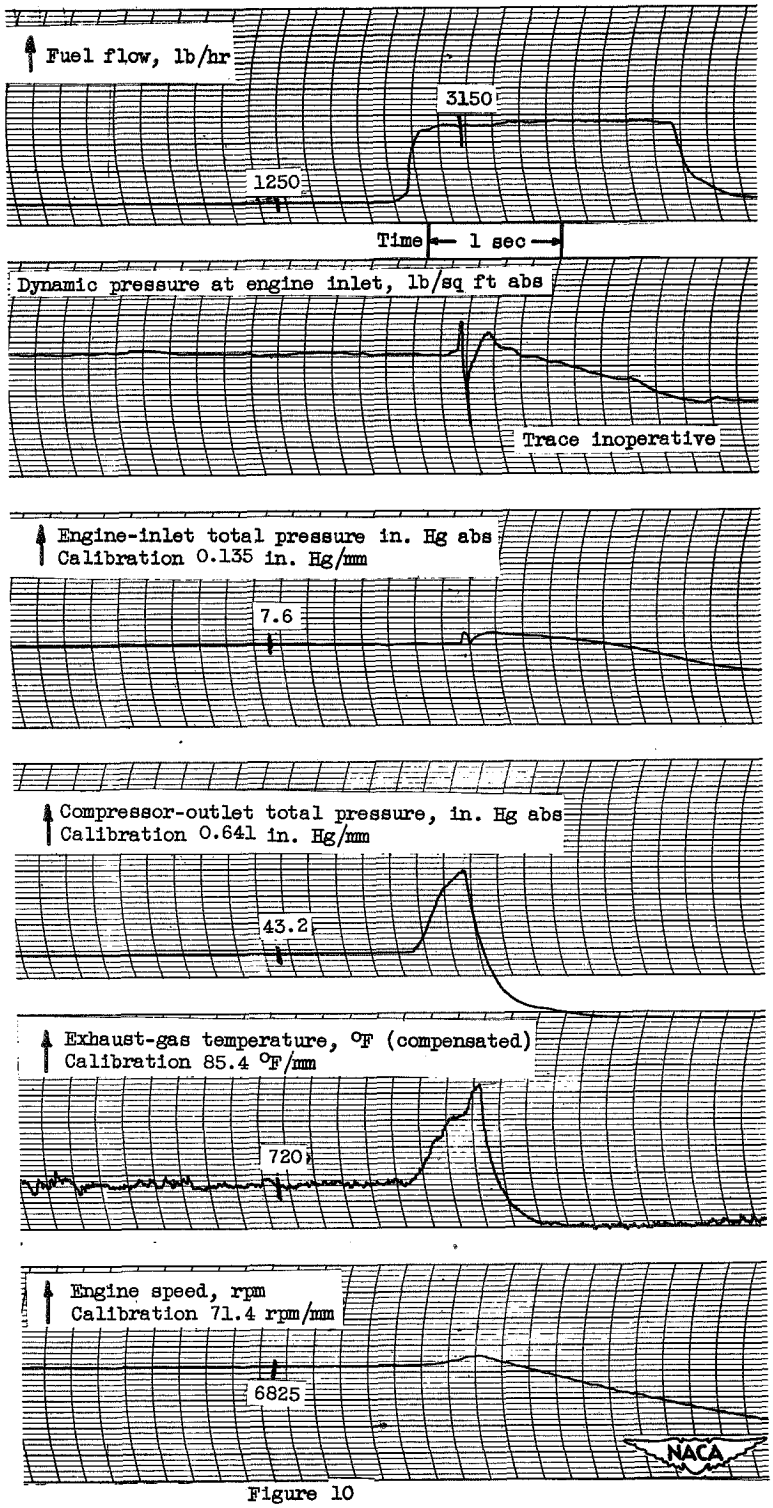

Figure 10

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 3° F; inlet guide vanes position, open.

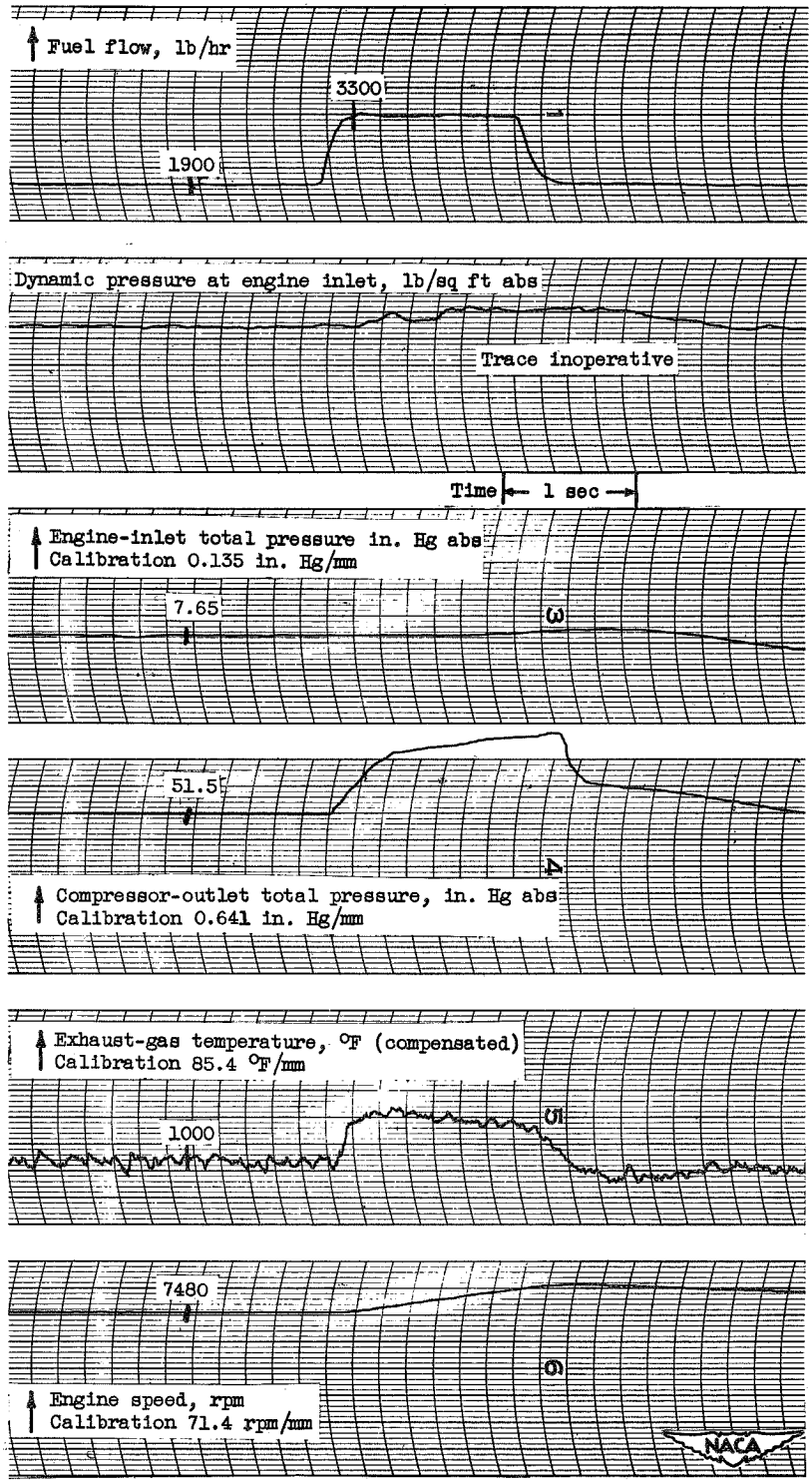

Figure 11

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 1 °F; inlet guide vanes position, open.

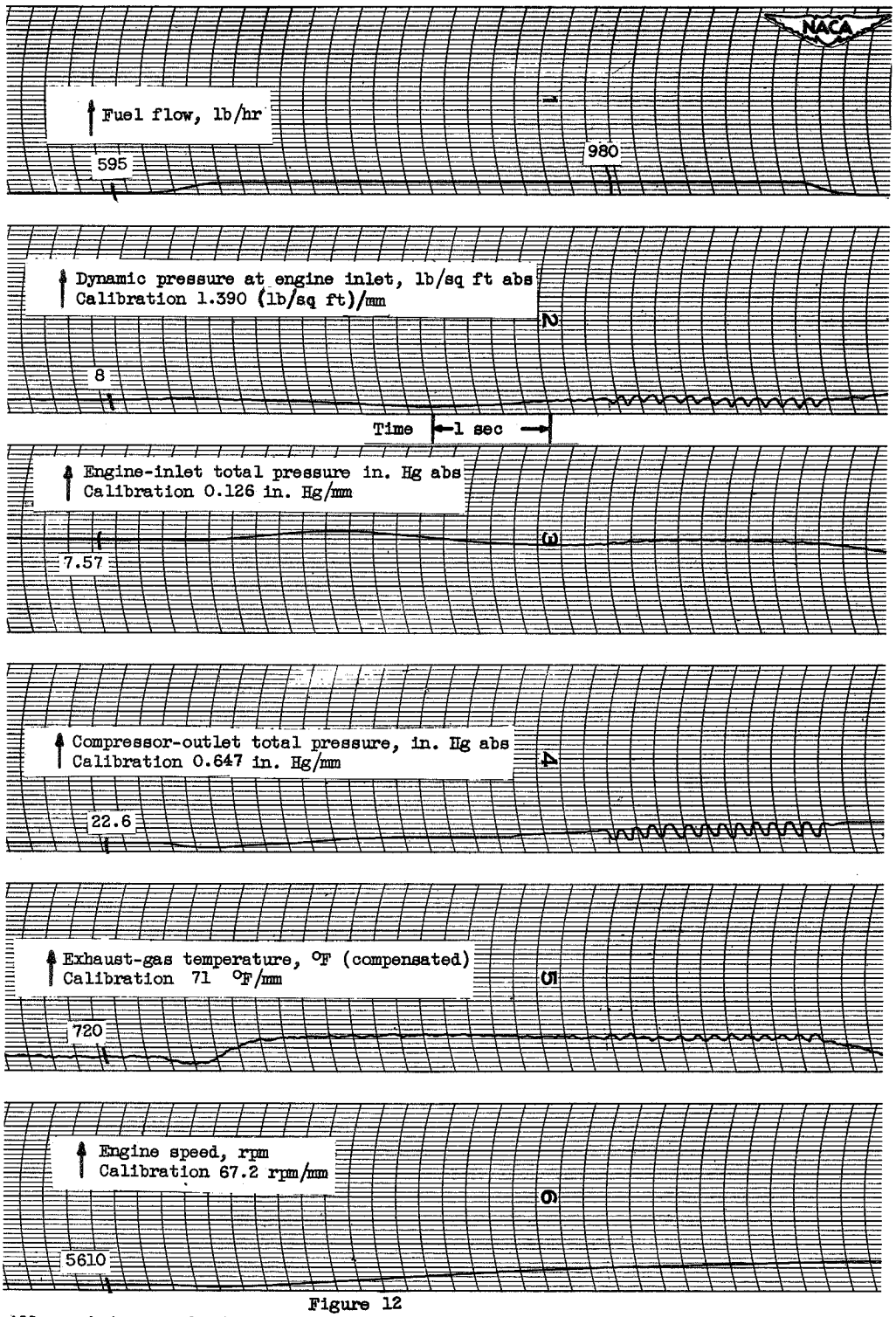

Figure 12

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

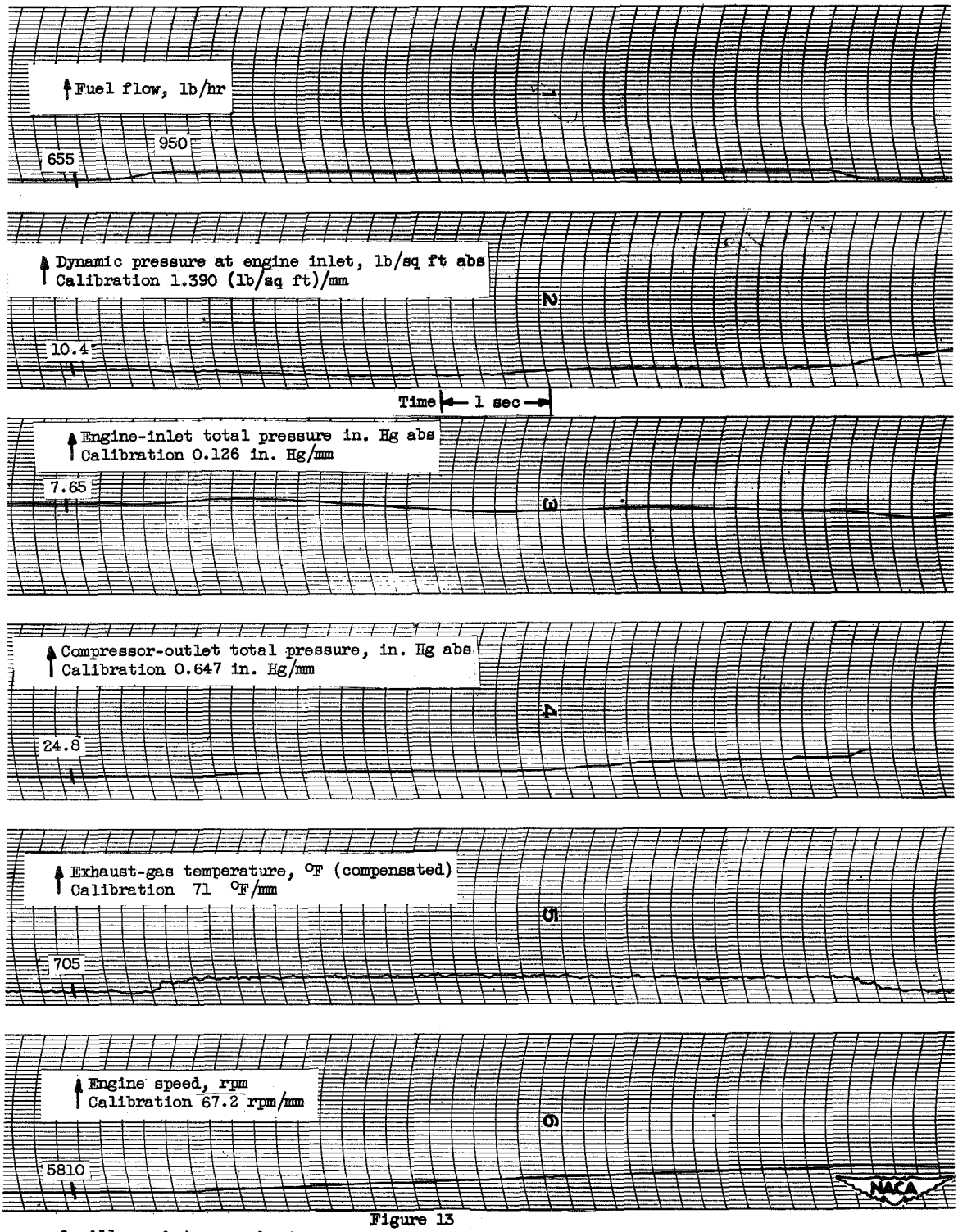

Figure 13

BL 90 Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

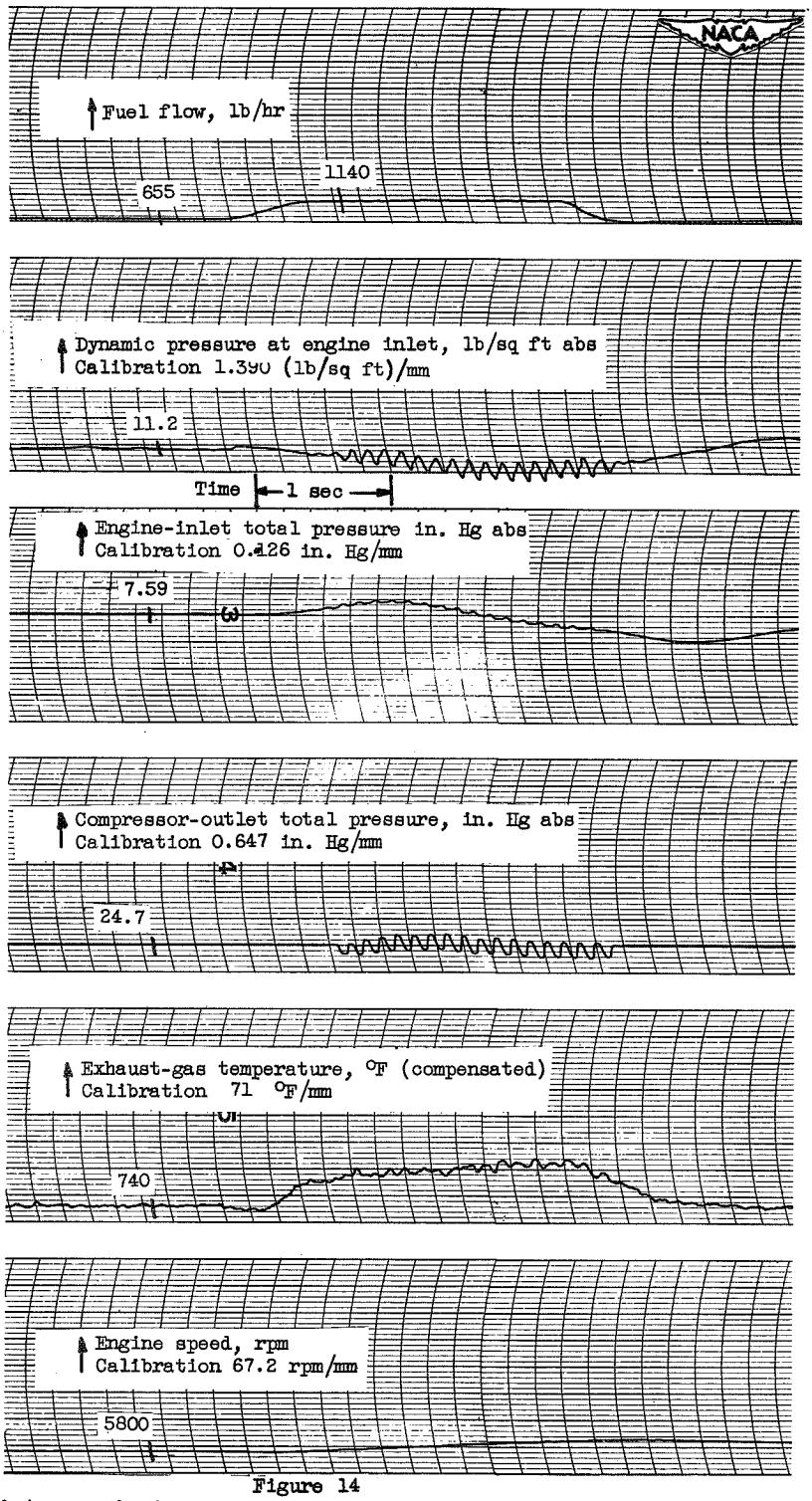

Figure 14

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

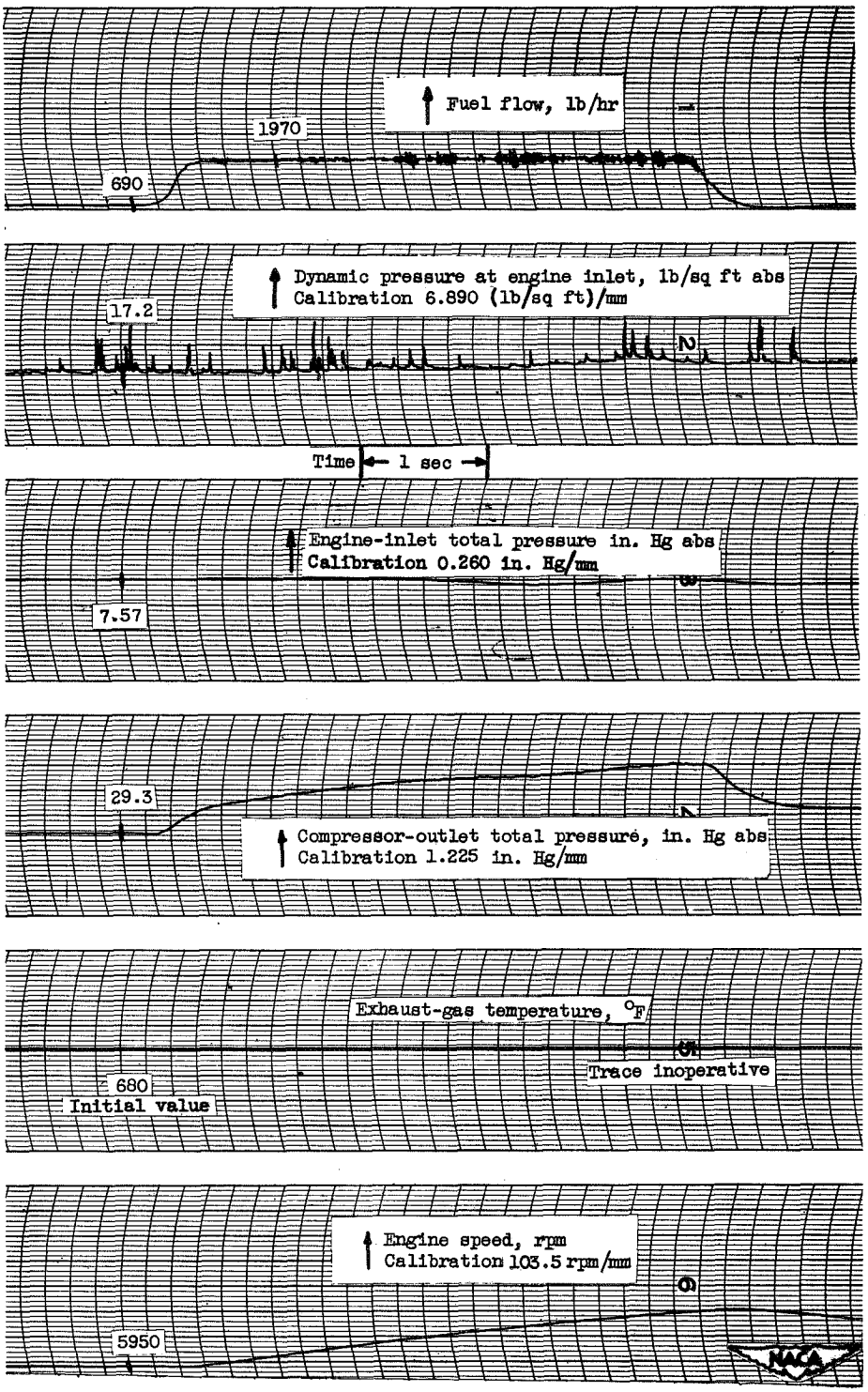

Figure 15

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

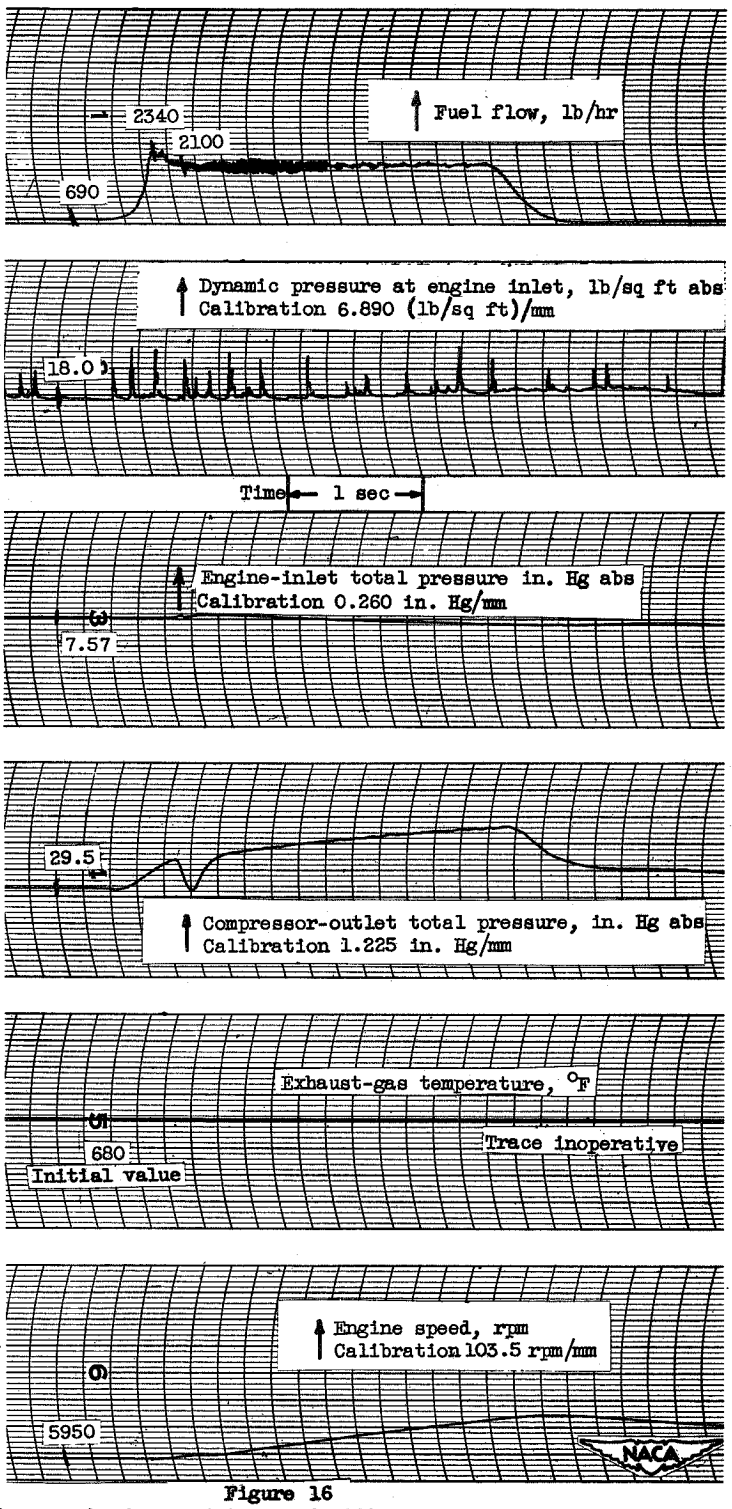

Figure 16

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3 ; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

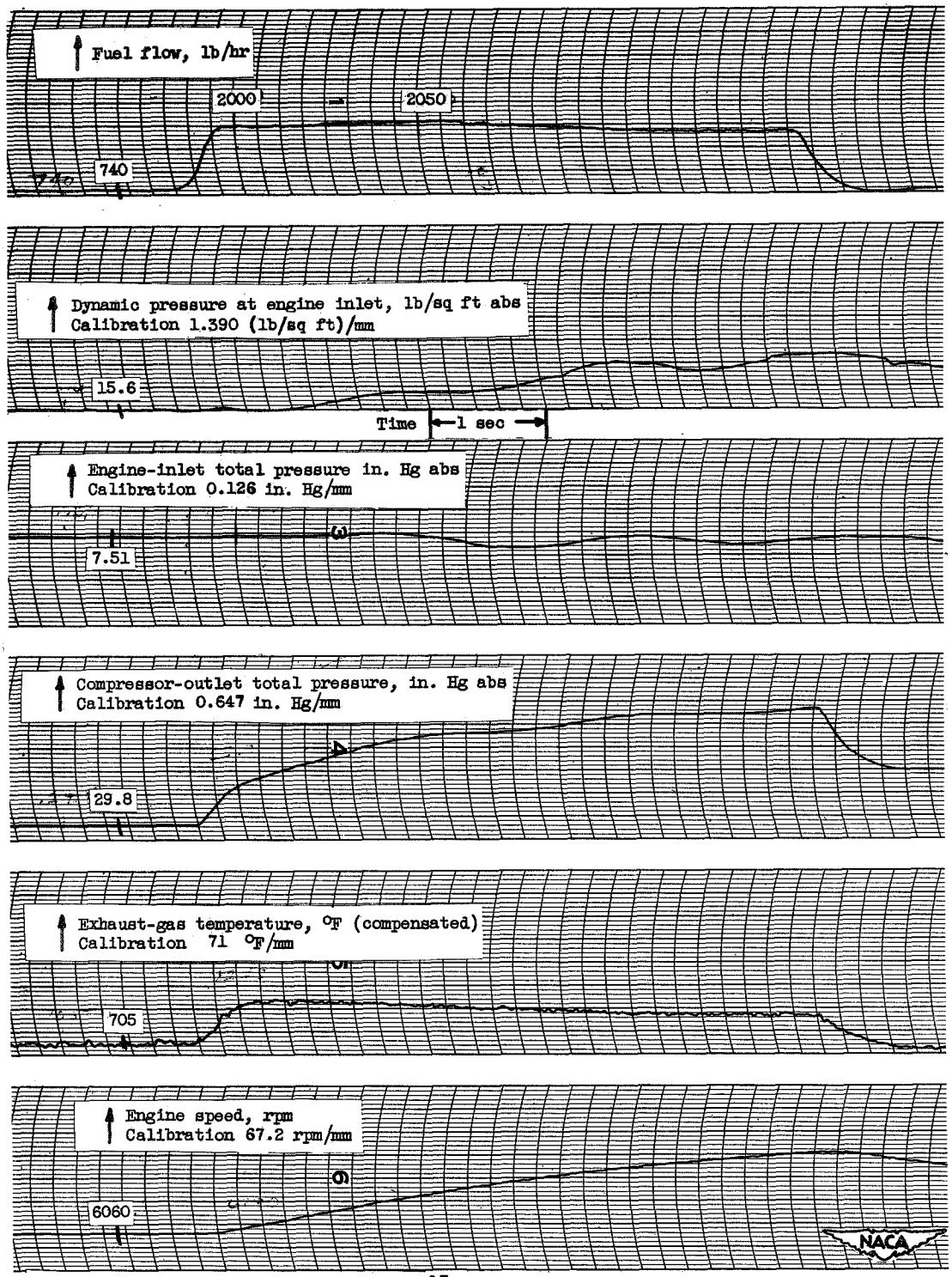

Figure 17

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38 °F; inlet guide vanes position, open.

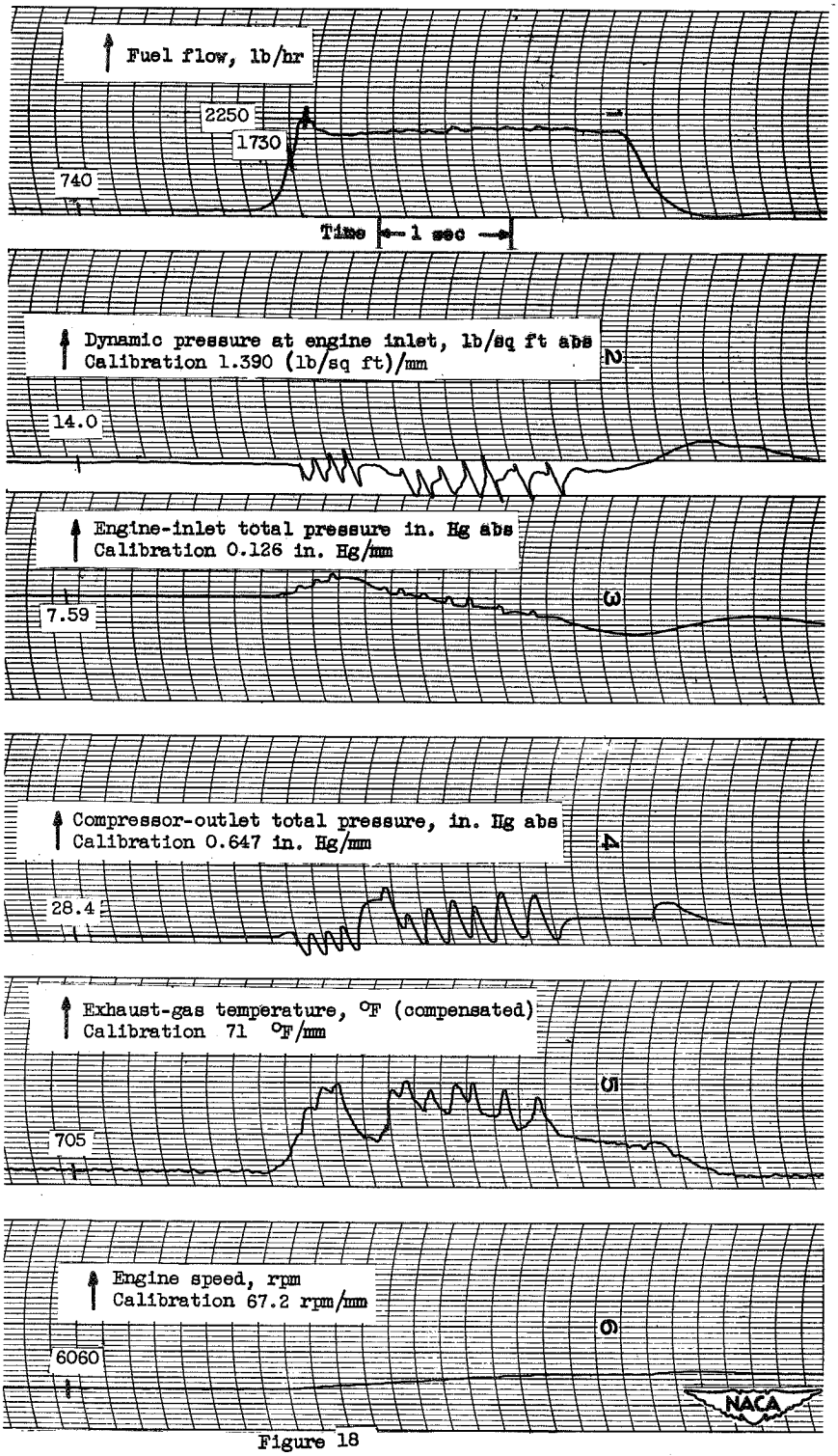

Figure 18

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

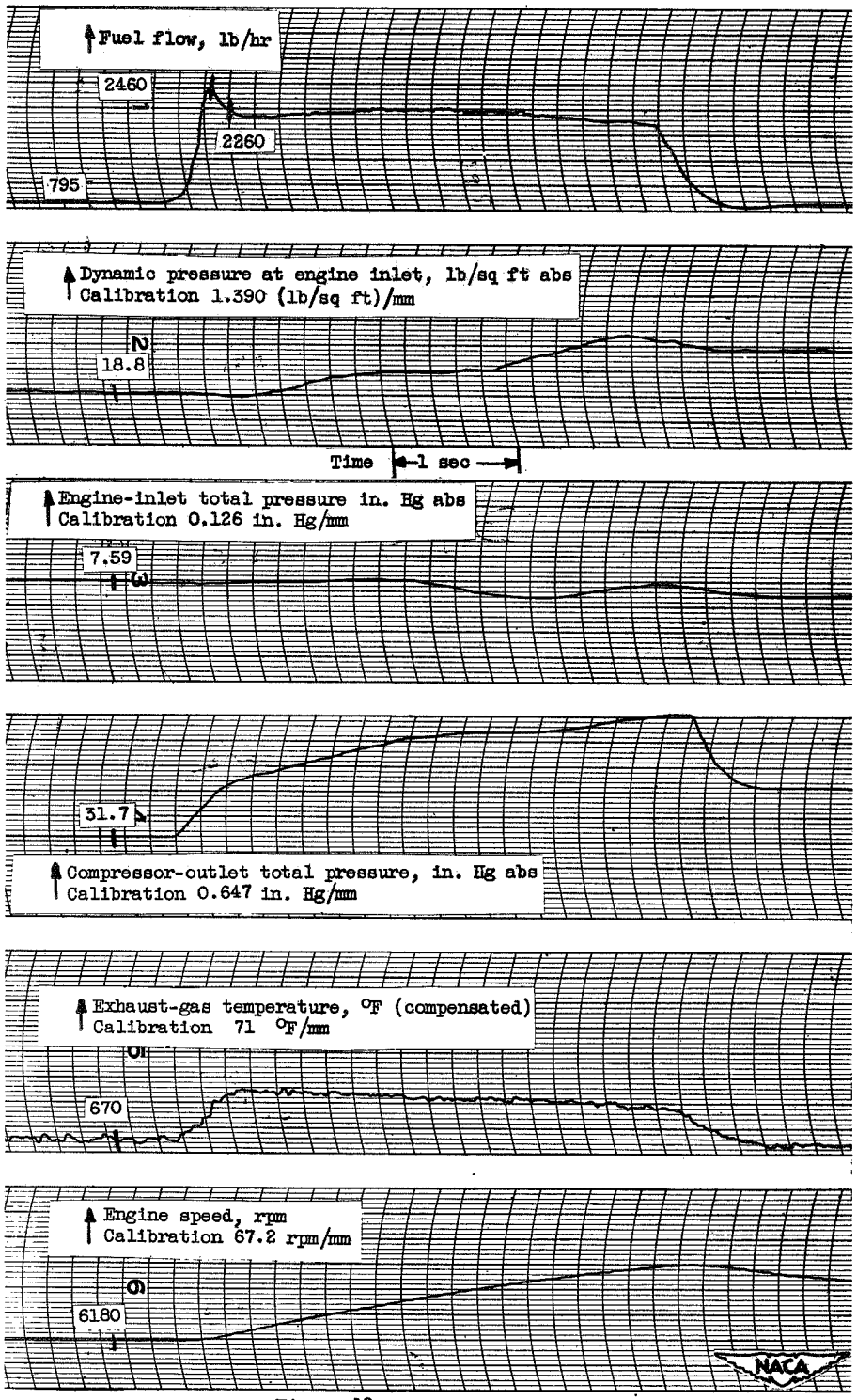

Figure 19

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

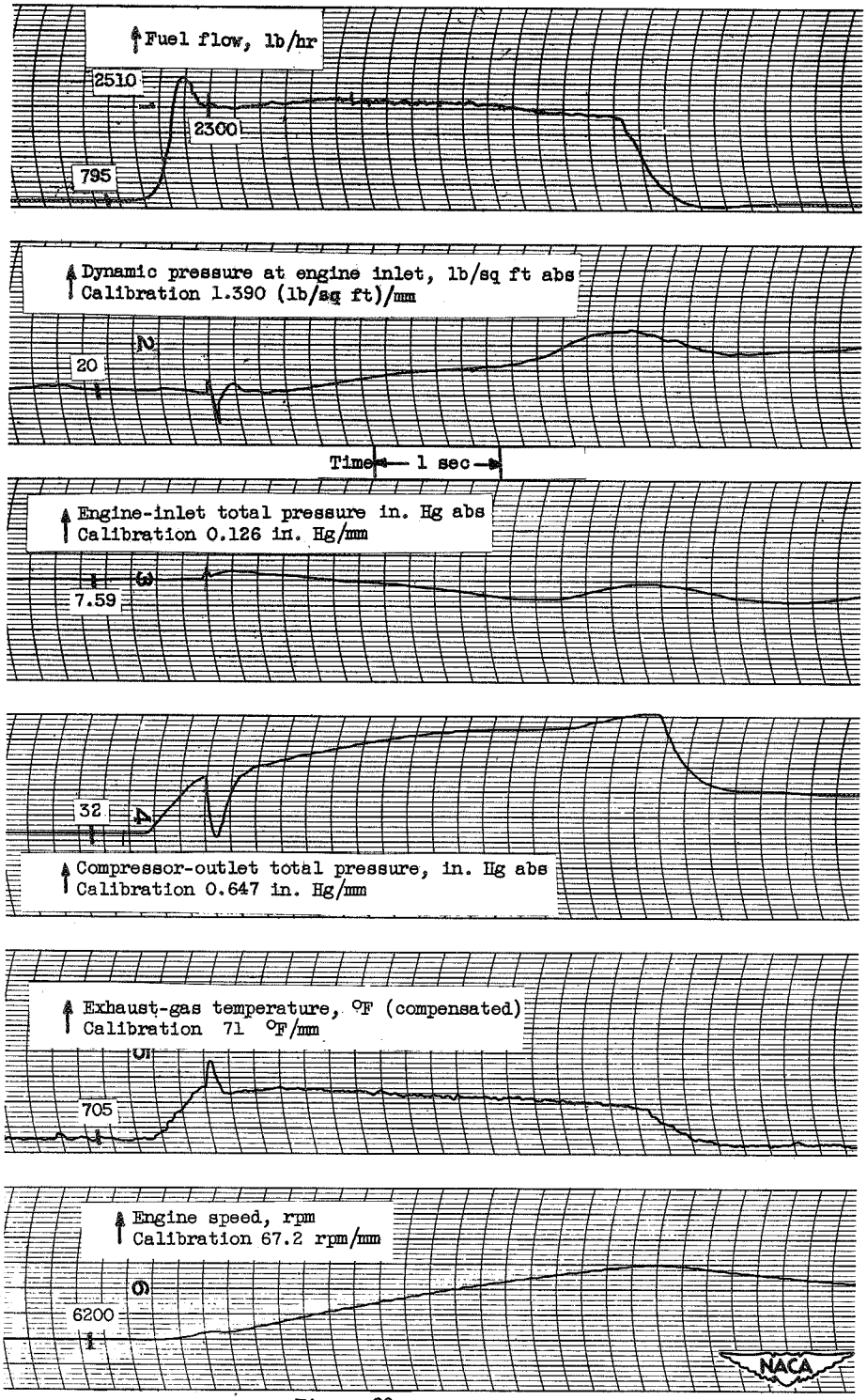

Figure 20

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37 ° F; inlet guide vanes position, open.

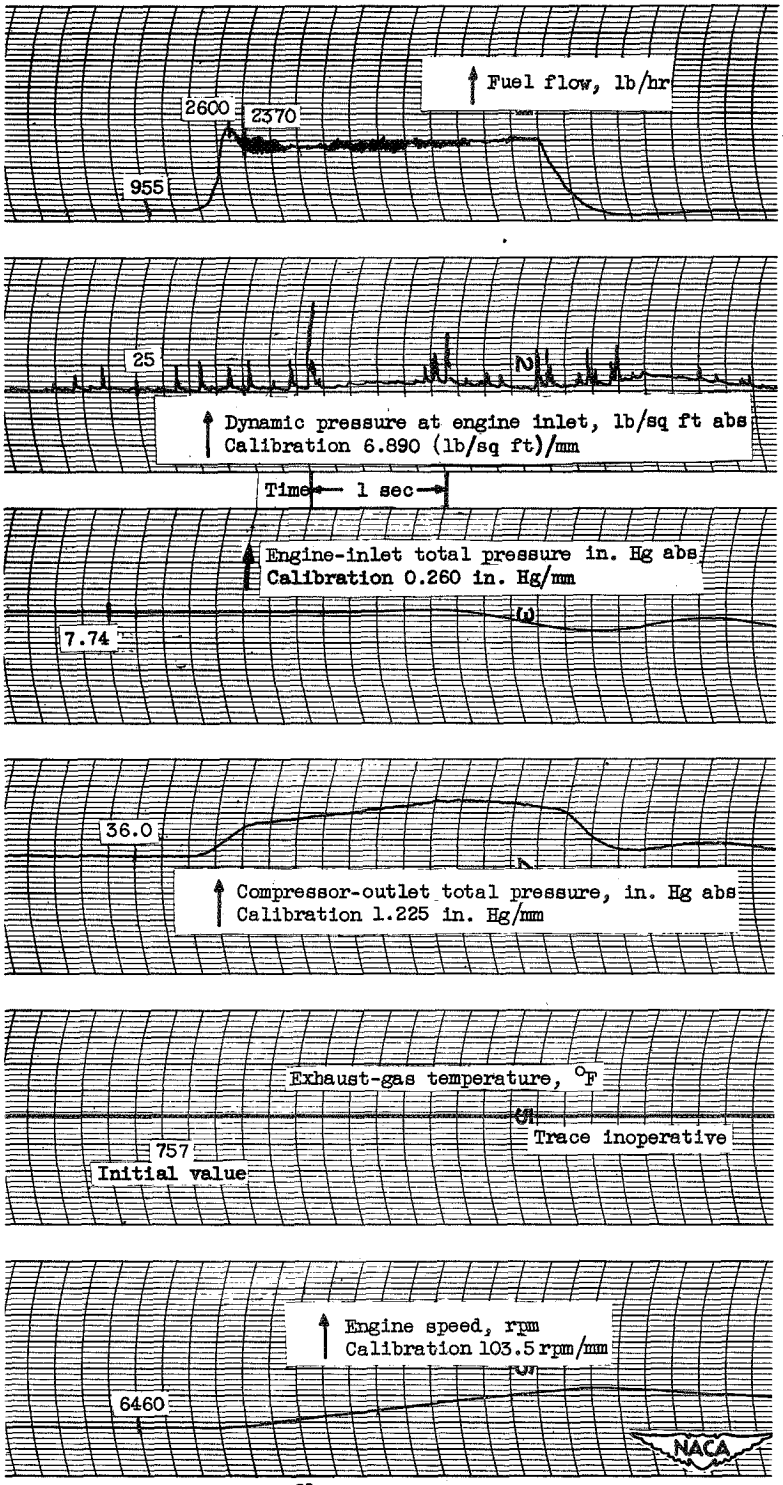

Figure 21

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

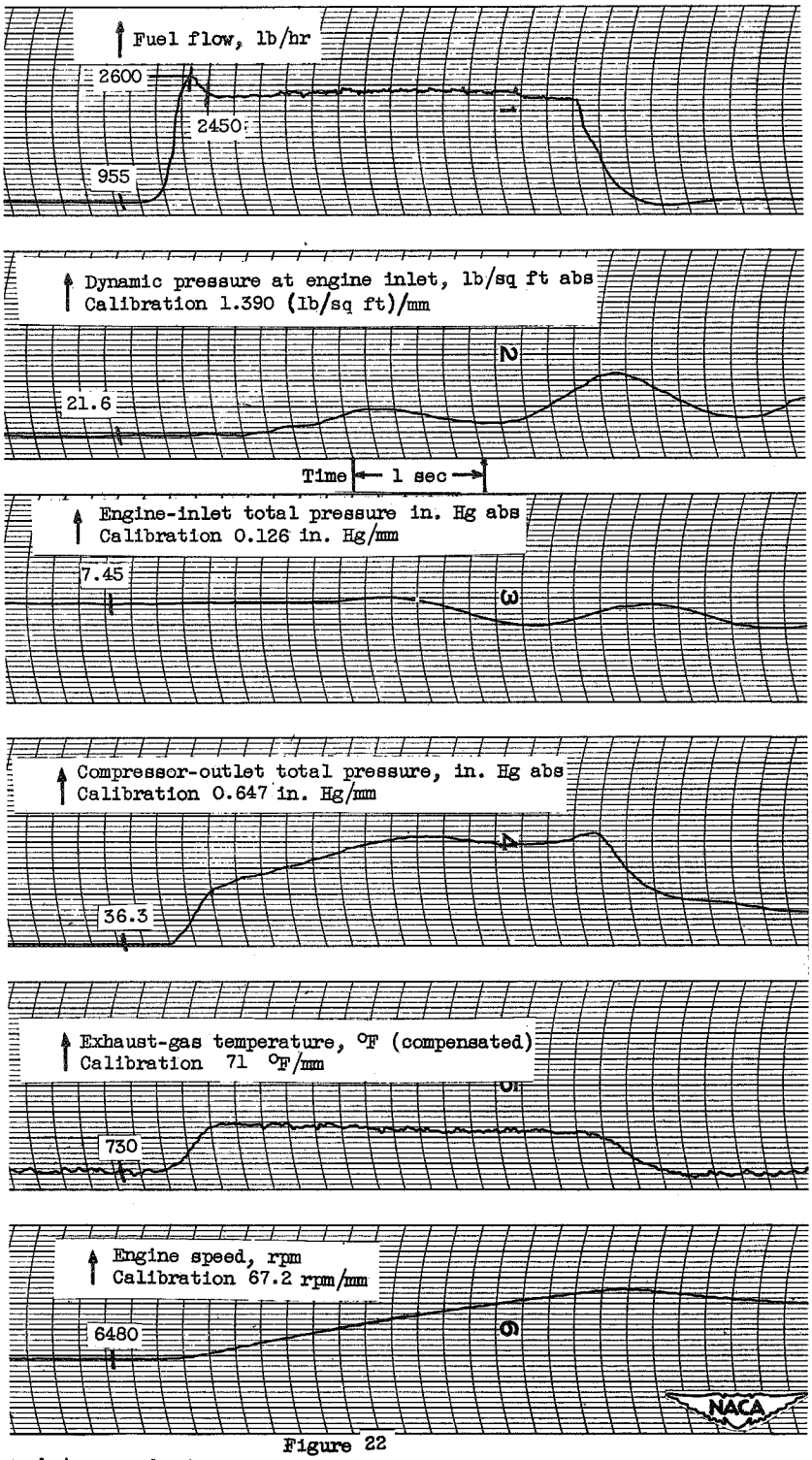

Figure 22

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38 °F; inlet guide vanes position, open.

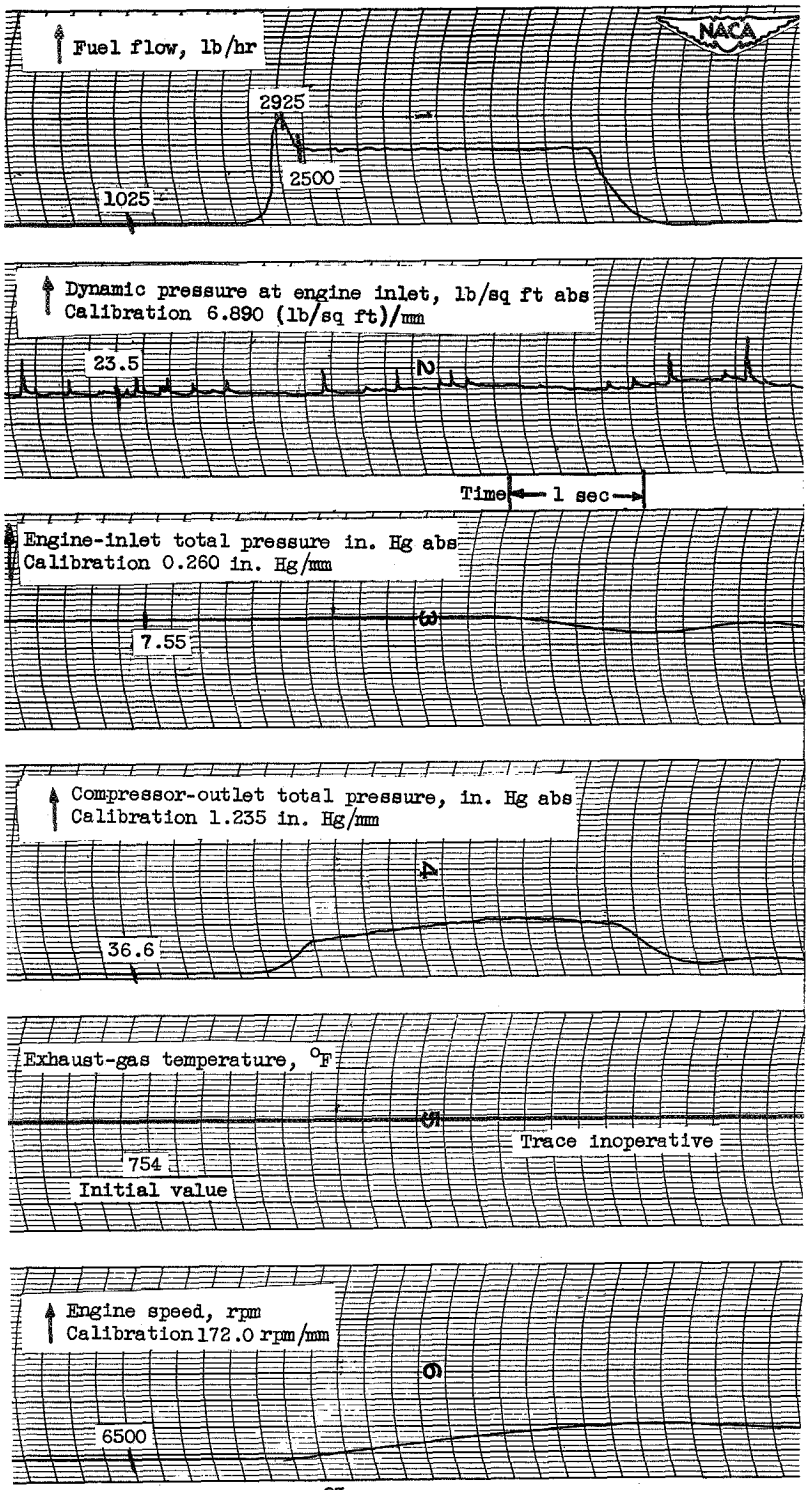

Figure 23

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3 ; engine-inlet air temperature, 37 °F; inlet guide vanes position, open.

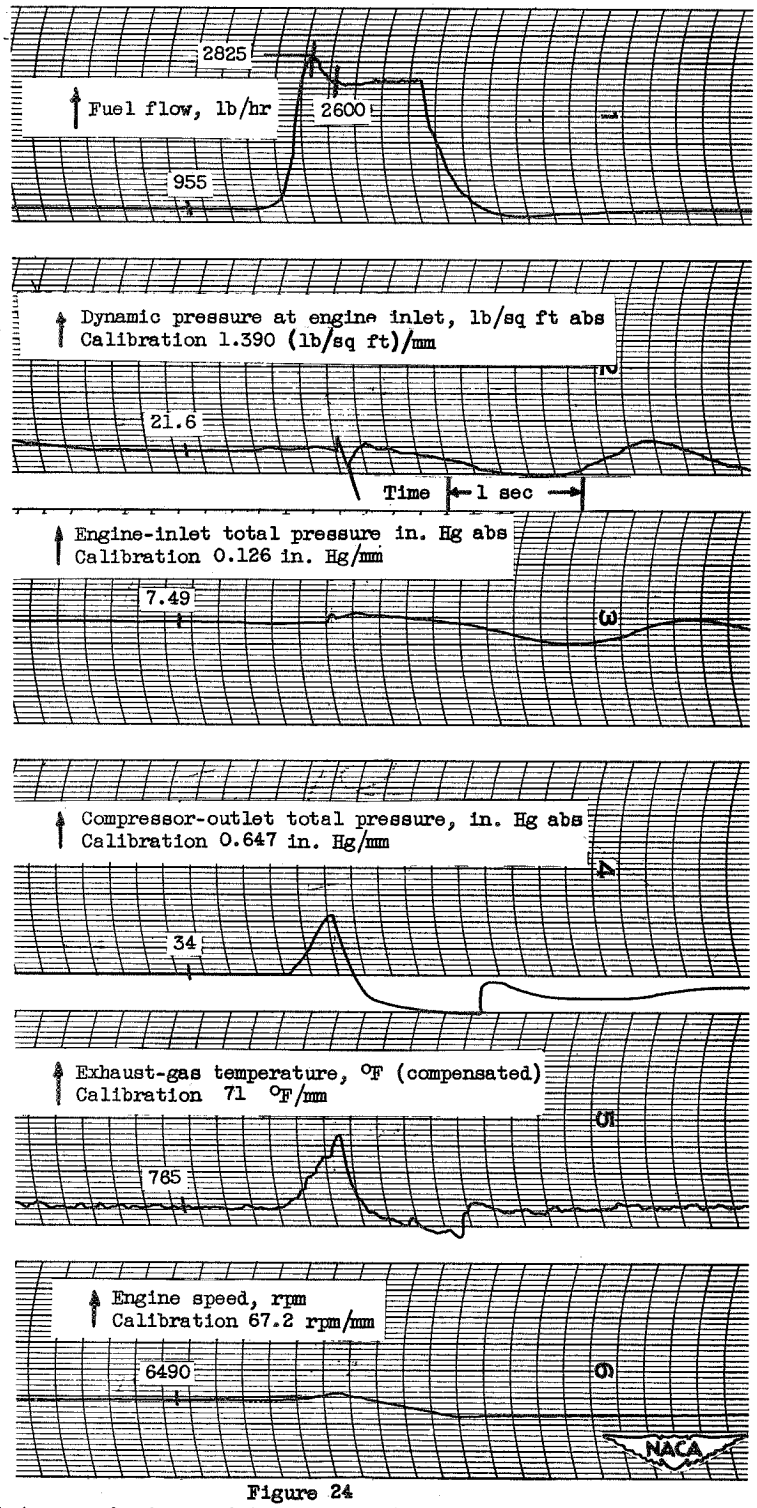

Figure 24

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

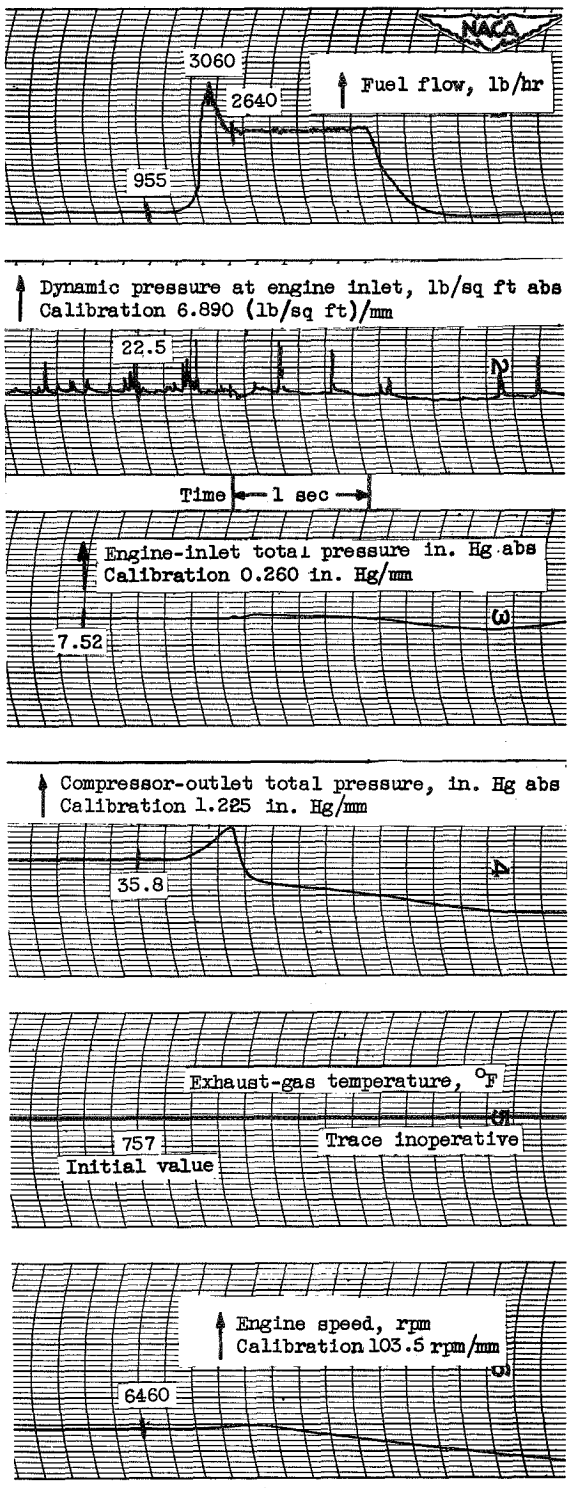

Figure 25

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

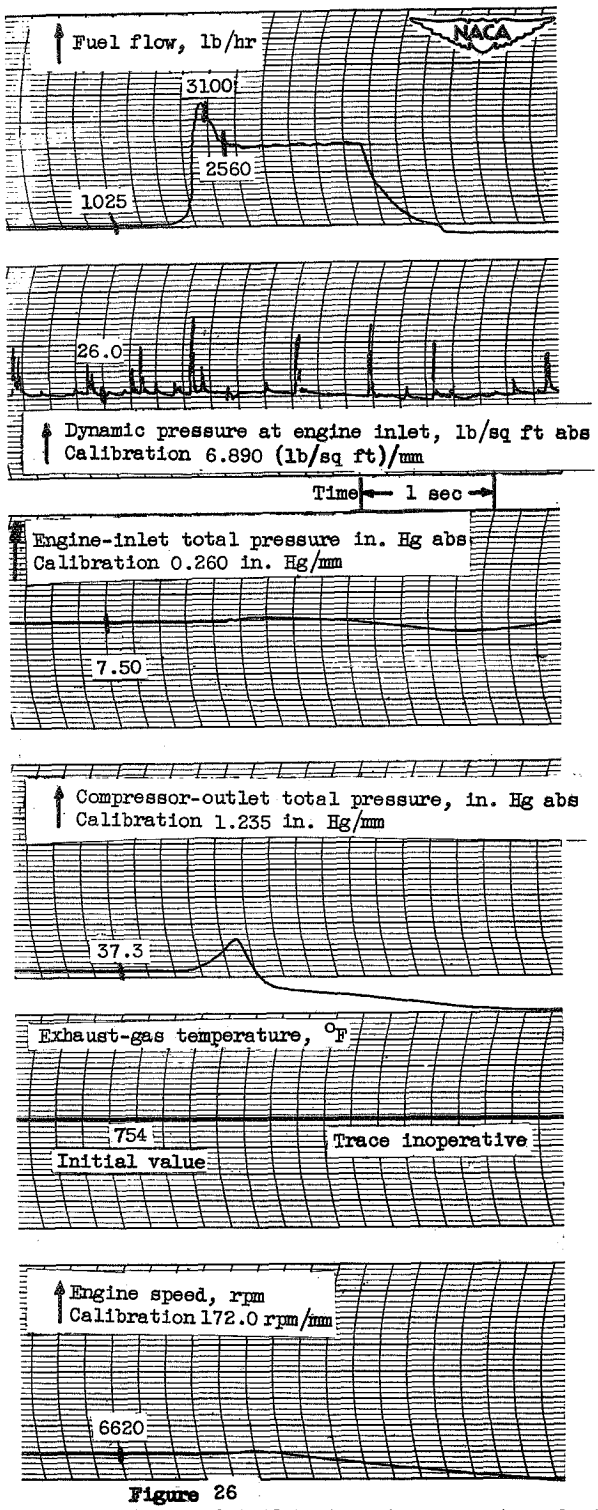

Figure 26

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

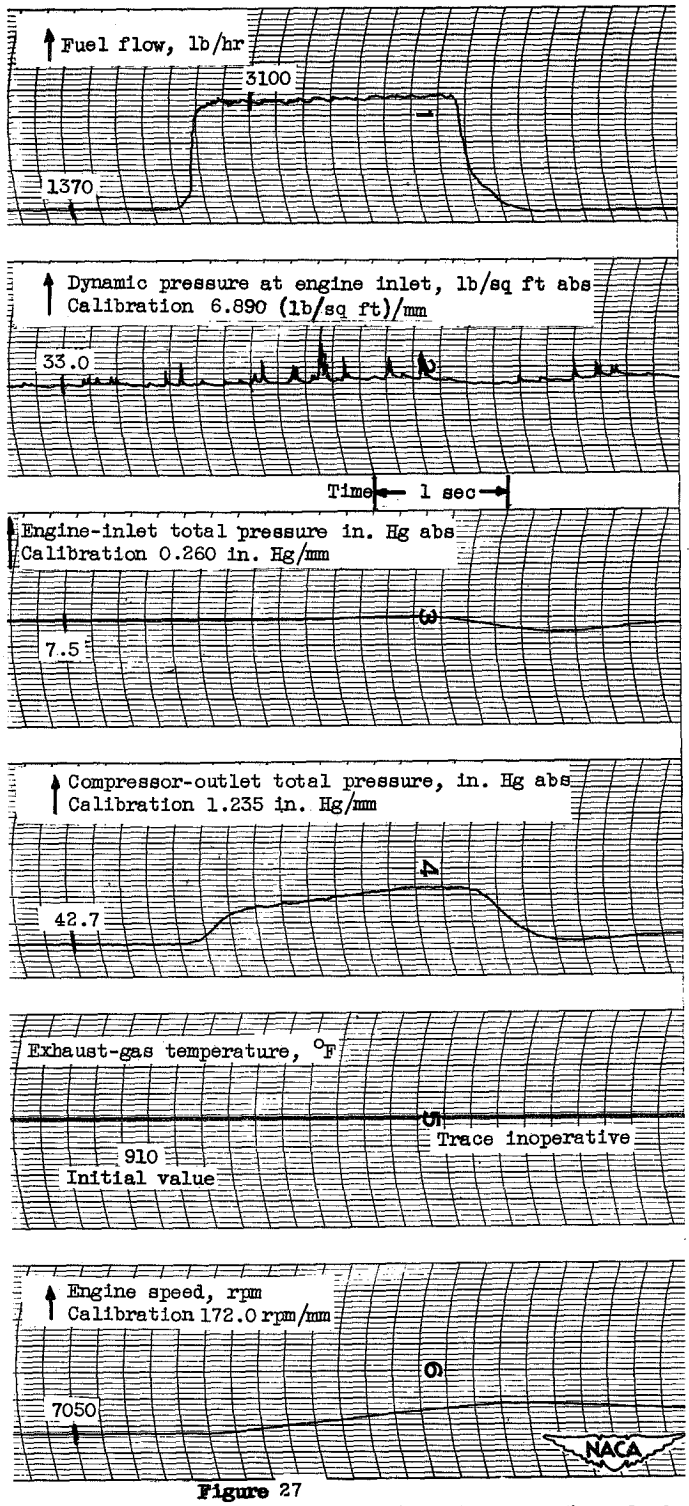

Figure 27

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 36° F; inlet guide vanes position, open.

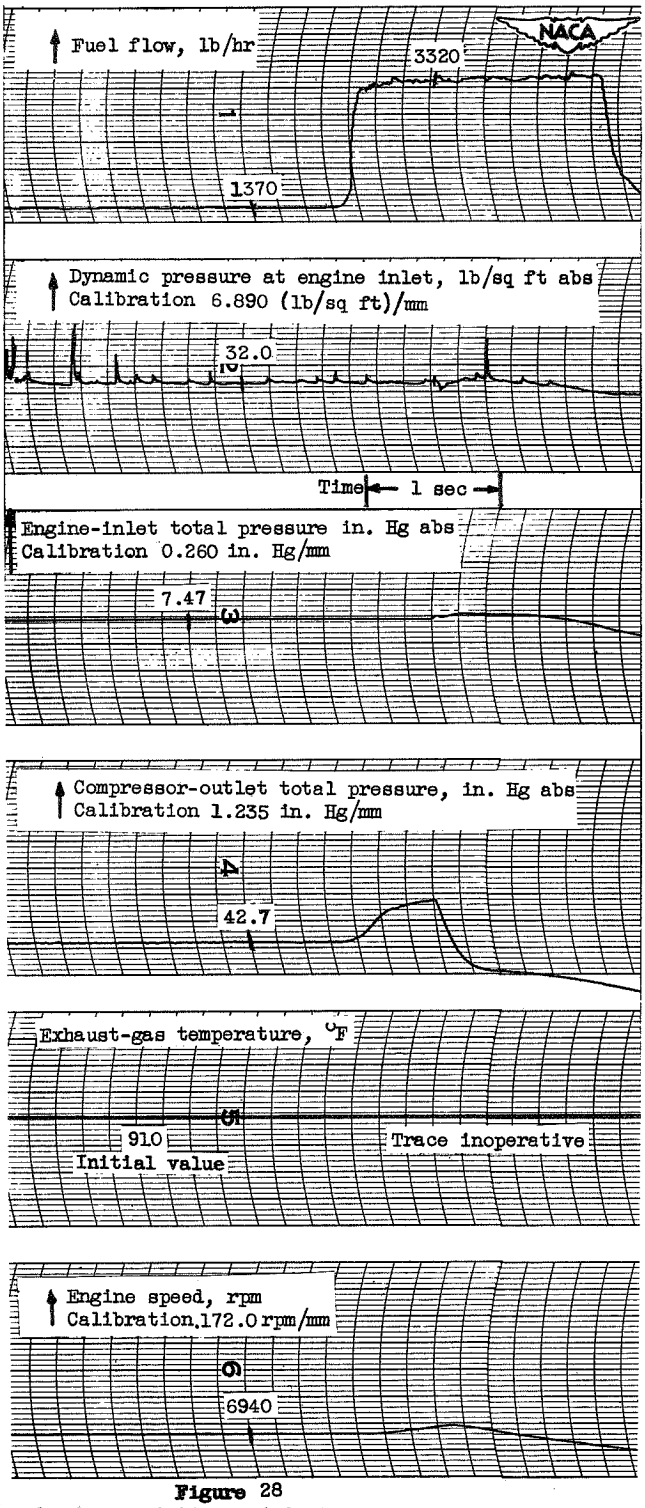

Figure 28

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 36 °F; inlet guide vanes position, open.

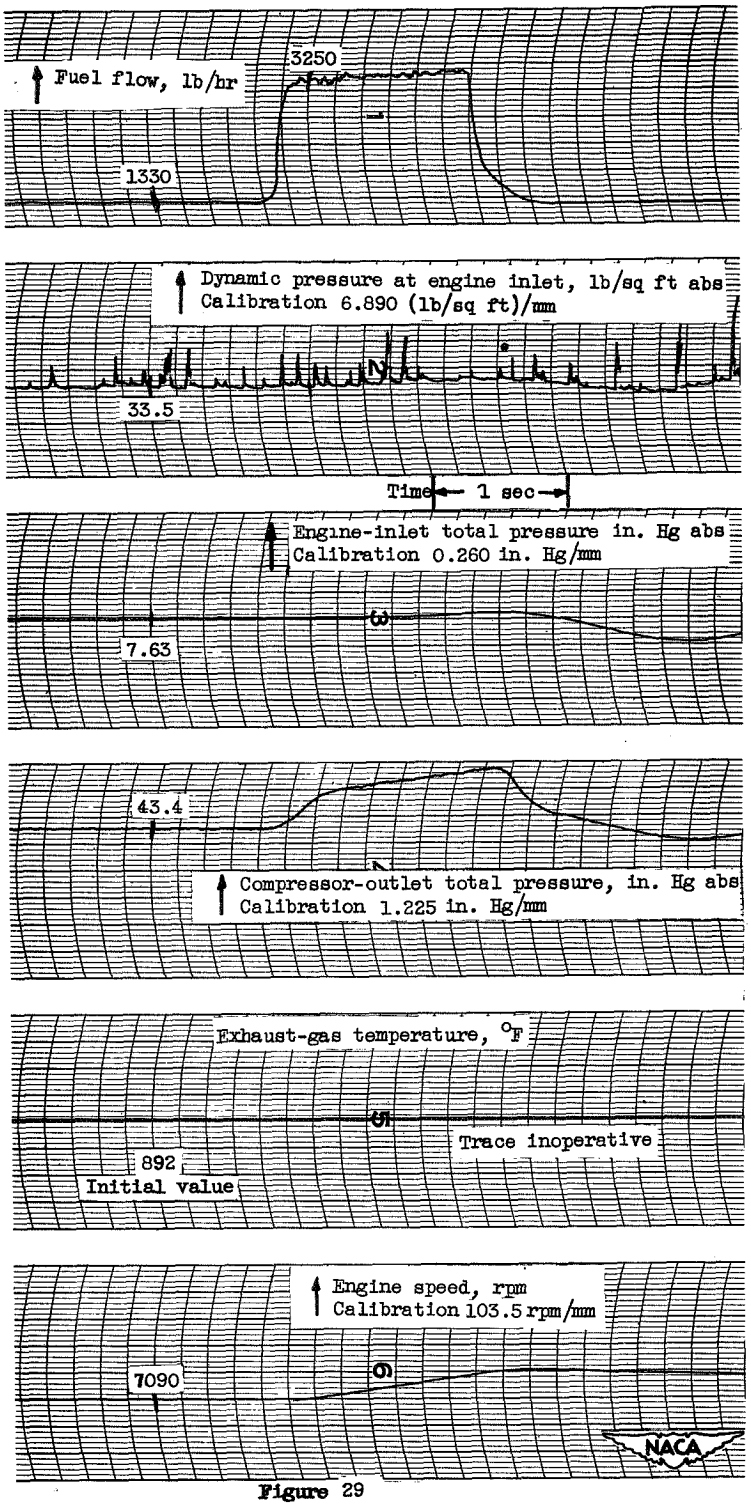

Figure 29

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

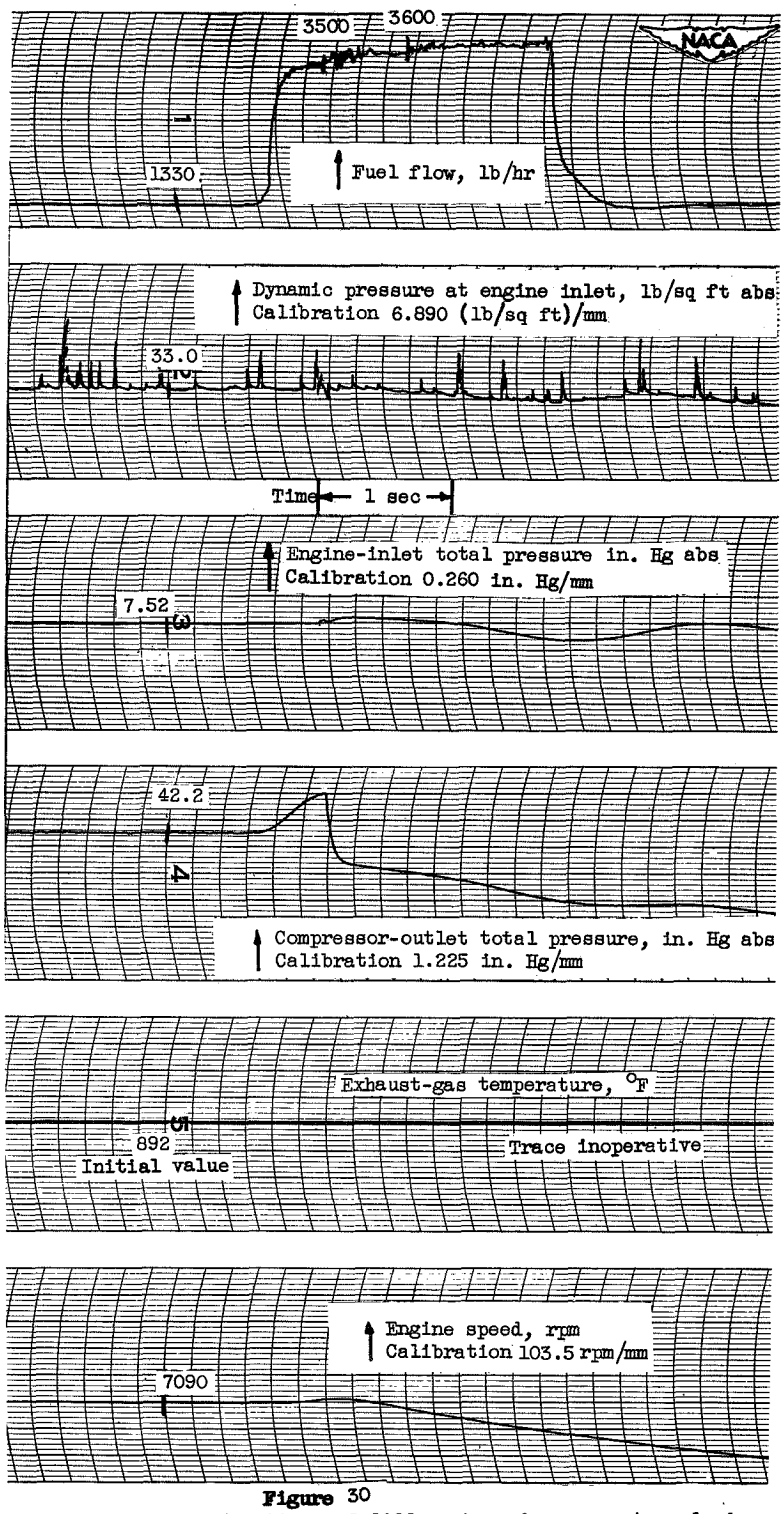

Figure 30

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37° F; inlet guide vanes position, open.

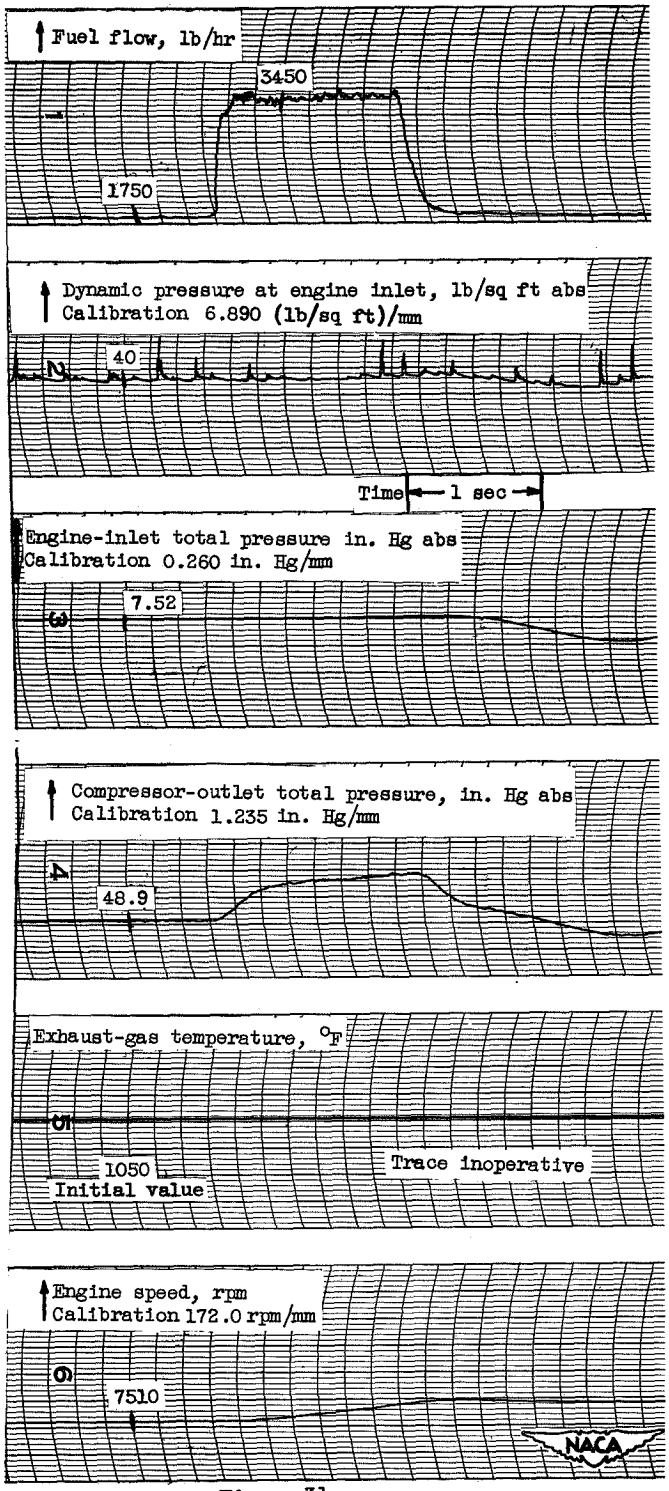

Figure 31

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 36° F; inlet guide vanes position, open.

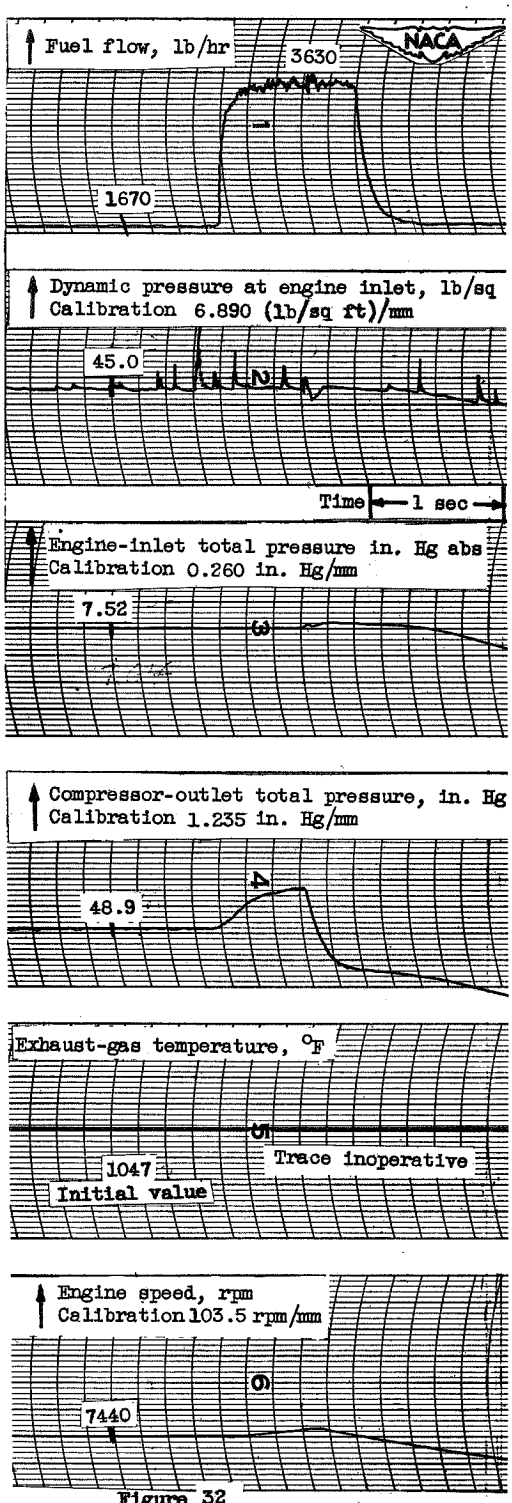

Figure 32

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 36° F; inlet guide vanes position, open.

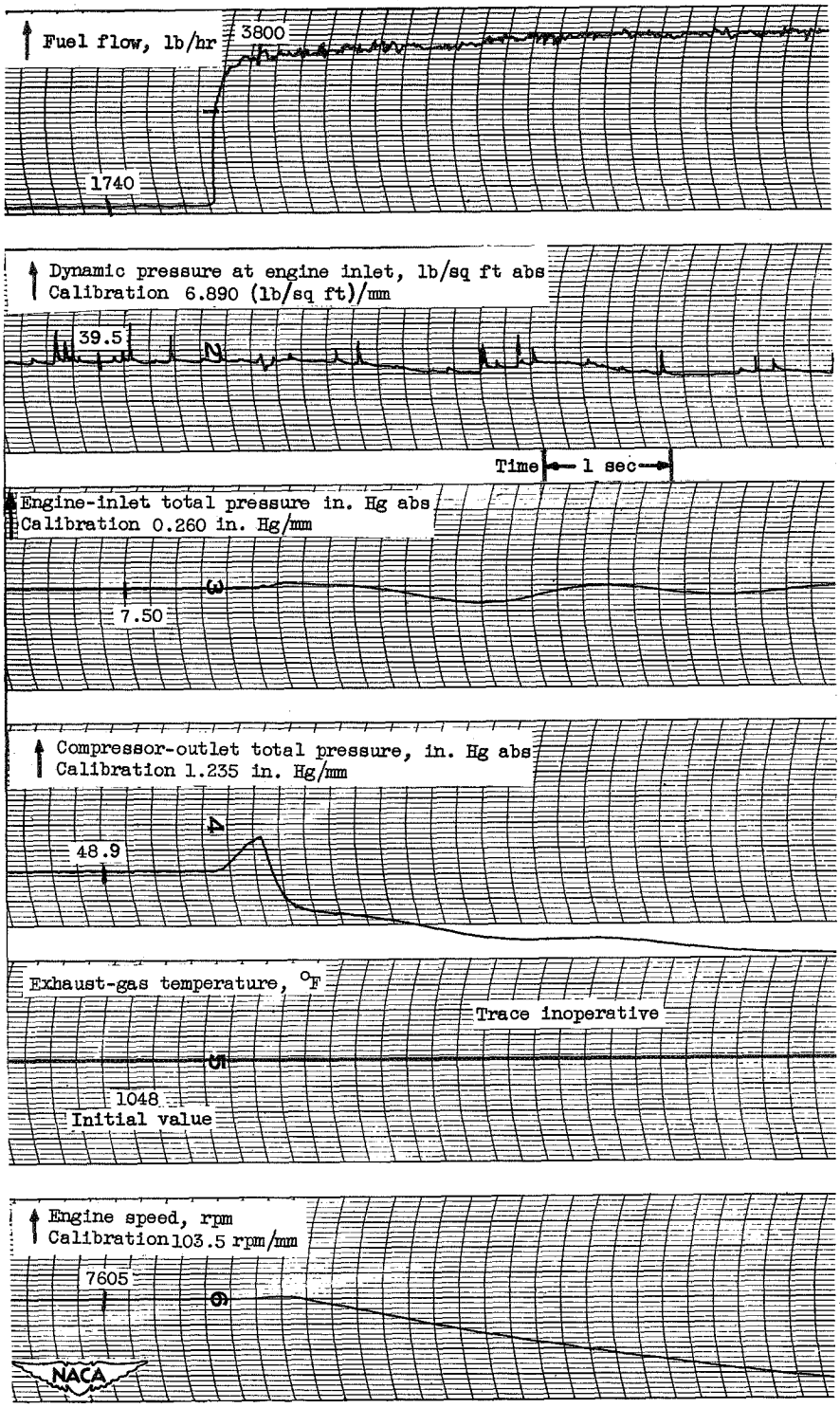

Figure 33

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 37 °F; inlet guide vanes position, open.

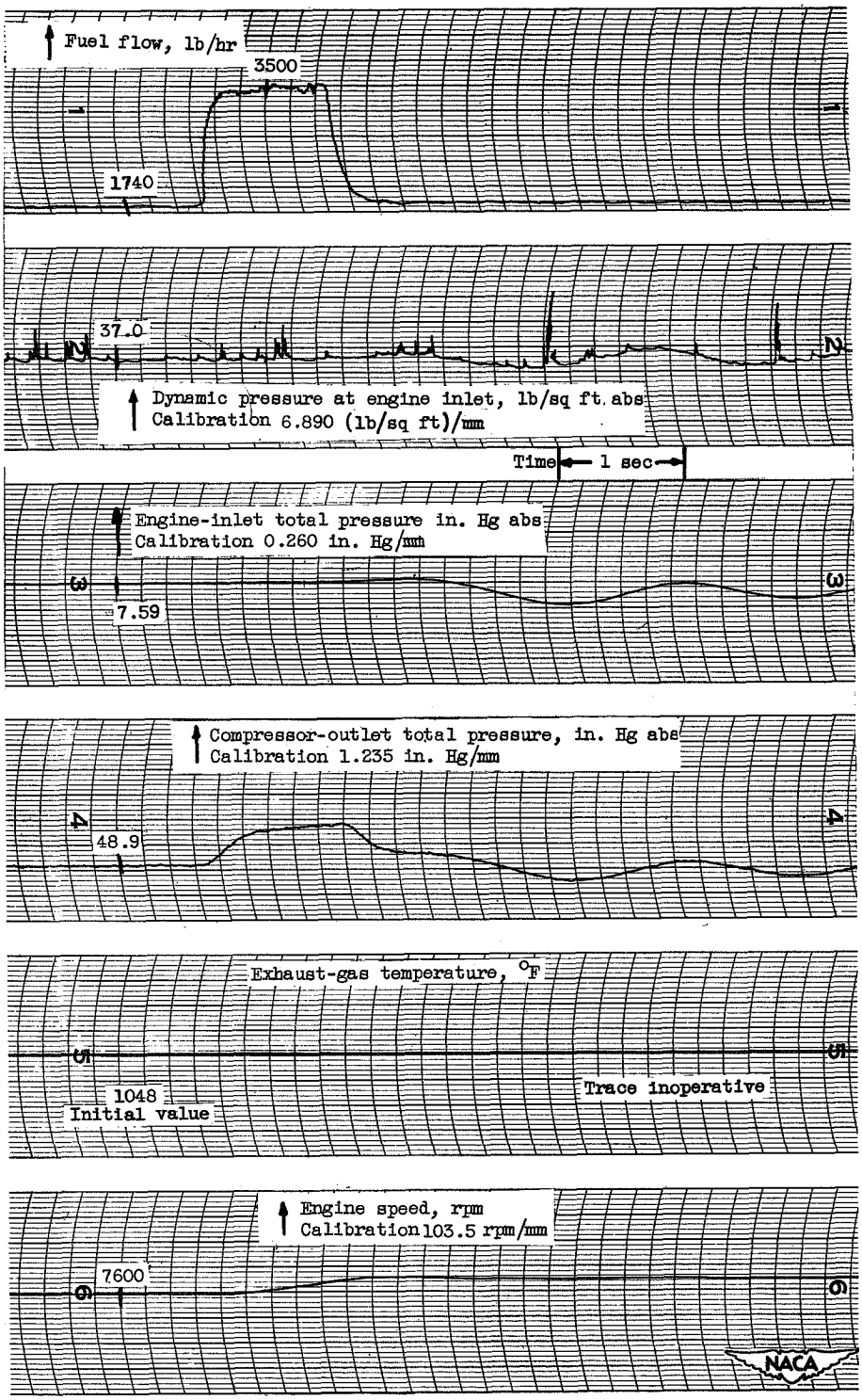

Figure 34

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, 36° F; inlet guide vanes position, open.

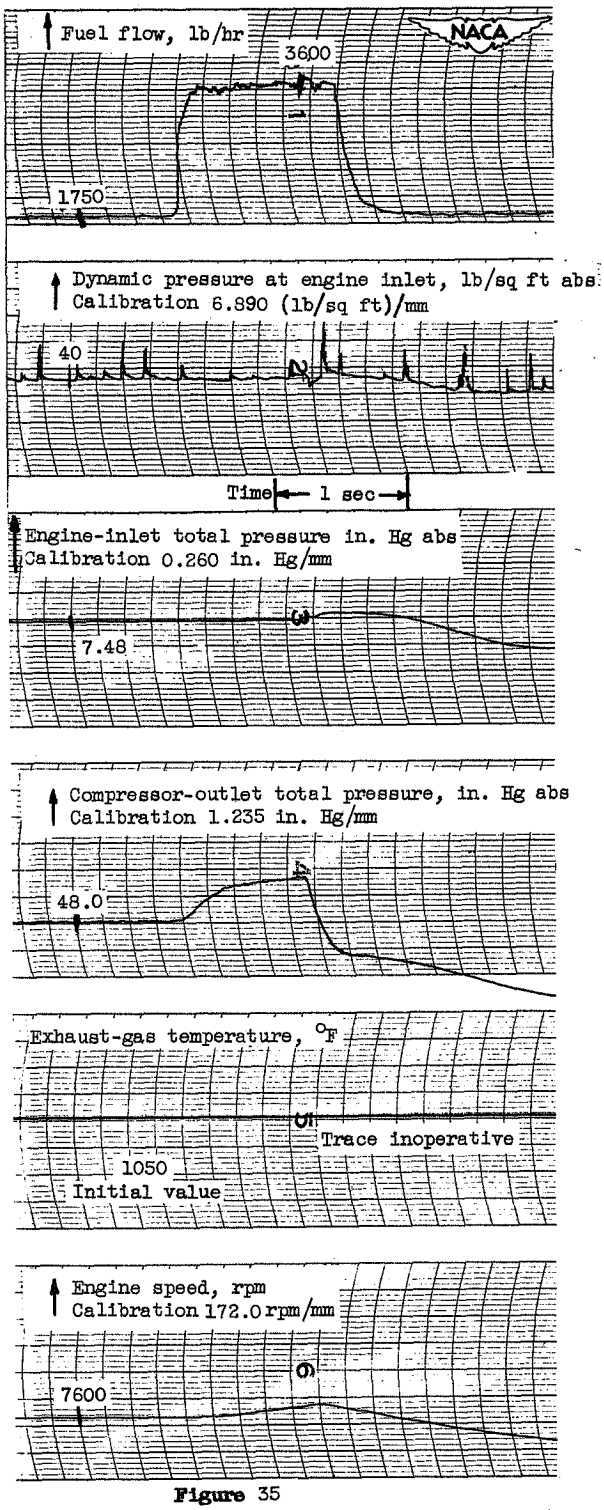

Figure 35

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 **feet; flight Mach number,** 0.3 **; engine-inlet air temperature,** 36° **F; inlet guide vanes position, open.**

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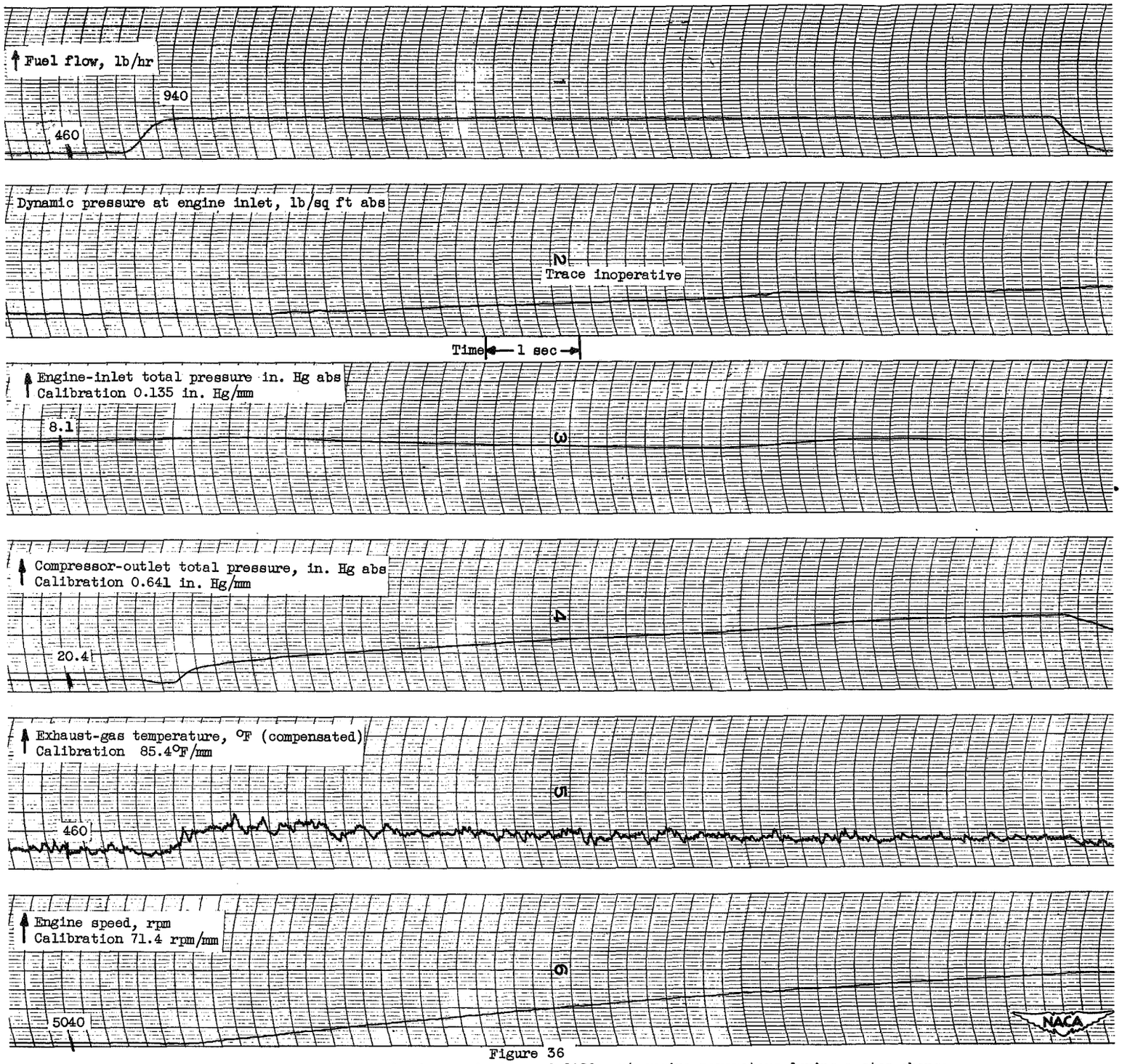

Figure 36

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -6° F; inlet guide vanes position, closed.

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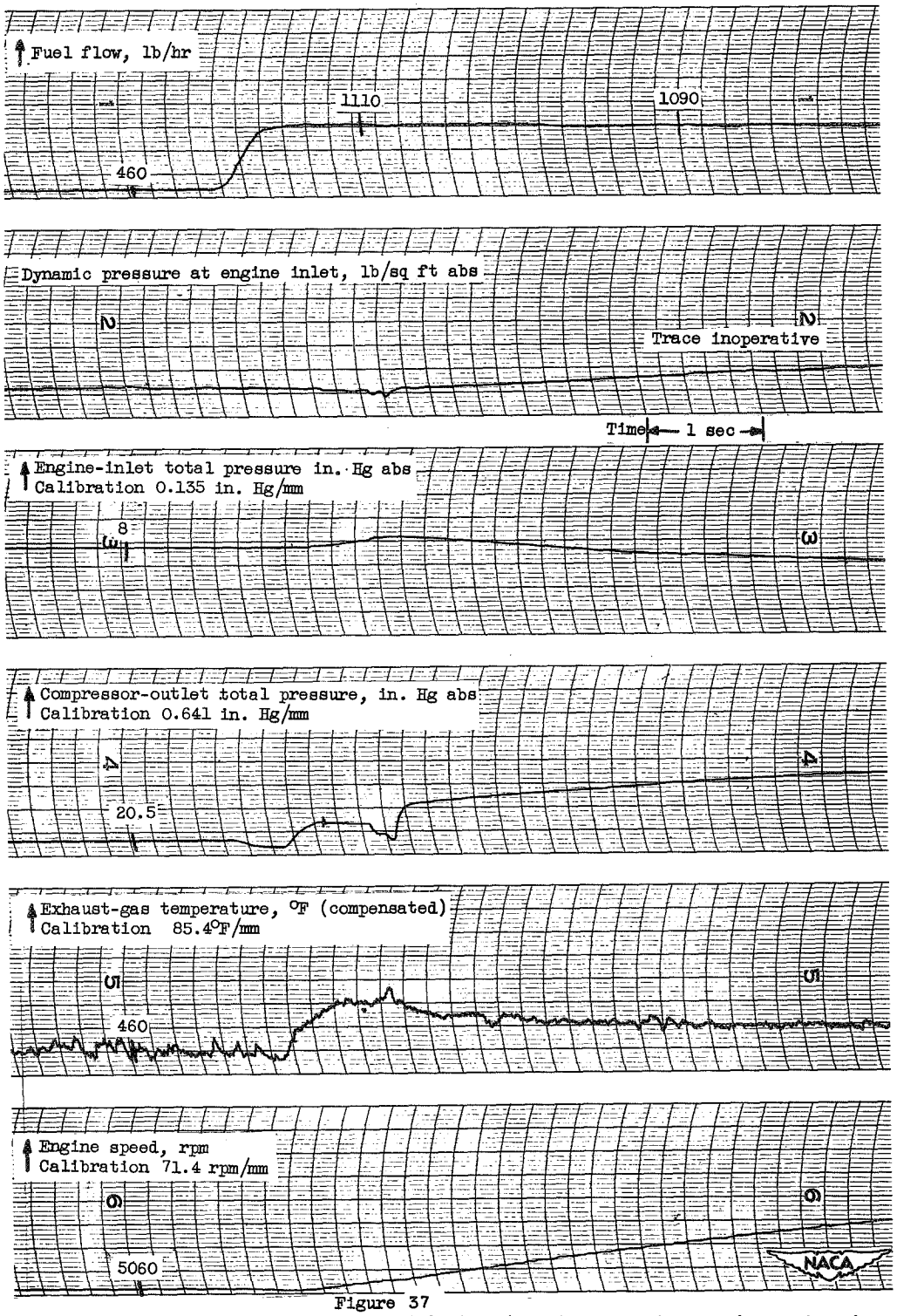

Figure 37

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -6 °F; inlet guide vanes position, closed.

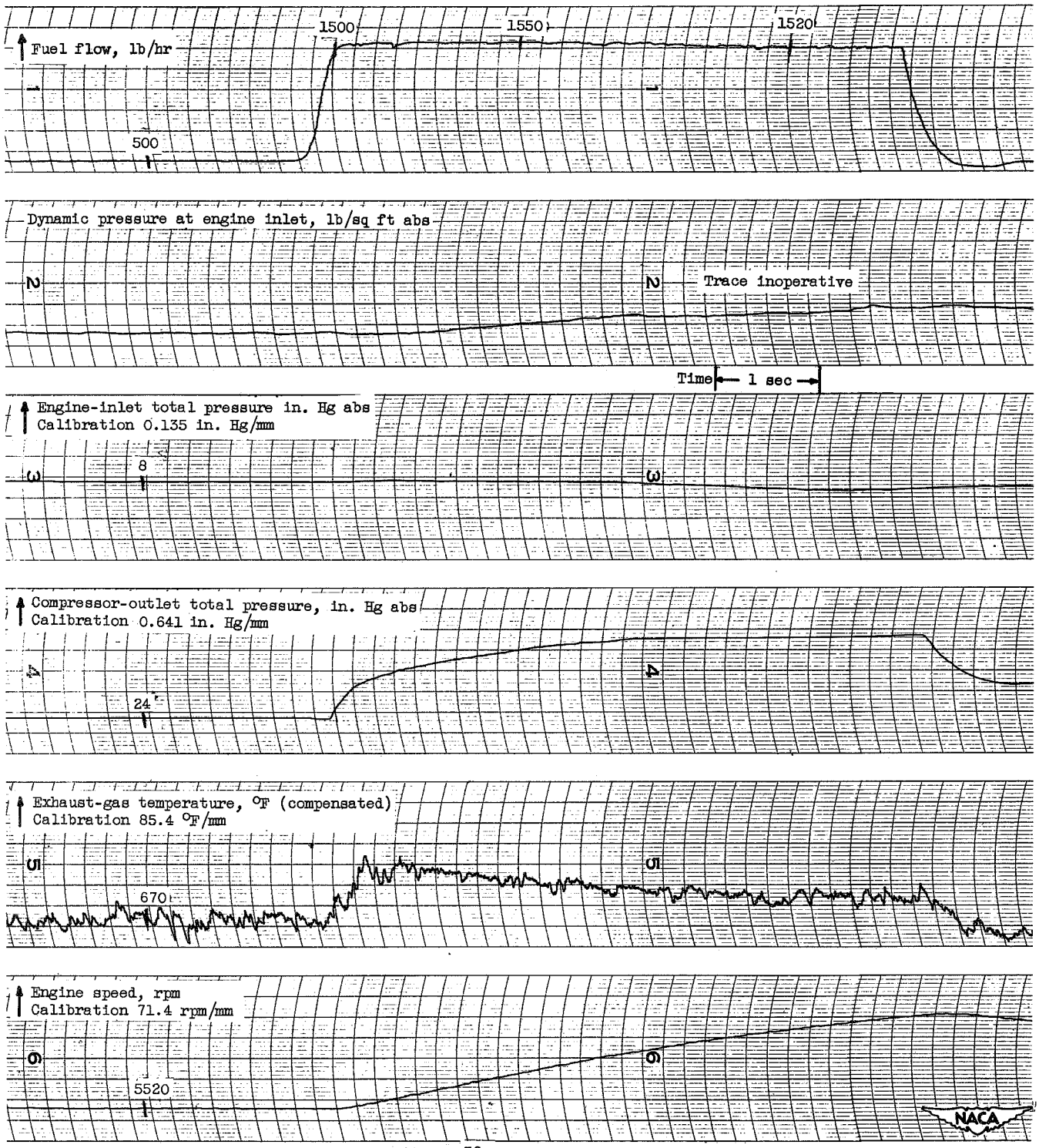

Figure 38

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3 ; engine-inlet air temperature, -5 ° F; inlet guide vanes position, closed.

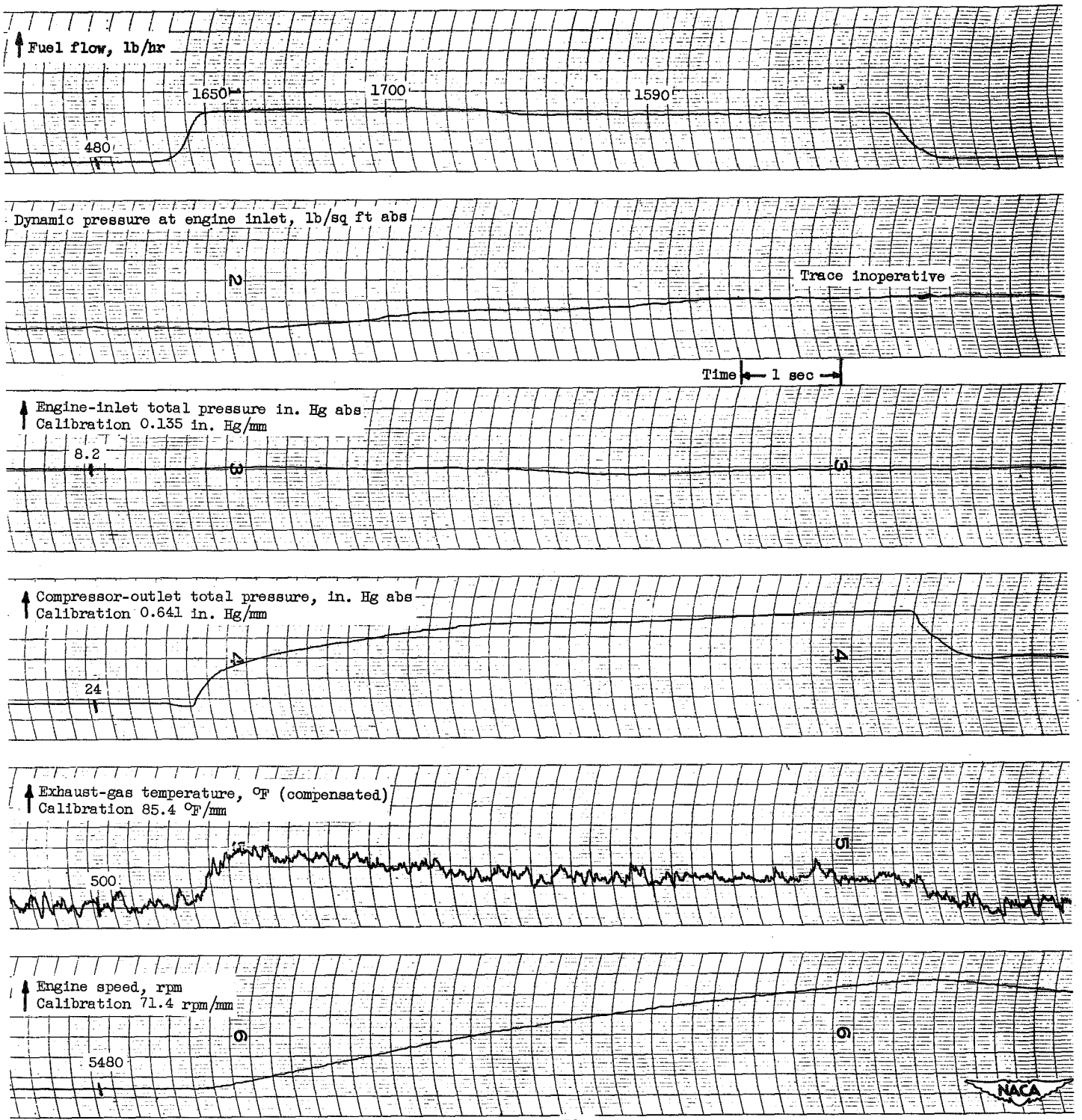

Figure 39

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -3 °F; inlet guide vanes position, closed.

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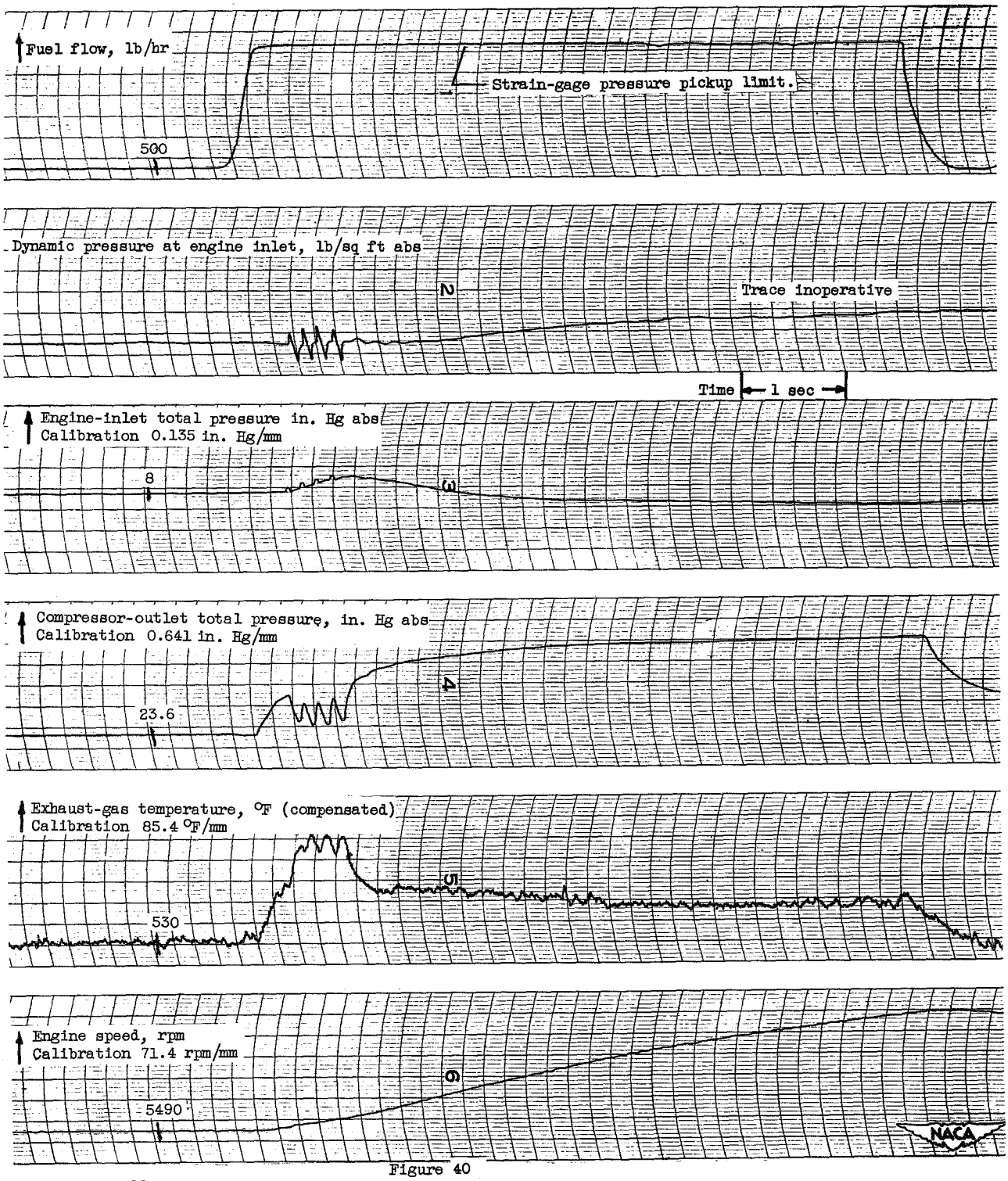

Figure 40

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -5° F; inlet guide vanes position, closed.

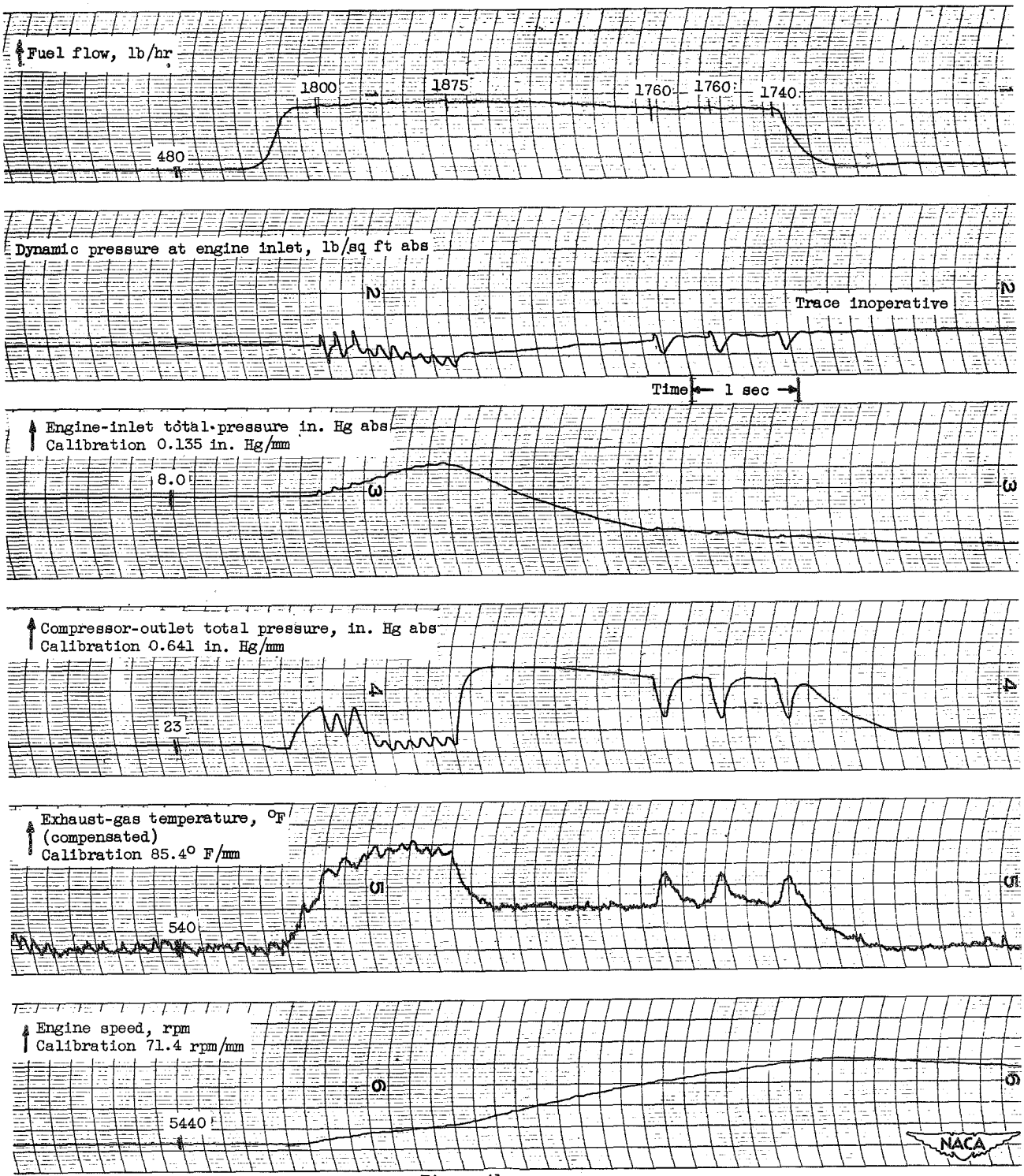

Figure 41

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000feet; flight Mach number, 0.3; engine-inlet air temperature, -3 ° F; inlet guide vanes position, closed.

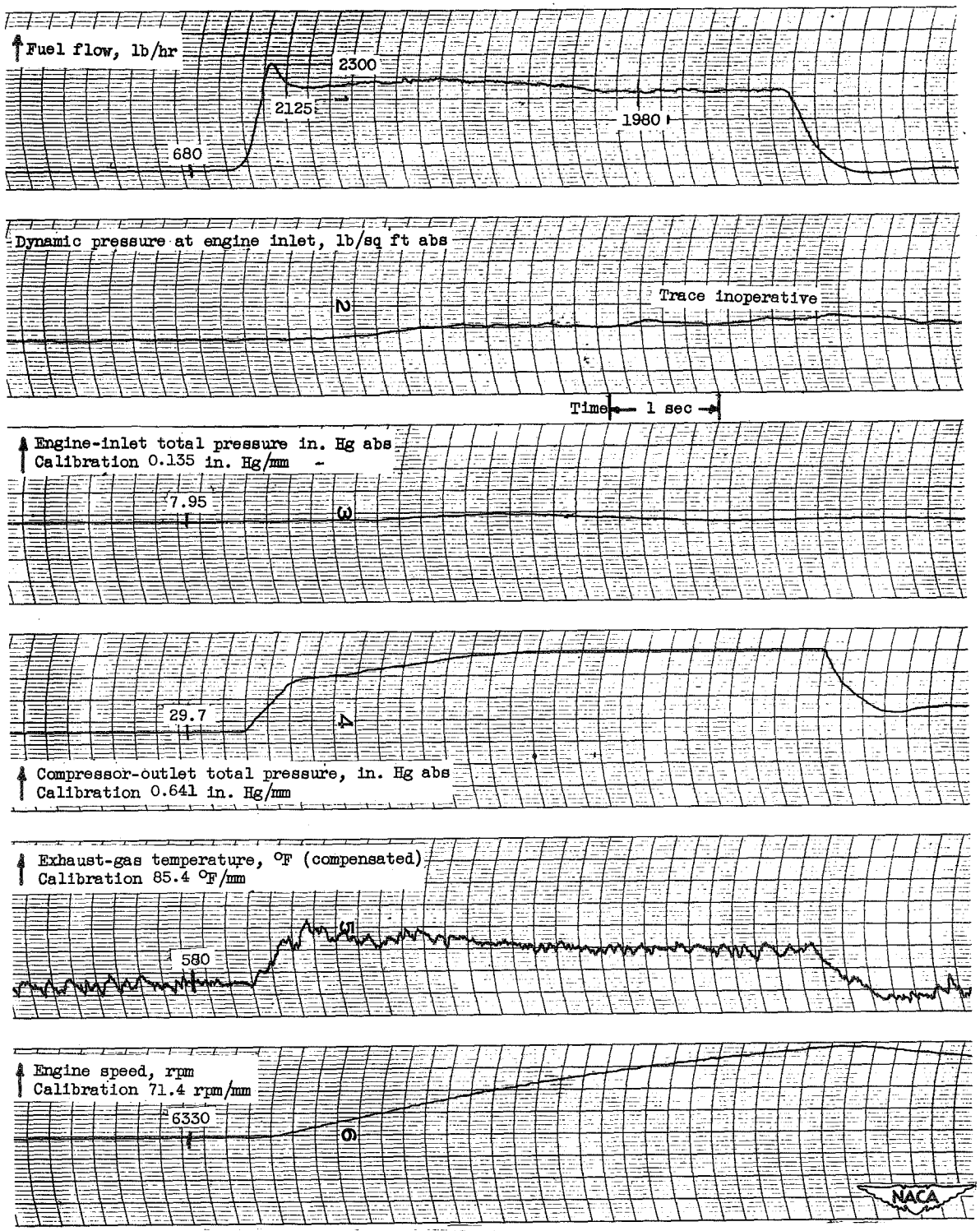

Figure 42

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -1 ° F; inlet guide vanes position, closed.

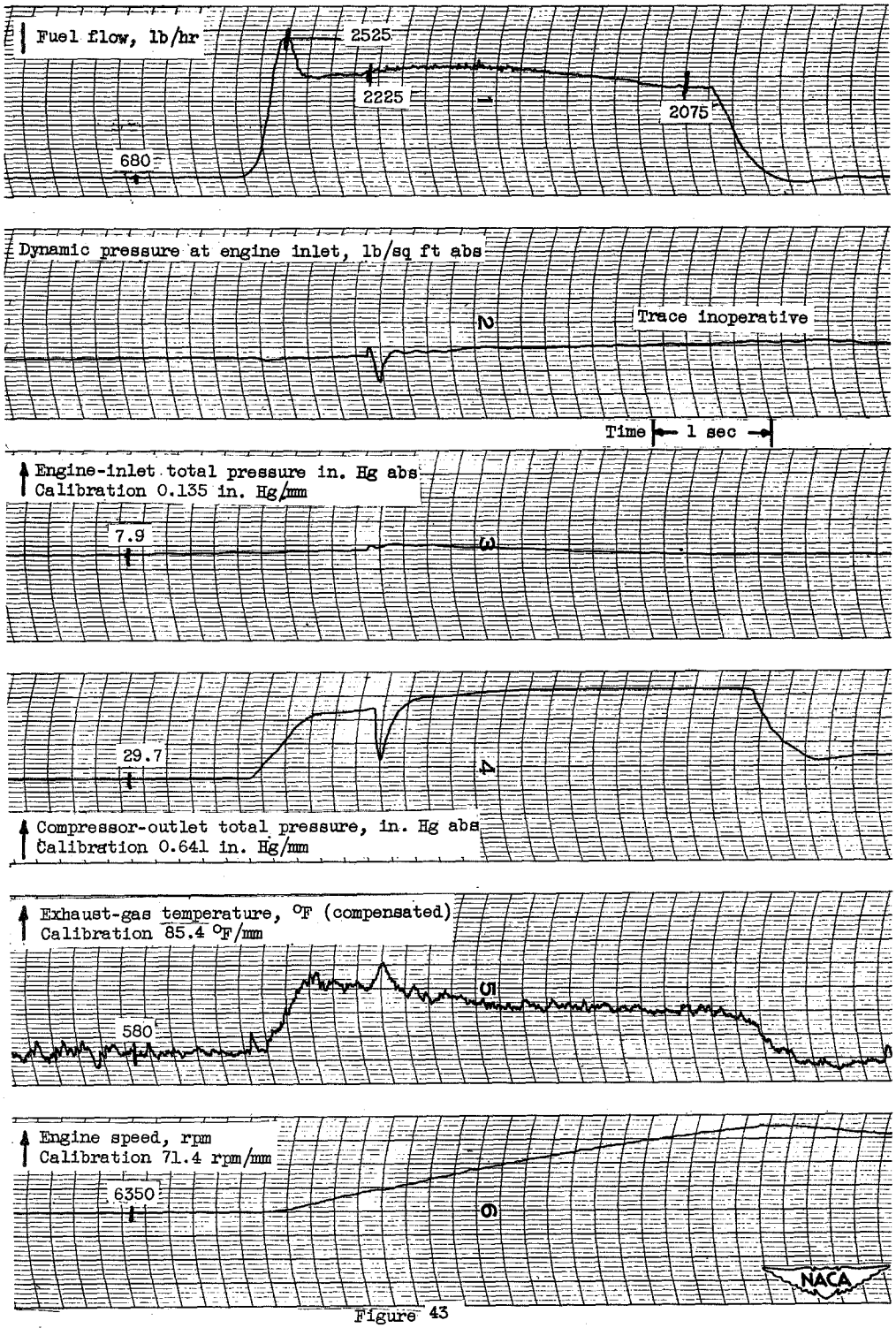

Figure 43

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -1 °F; inlet guide vanes position, closed.

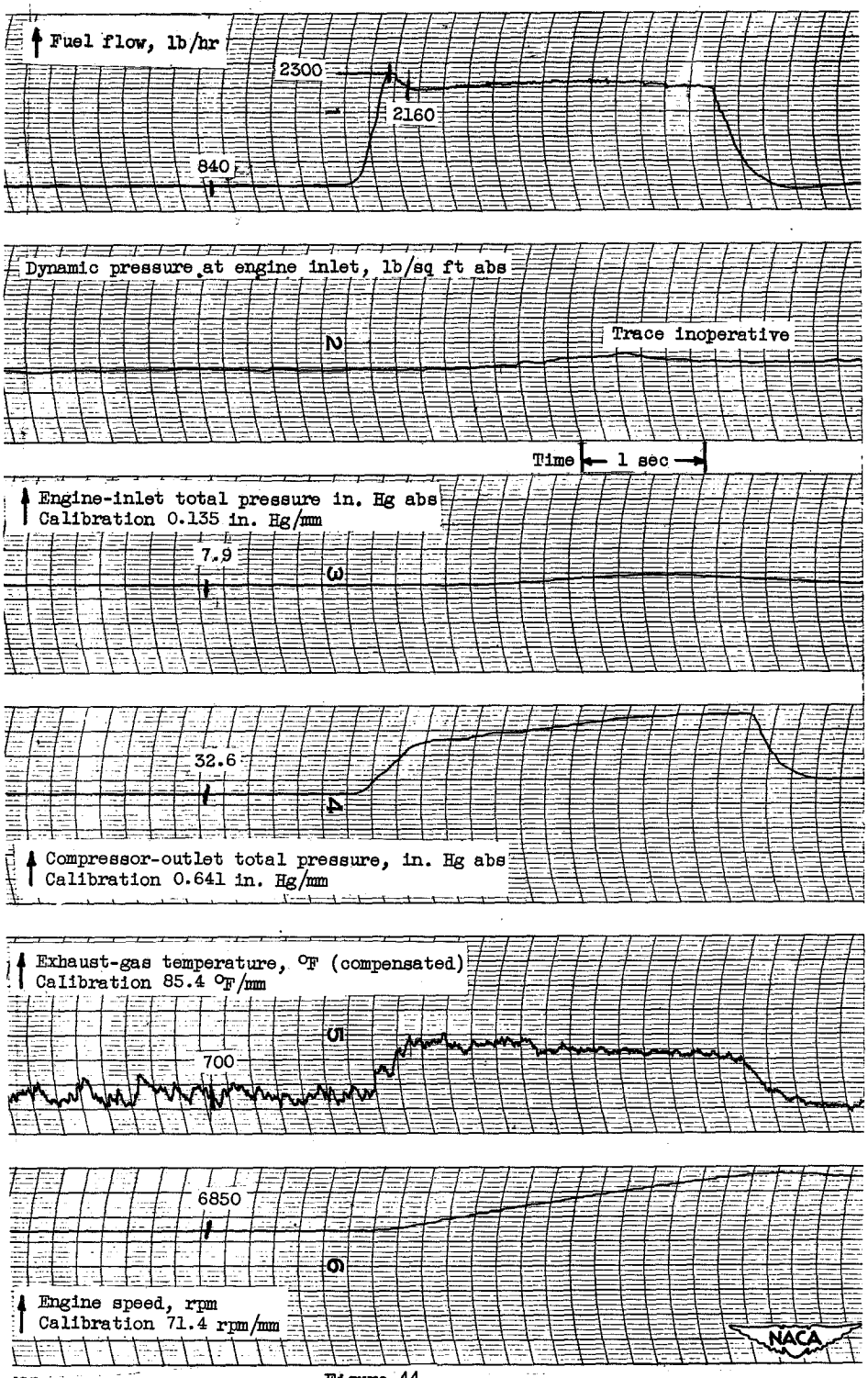

Figure 44

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -2 °F; inlet guide vanes position, closed.

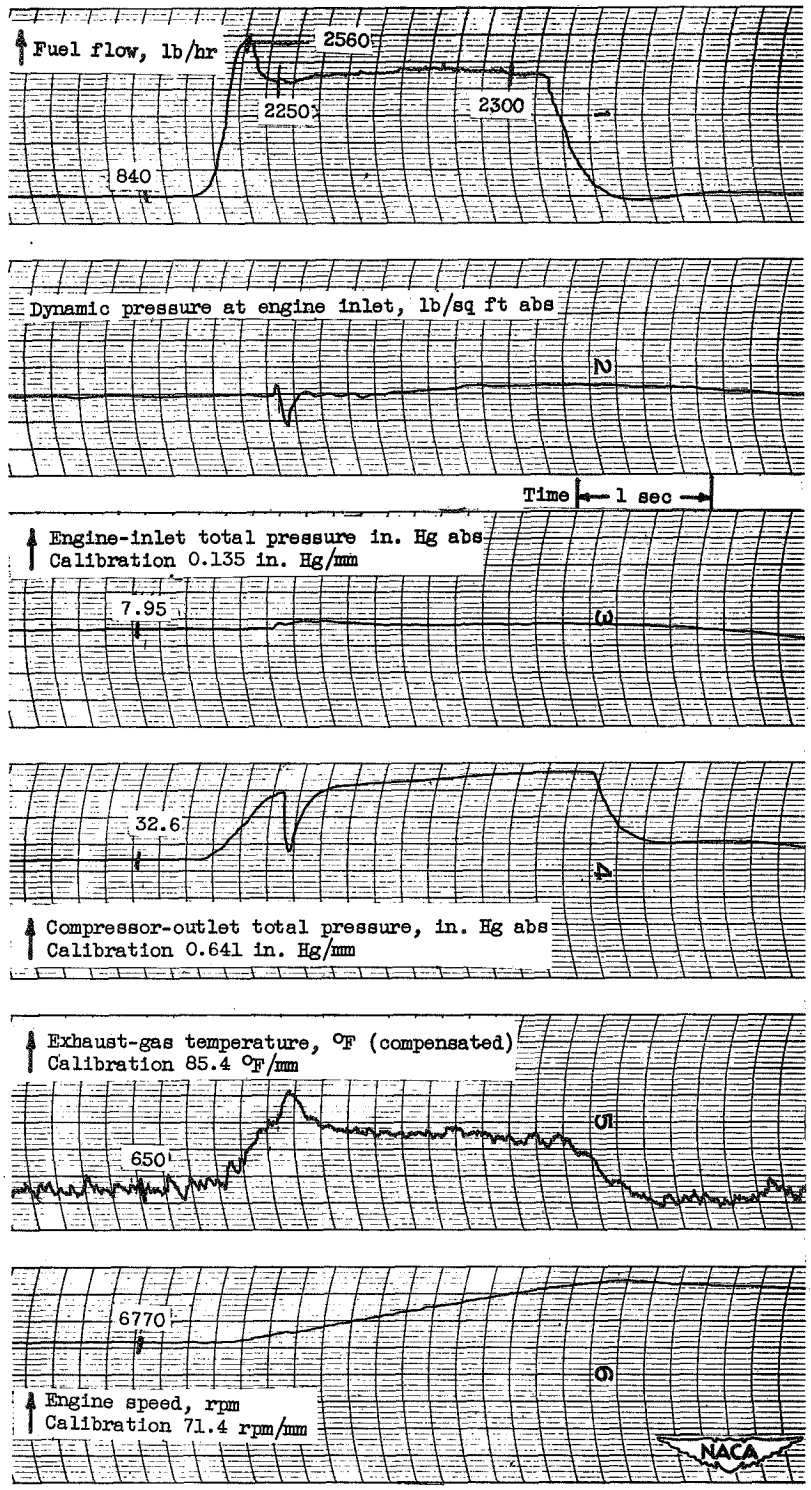

Figure 45

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.3; engine-inlet air temperature, -2 ° F; inlet guide vanes position, closed.

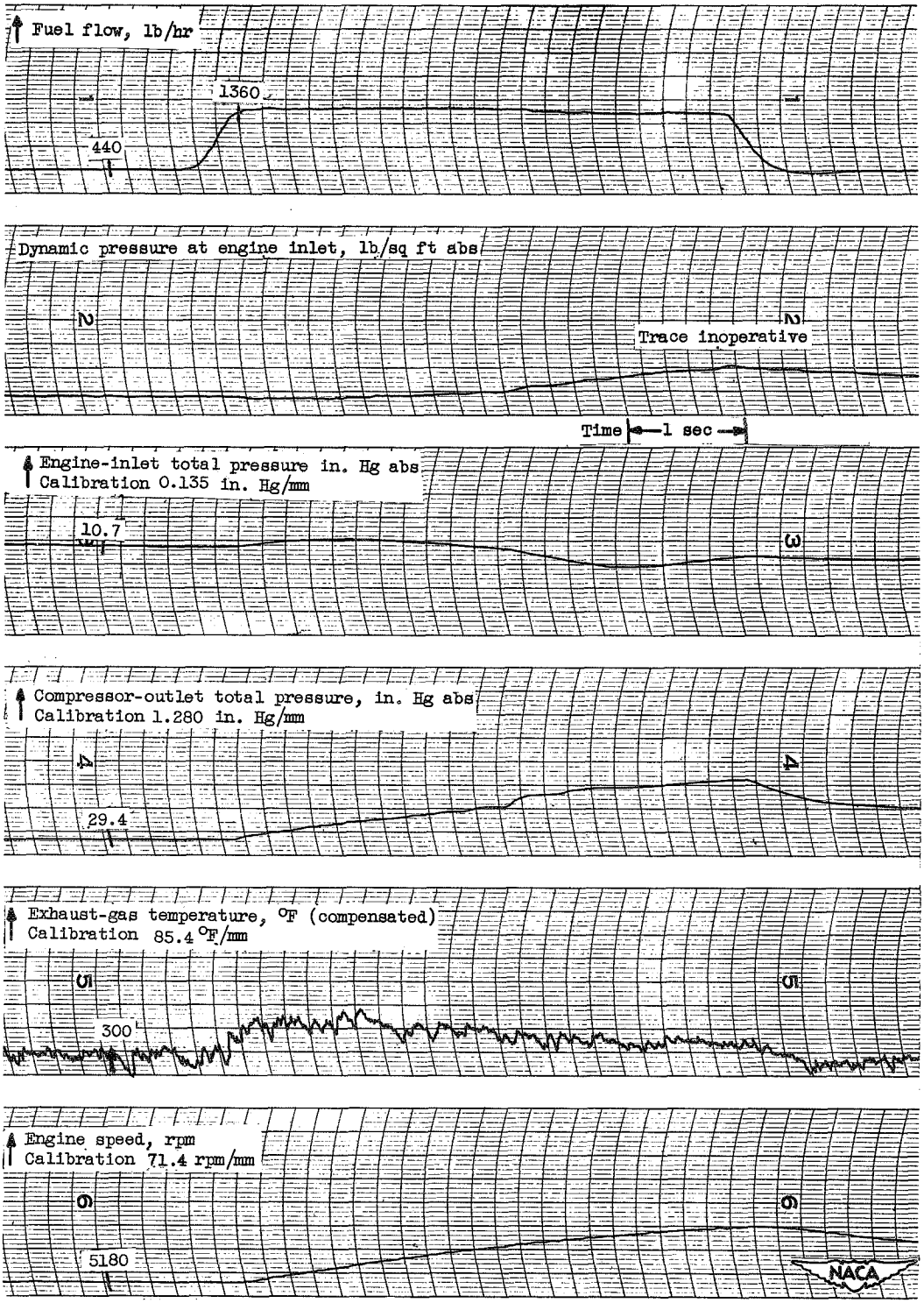

Figure 46

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -10° F; inlet guide vanes position, open.

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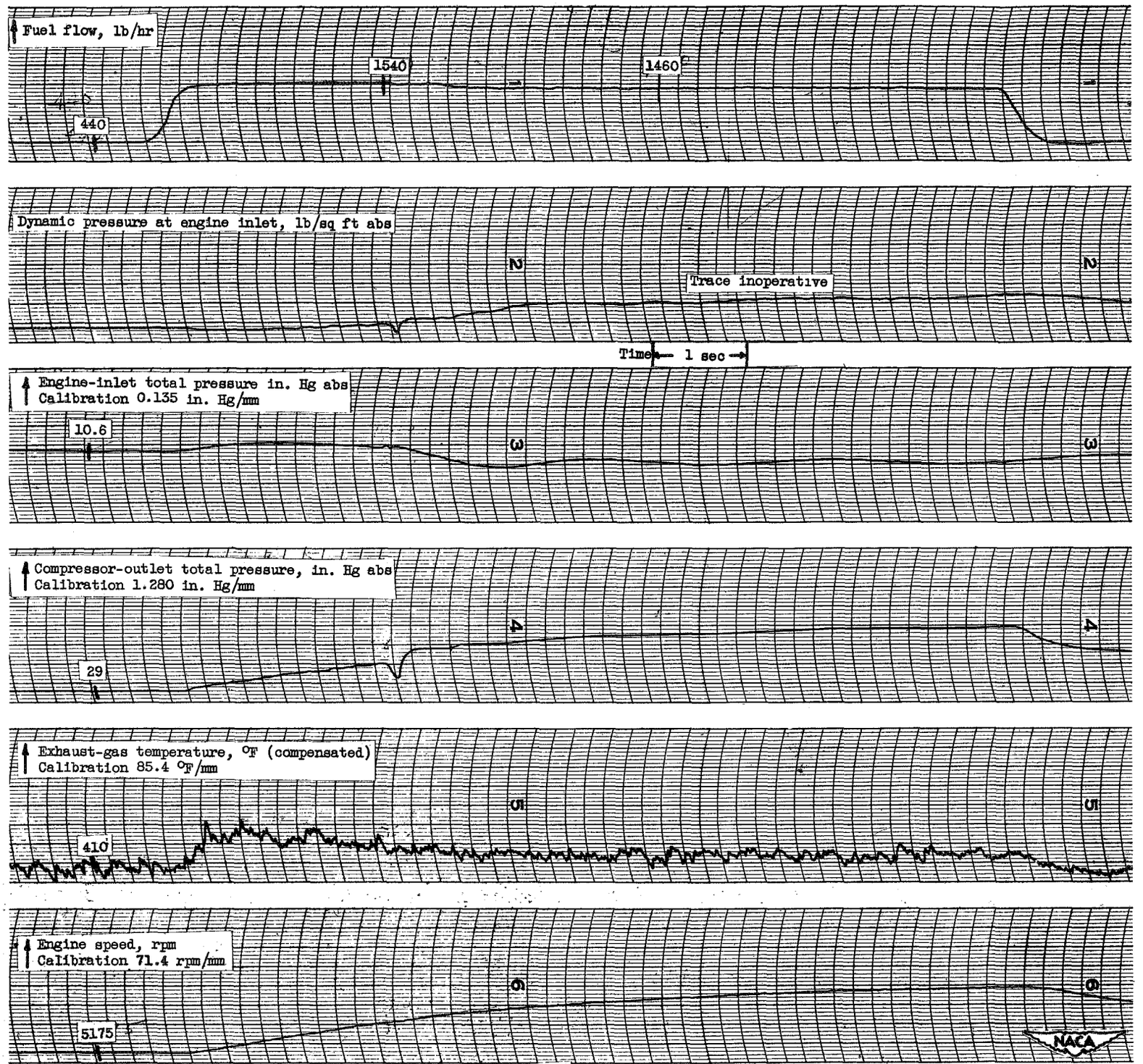

Figure 47

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -10 ° F; inlet-guide vanes position, open.

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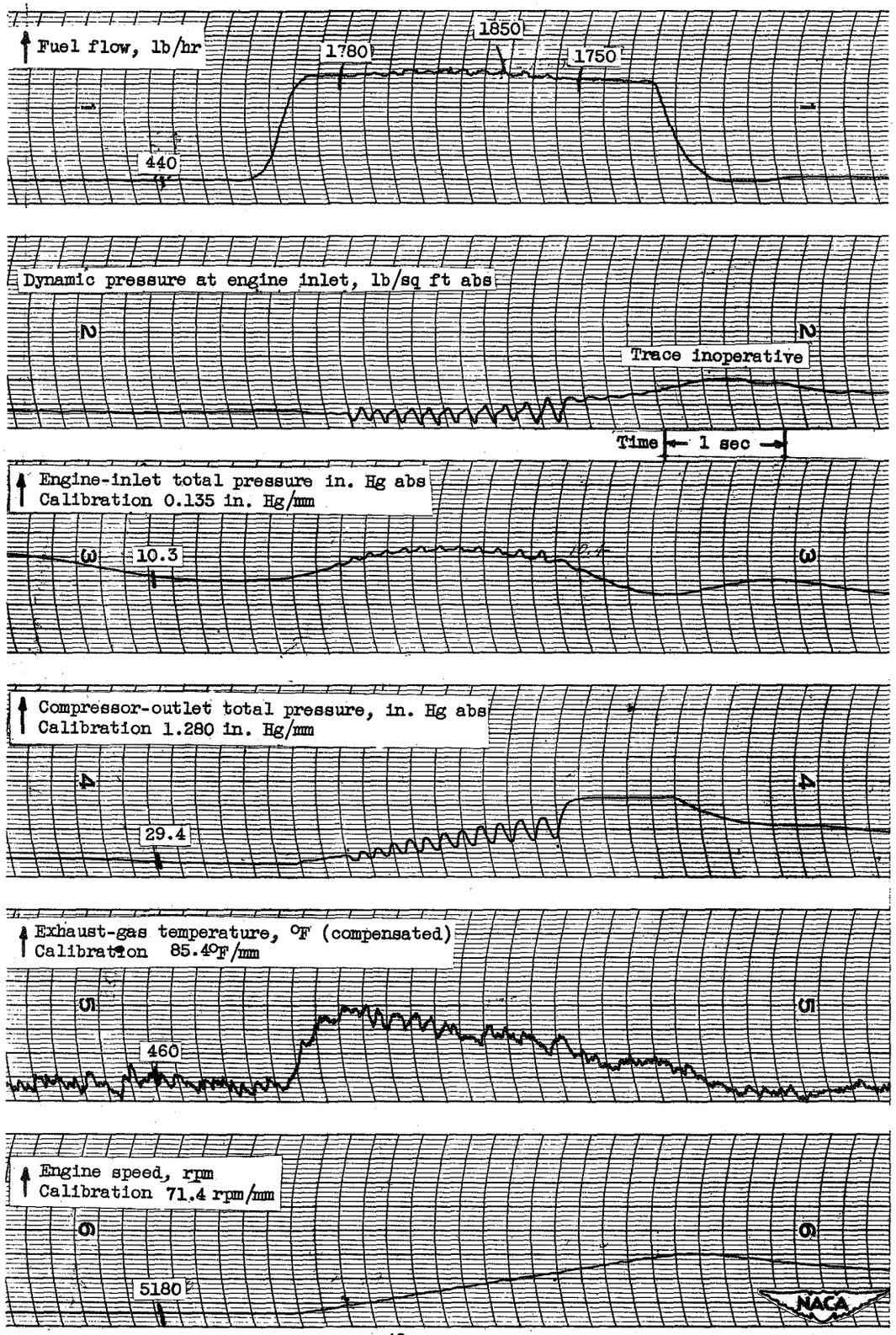

Figure 48

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -10 °F; inlet guide vanes position, open.

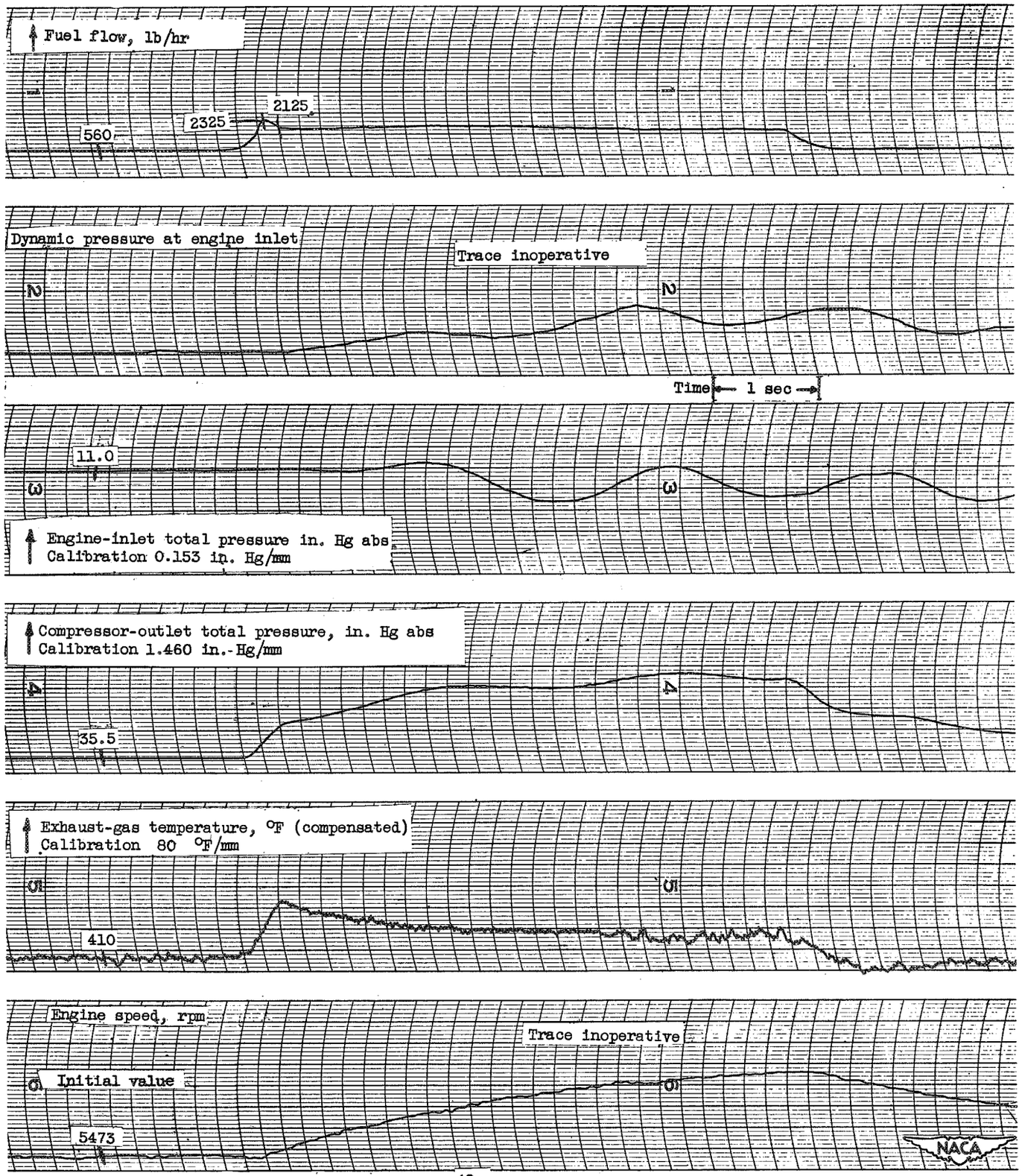

Figure 49

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -8 ° F; inlet guide vanes position, open.

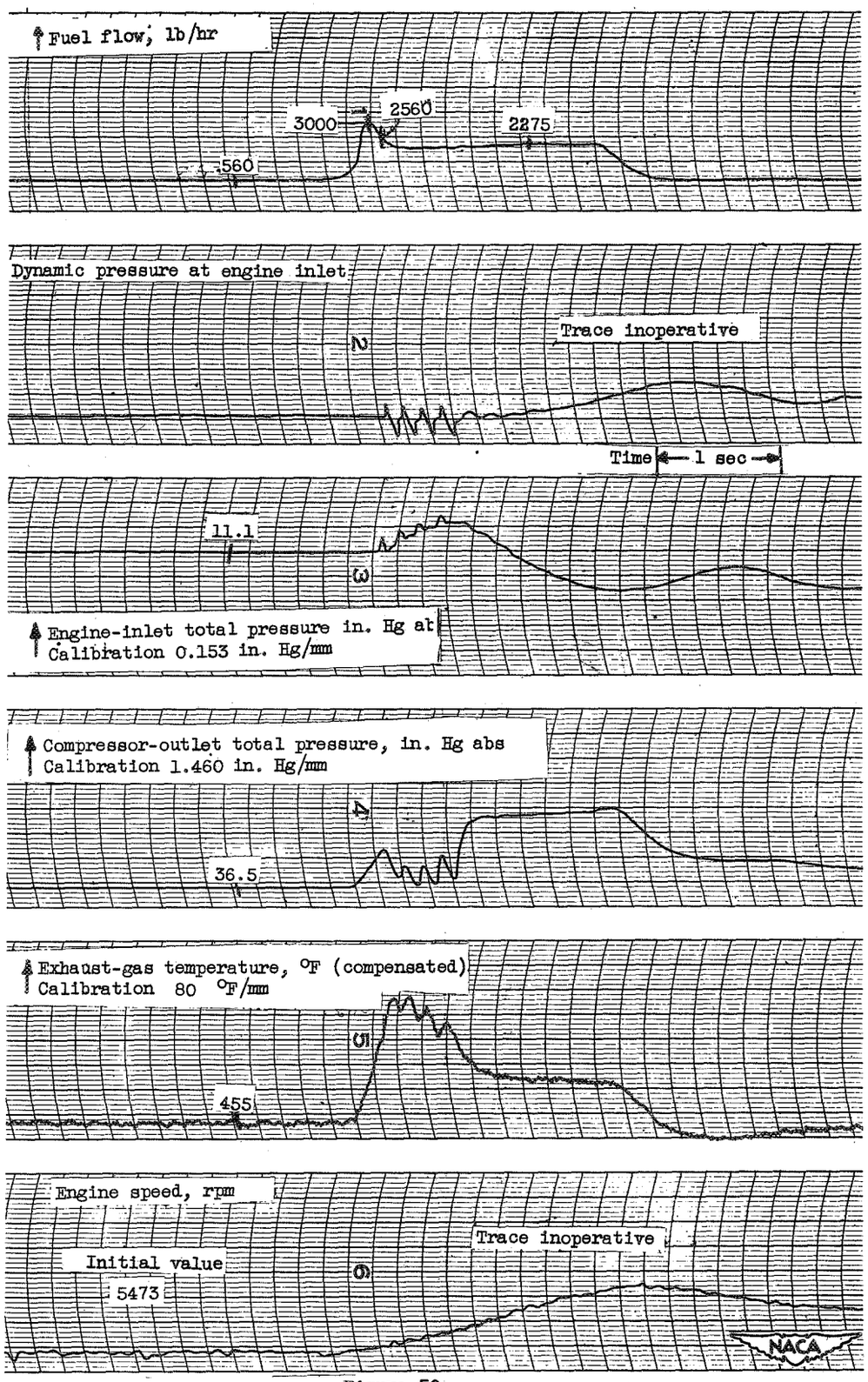

Figure 50

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -80 F; inlet guide vanes position, open.

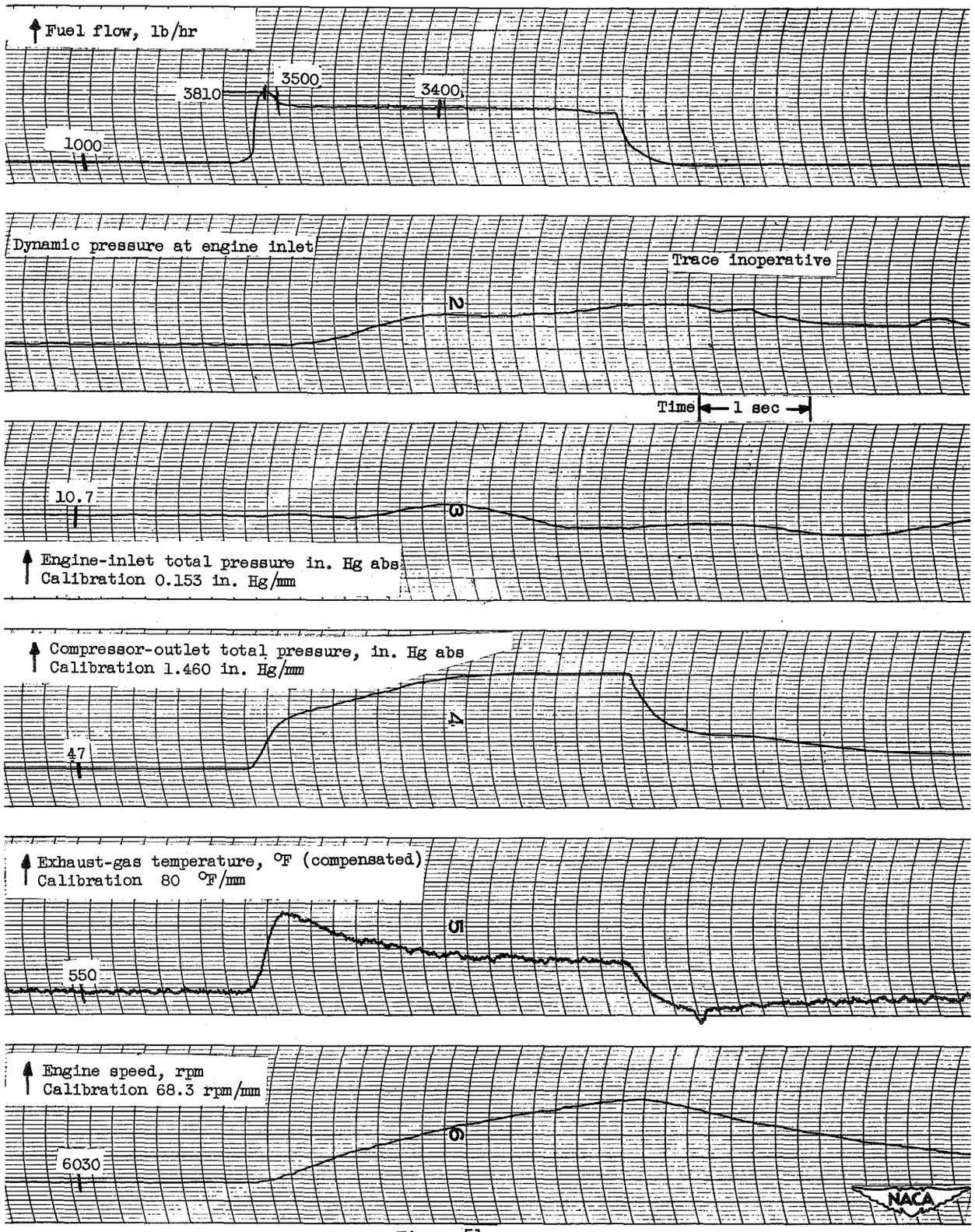

Figure 51

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -6 °F; inlet guide vanes position, open.

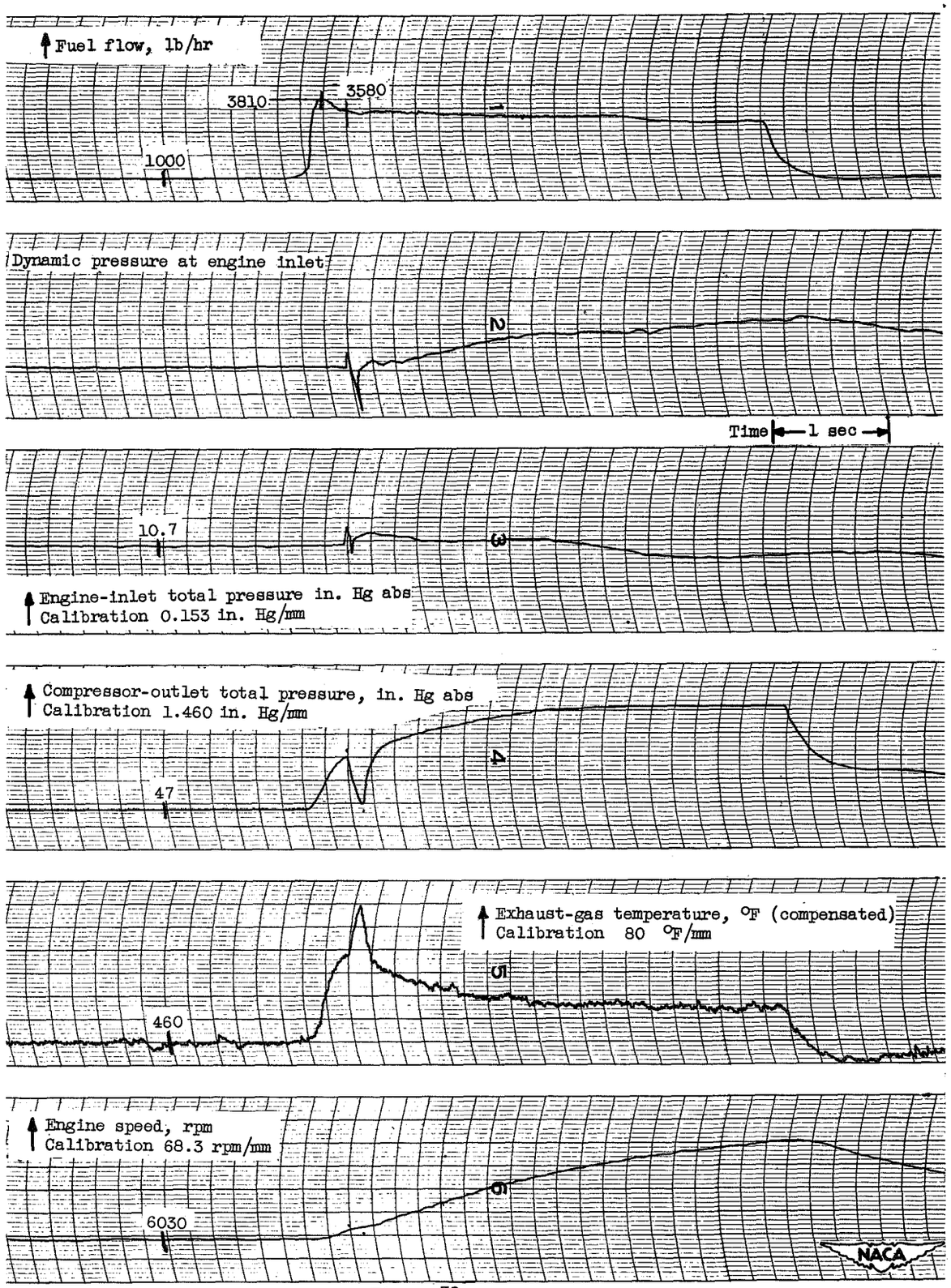

Figure 52

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -6 °F; inlet guide vanes position, open.

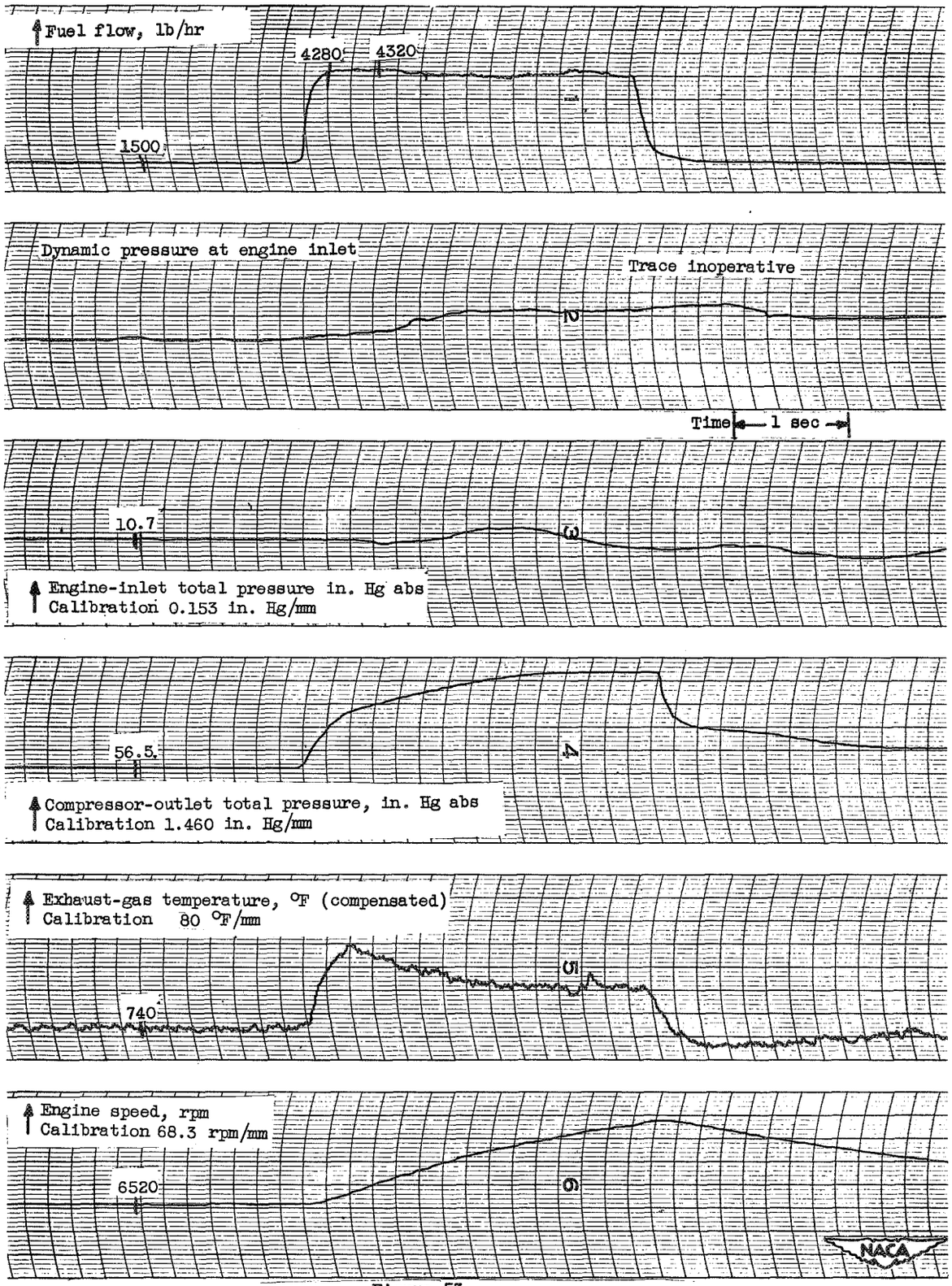

Figure 53

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -6 °F; inlet guide vanes position, open.

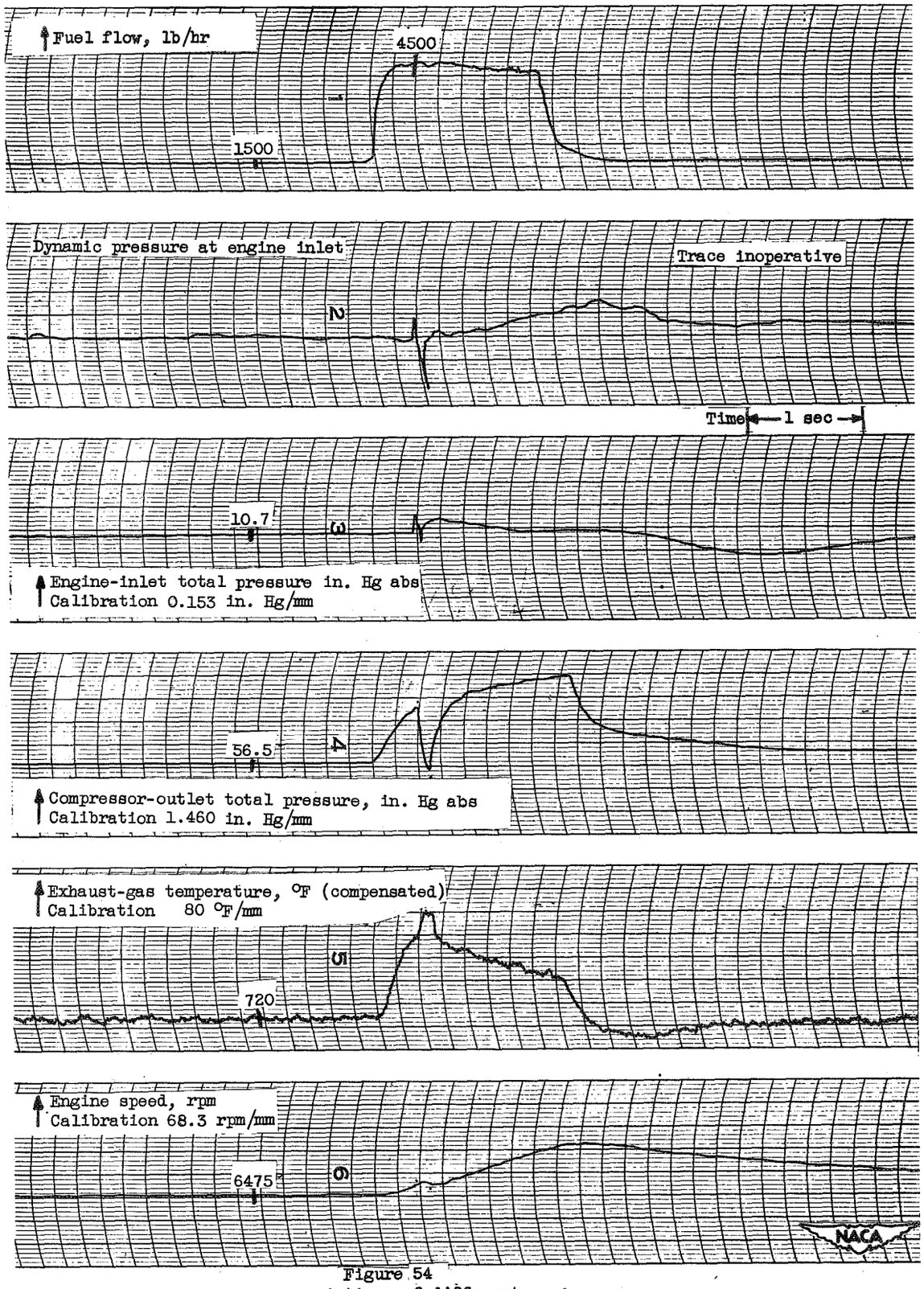

Figure 54

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -6° F; inlet guide vanes position, open.

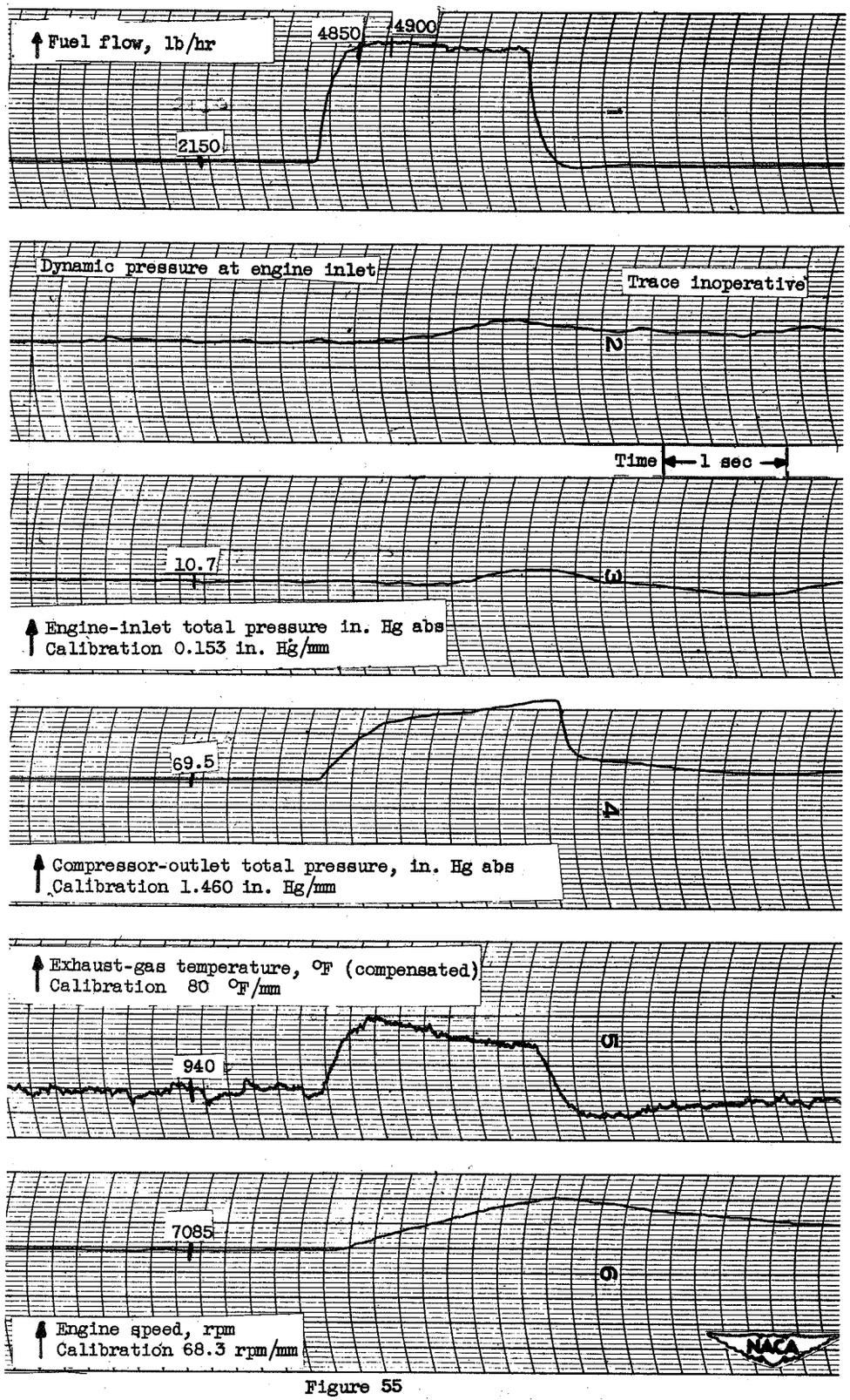

Figure 55

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -8 ° F; inlet guide vanes position, open.

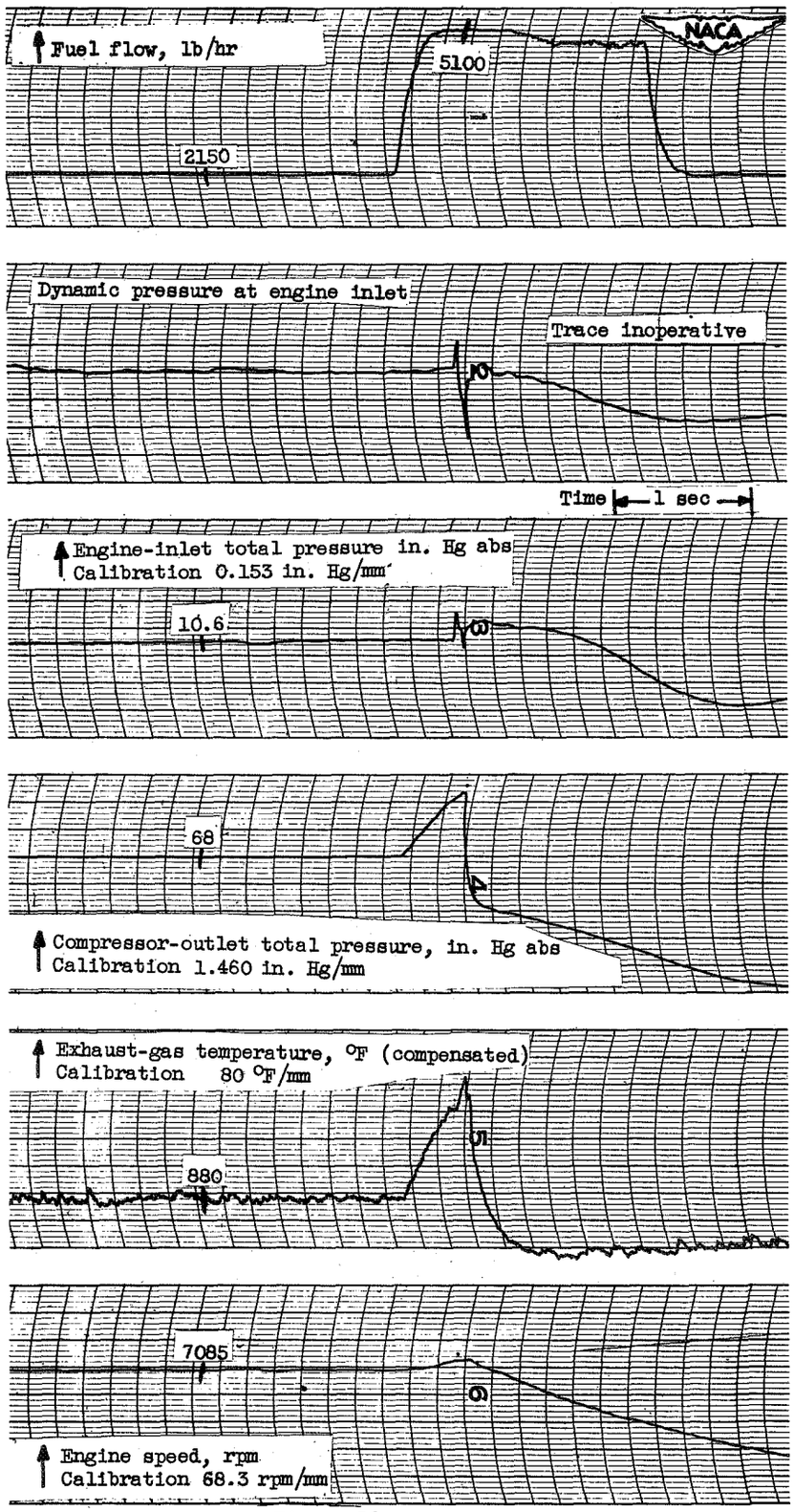

Figure 56

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -8 °F; inlet guide vanes position, open.

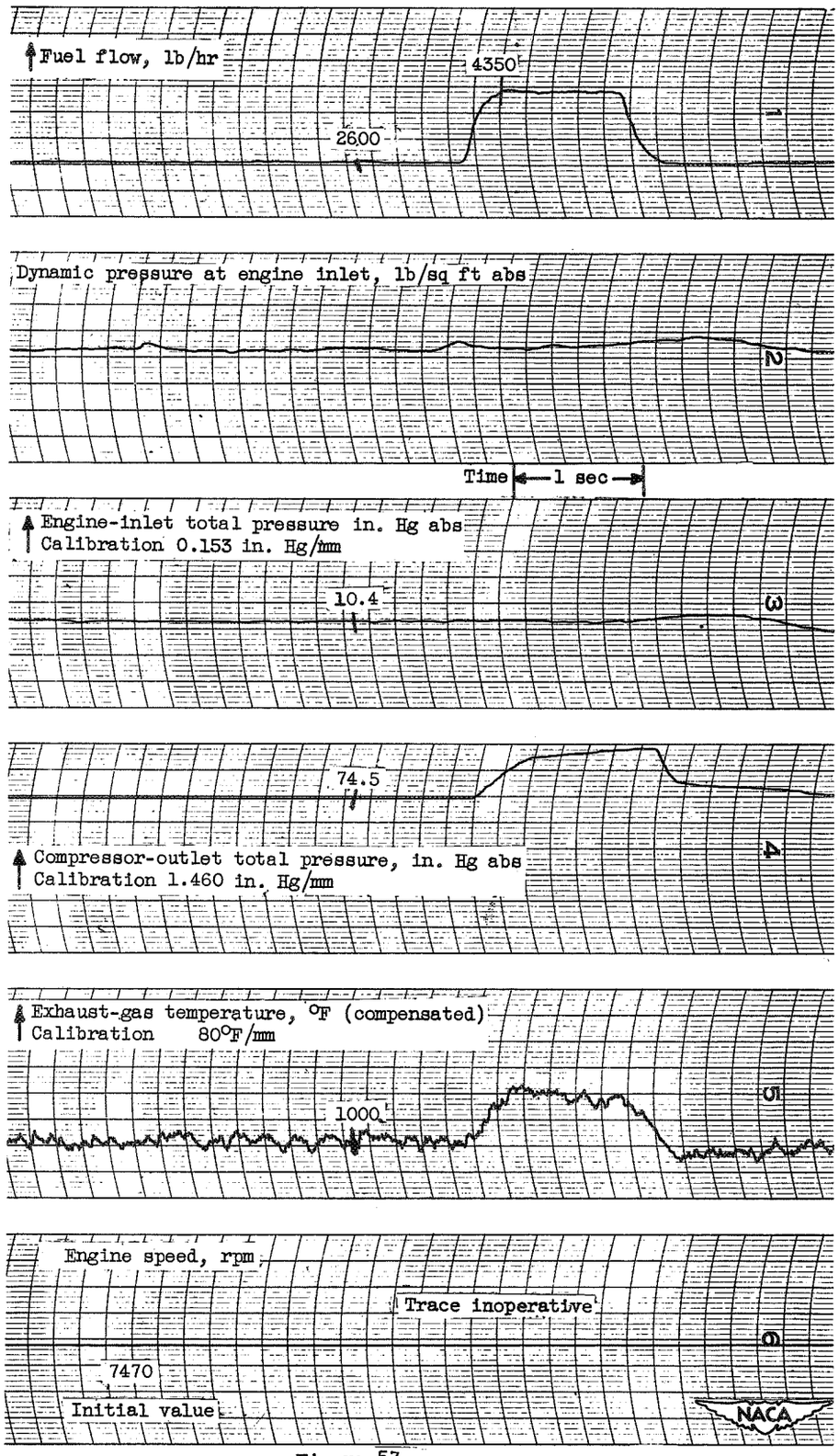

Figure 57

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -9 °F; inlet guide vanes position, open.

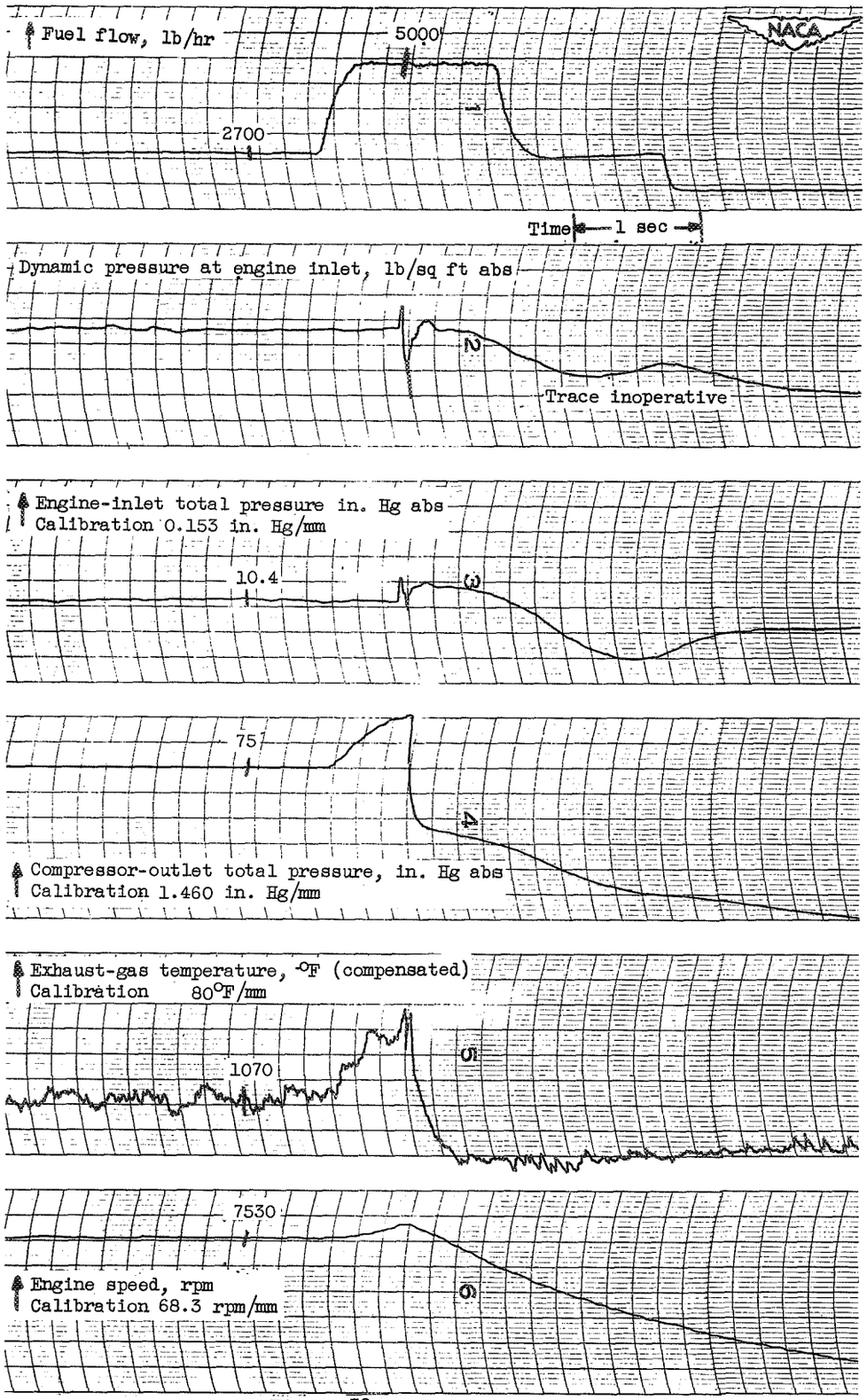

Figure 58

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -10° F; inlet guide vanes position, open.

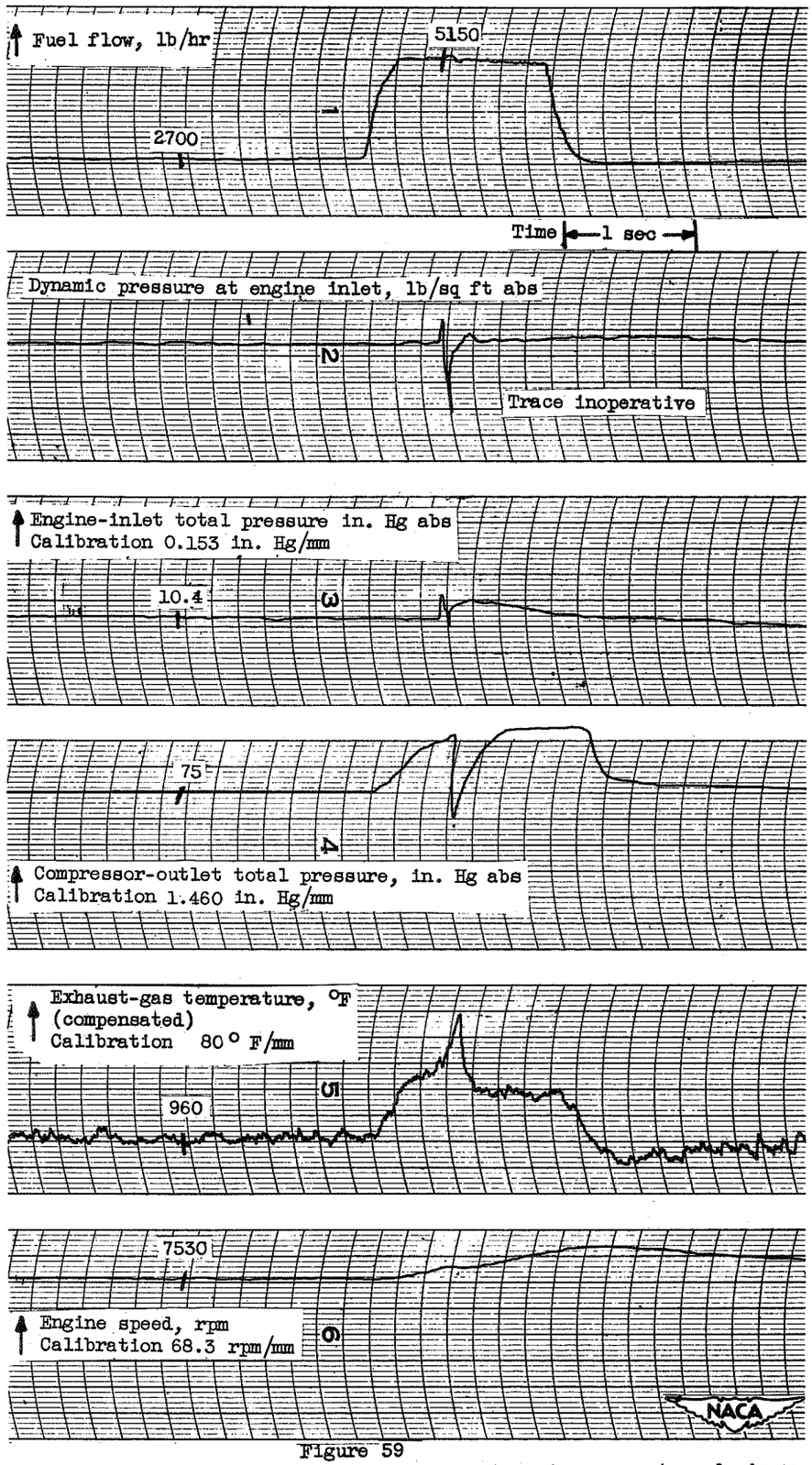

Figure 59

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -10° F; inlet guide vanes position, open.

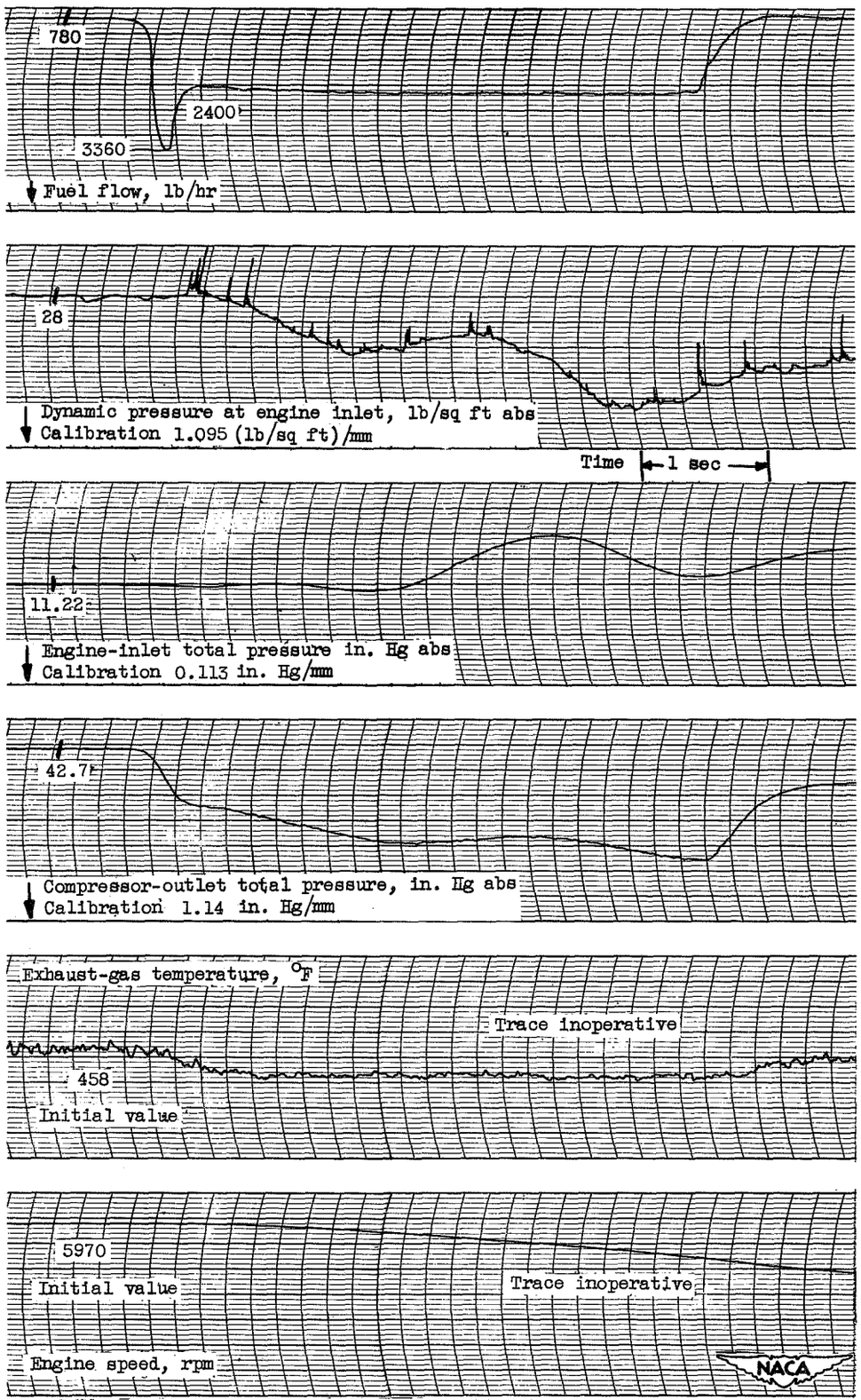

Figure 60

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

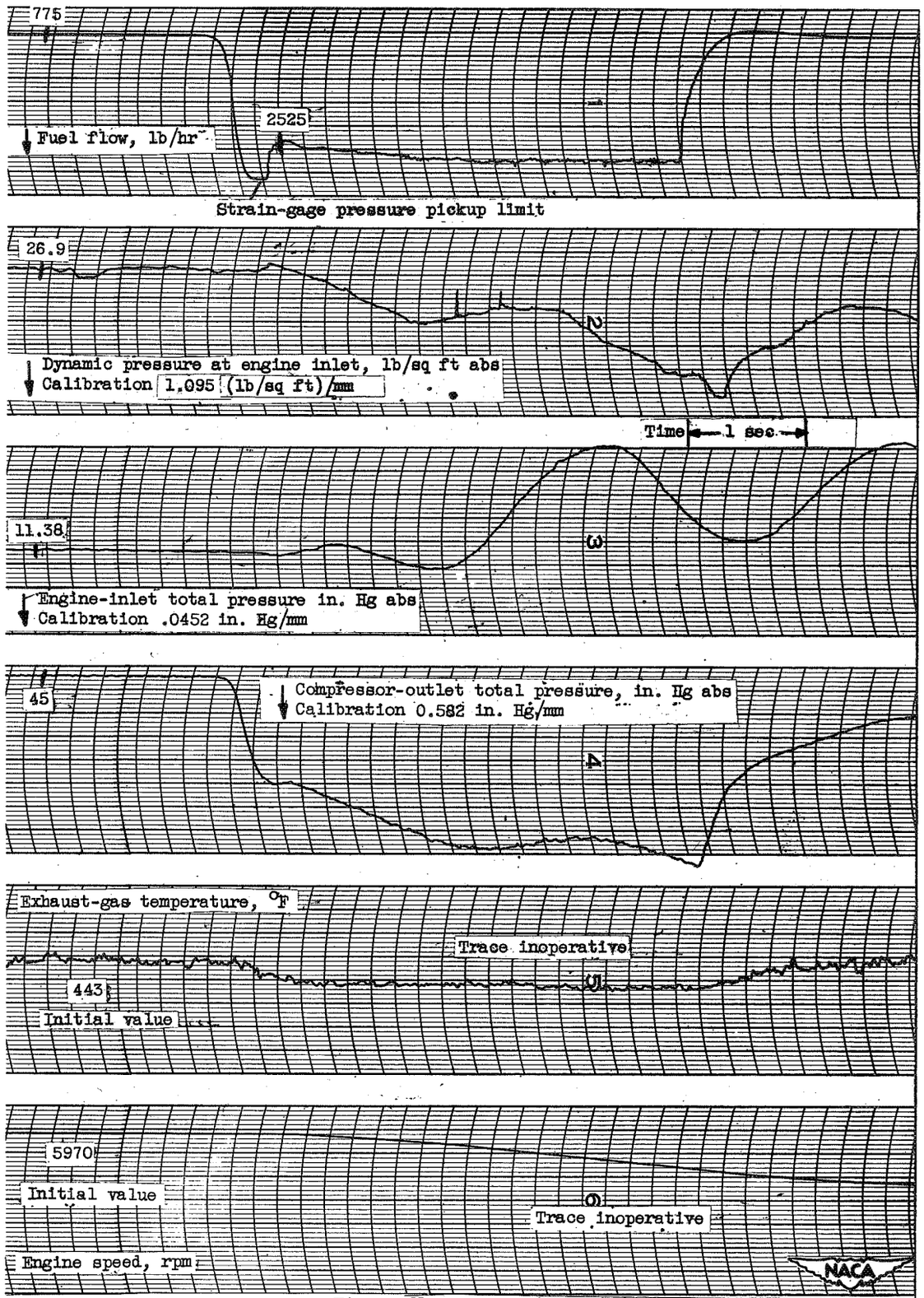

Figure 61

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 28° F; inlet guide vanes position, open.

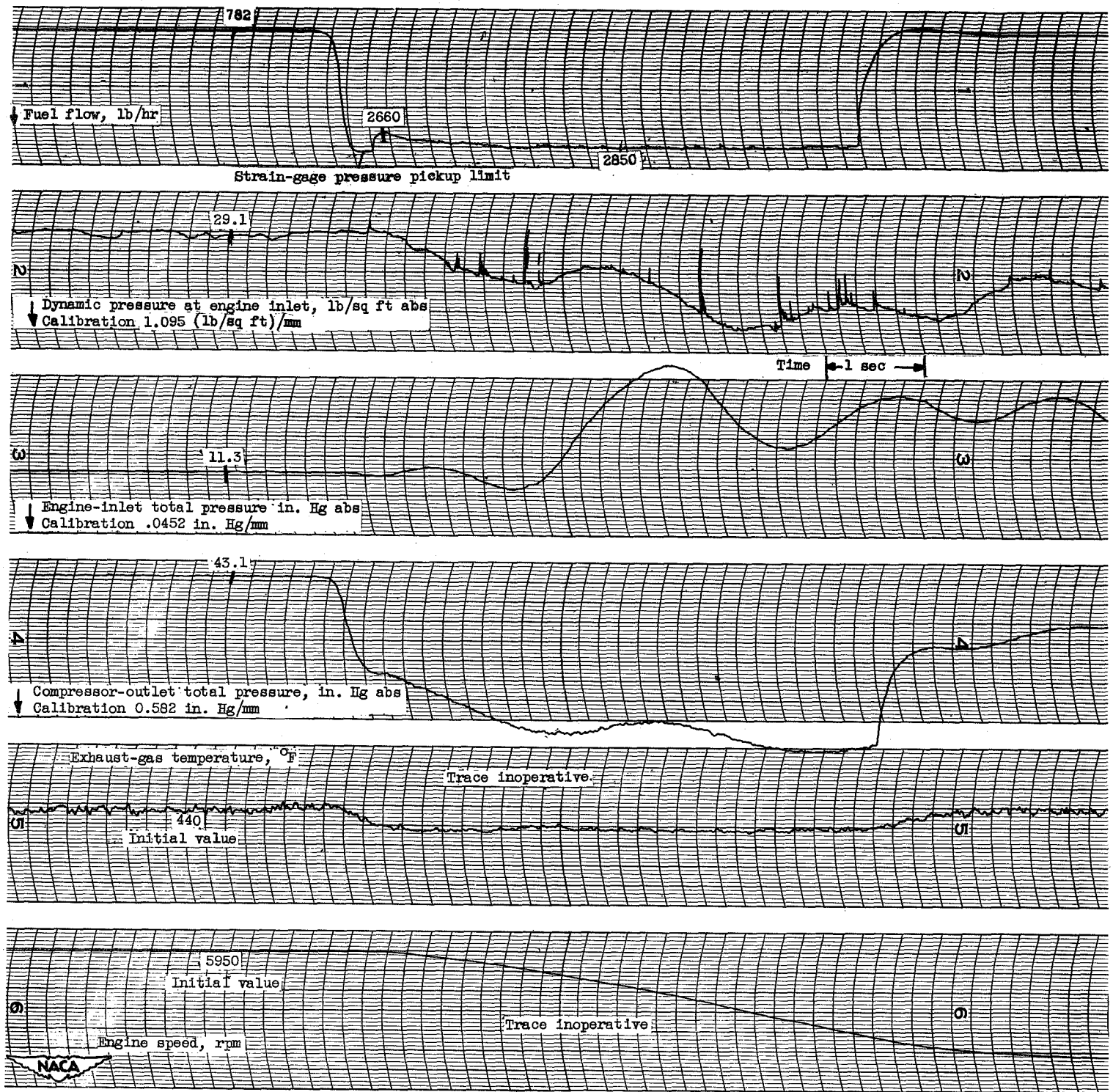

Figure 62

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 28 °F; inlet guide vanes position, open.

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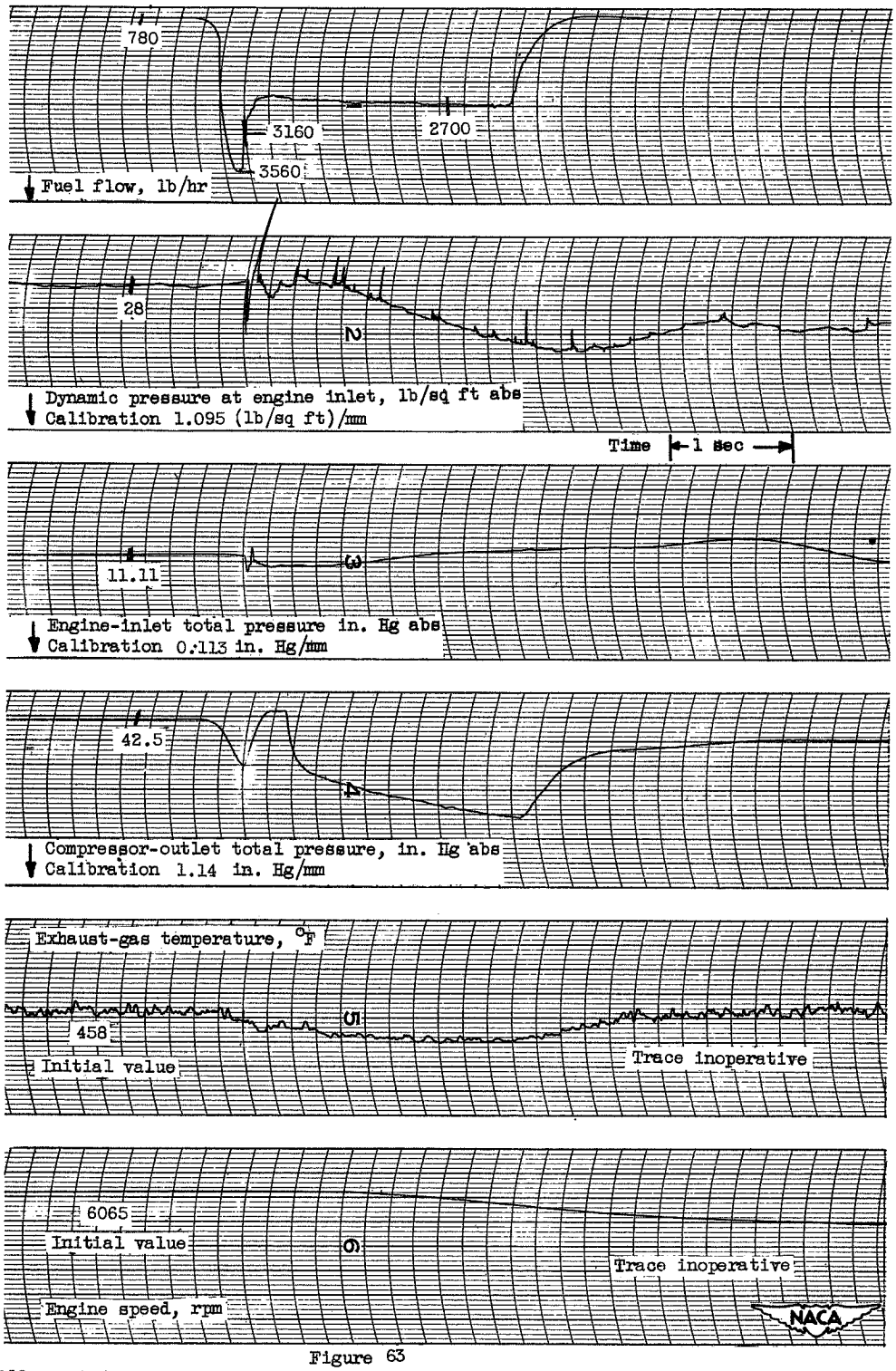

Figure 63

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

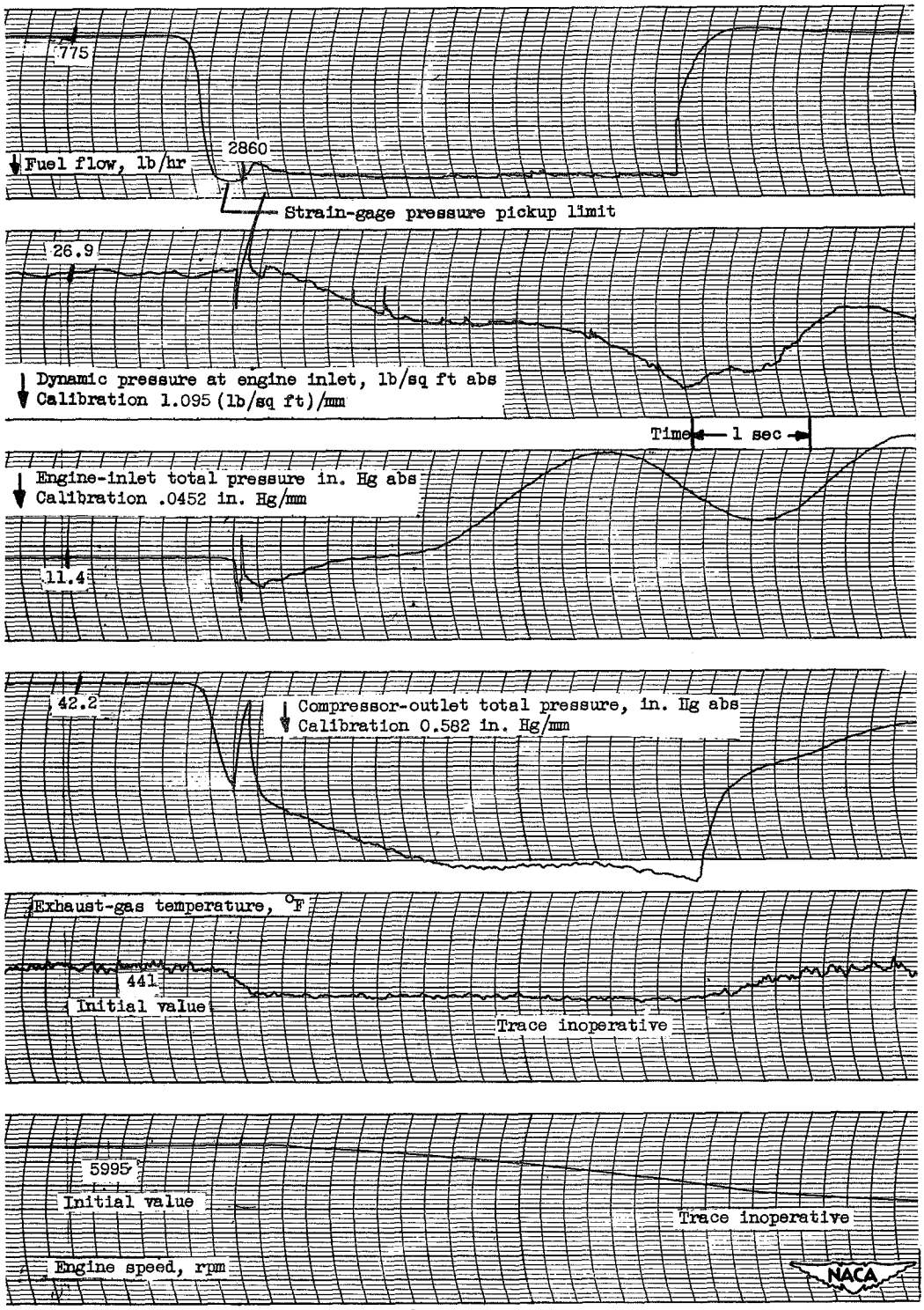

Figure 64

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 28 °F; inlet guide vanes position, open.

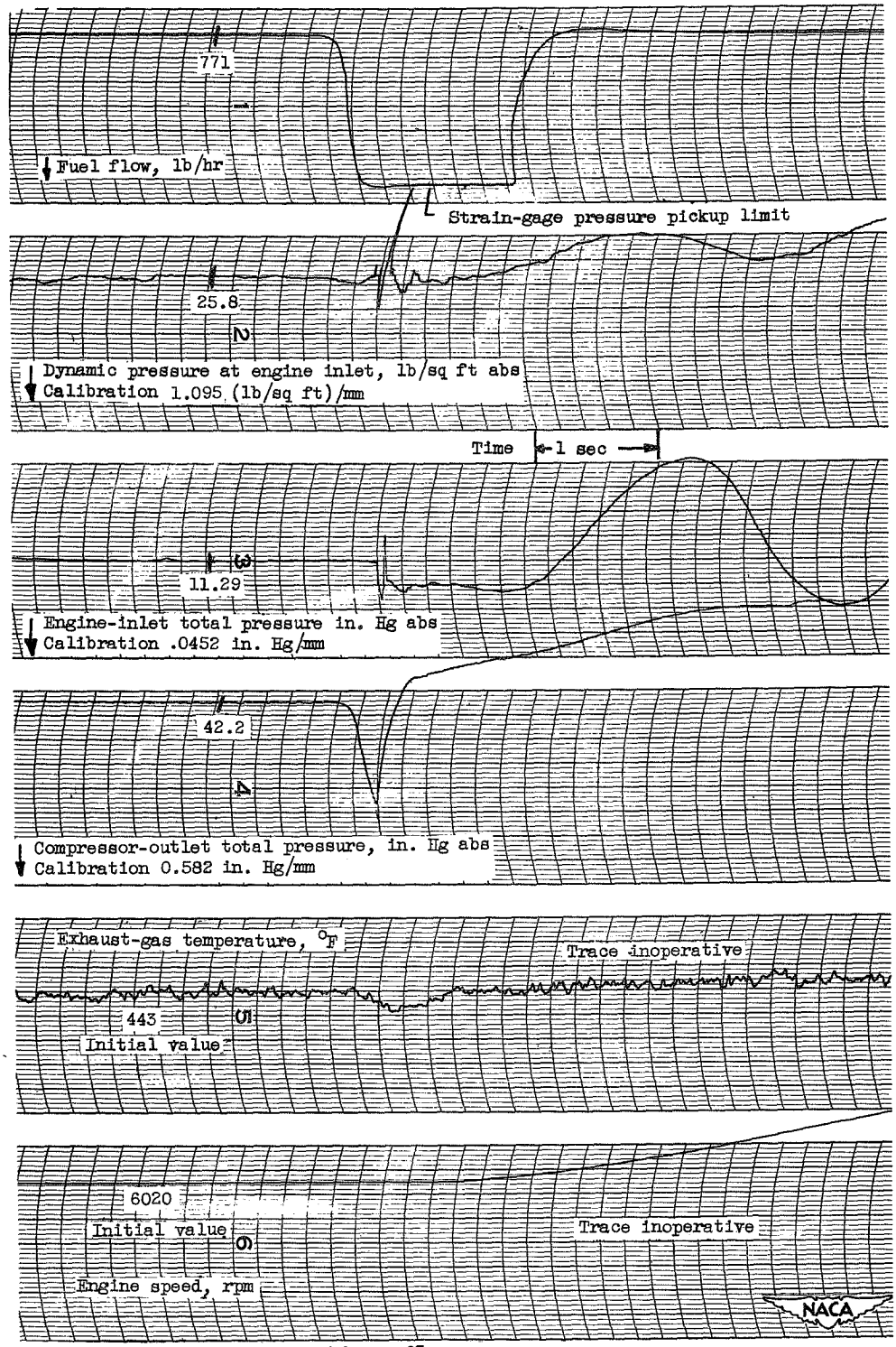

Figure 65

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 28° F; inlet guide vanes position, open.

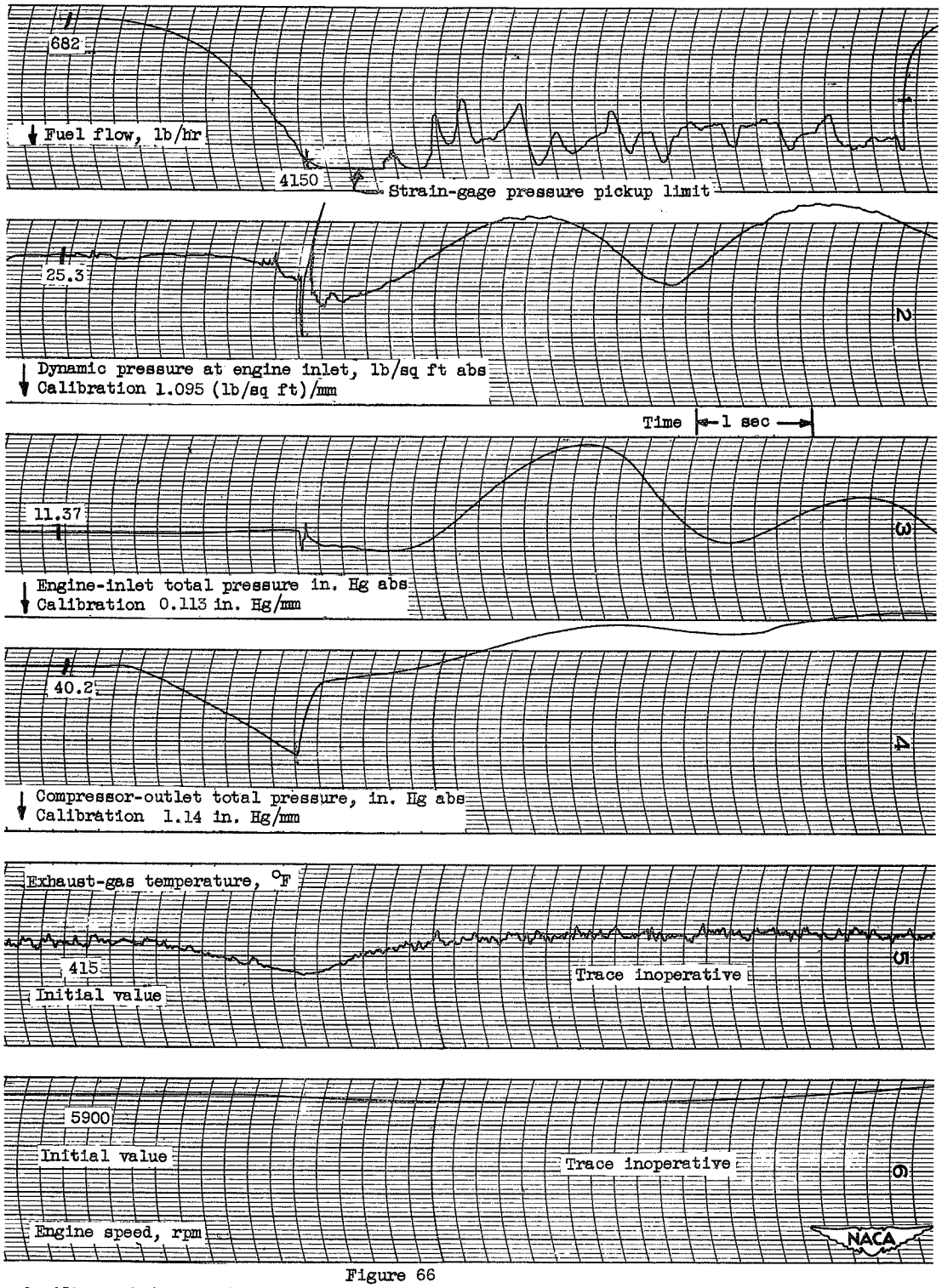

Figure 66

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

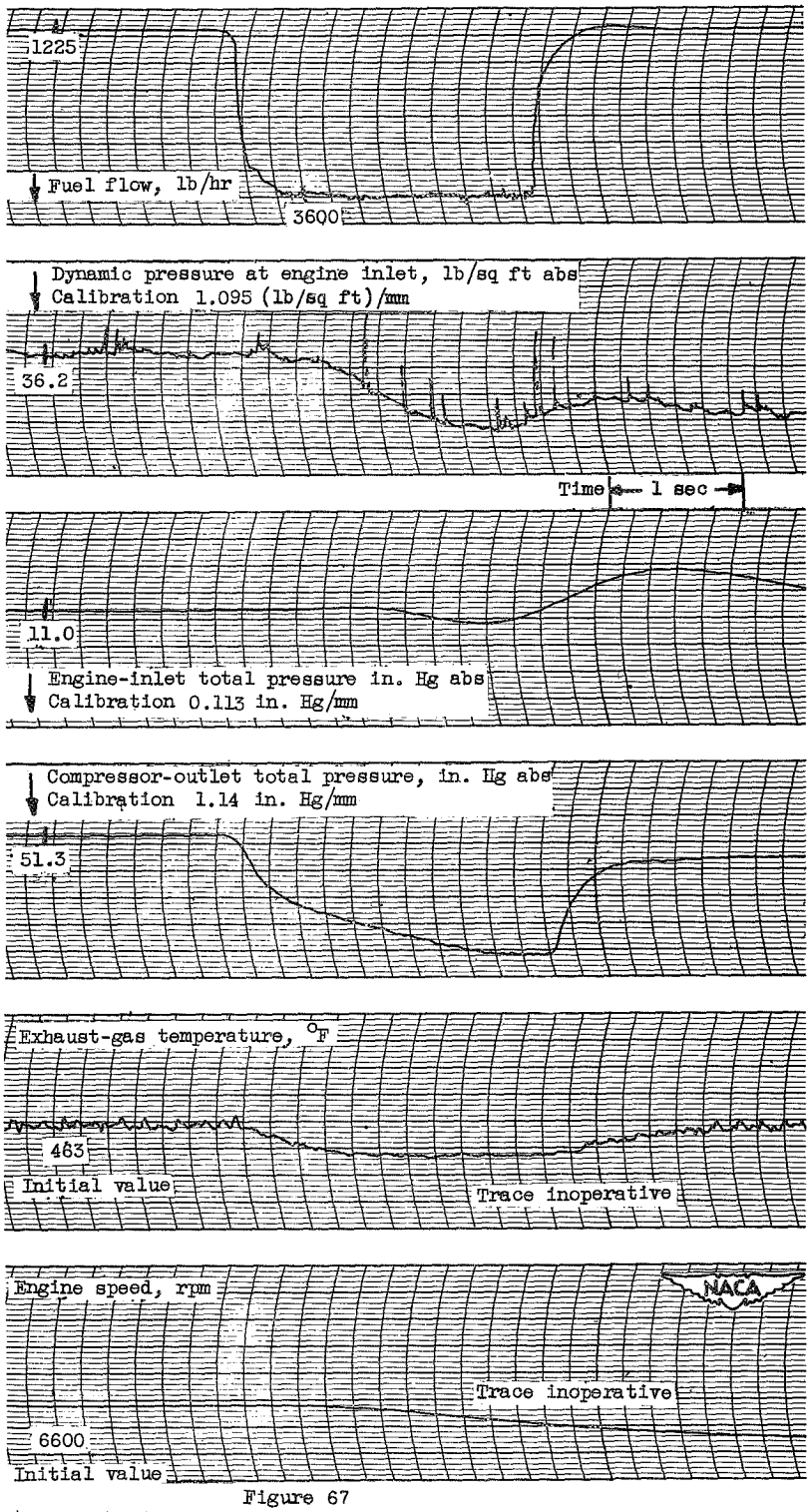

Figure 67

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

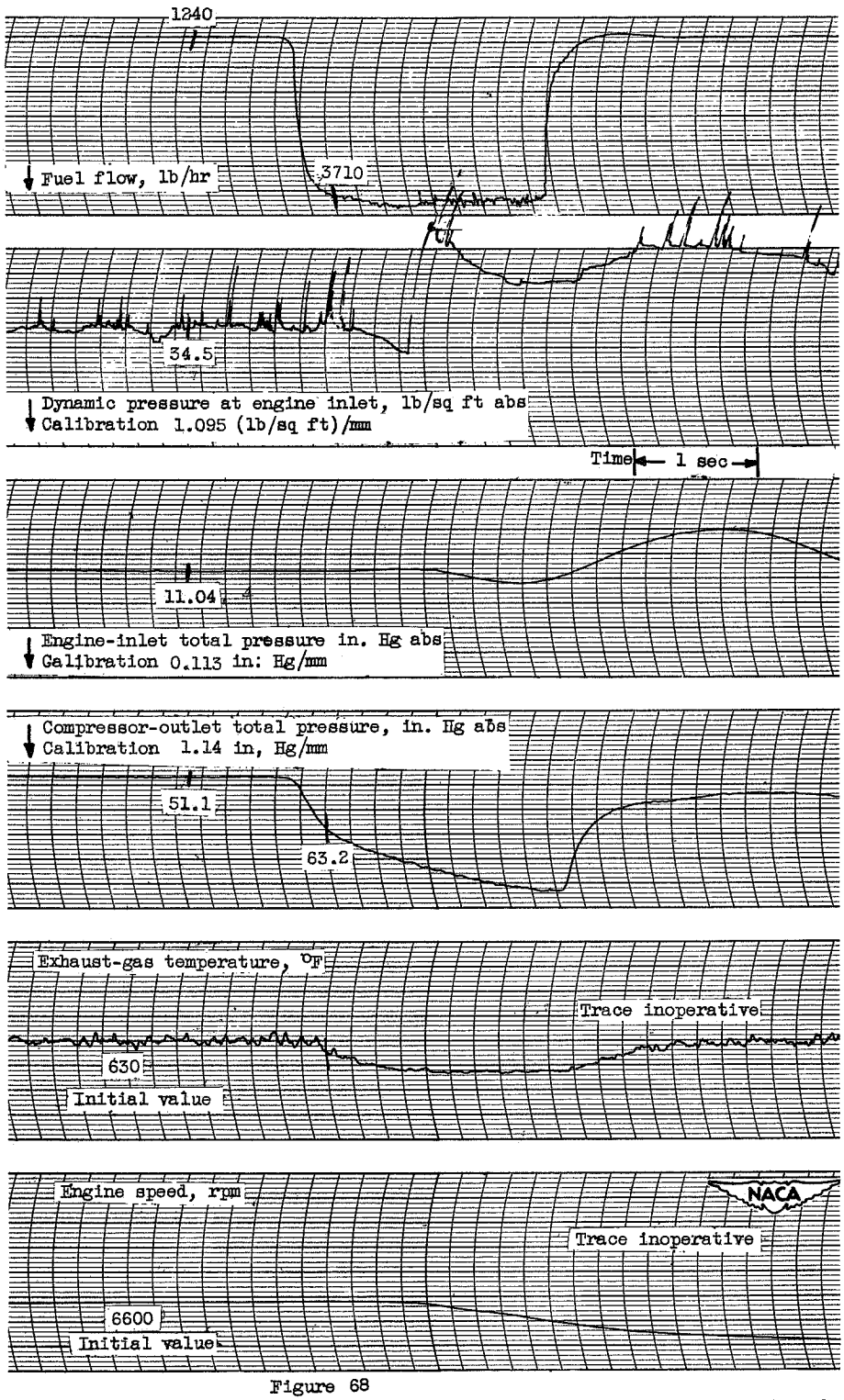

Figure 68

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

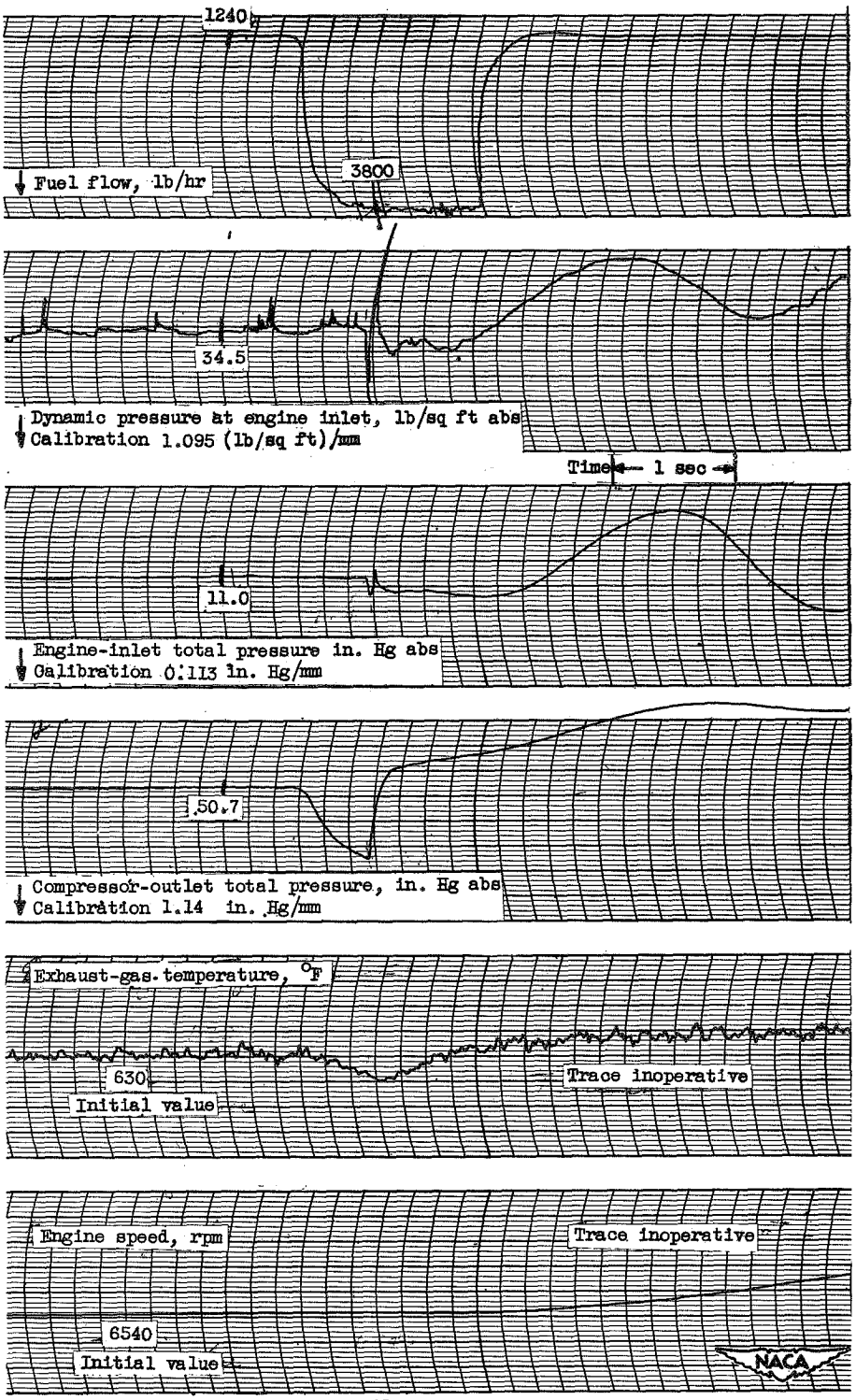

Figure 69

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30 °F; inlet guide vanes position, open.

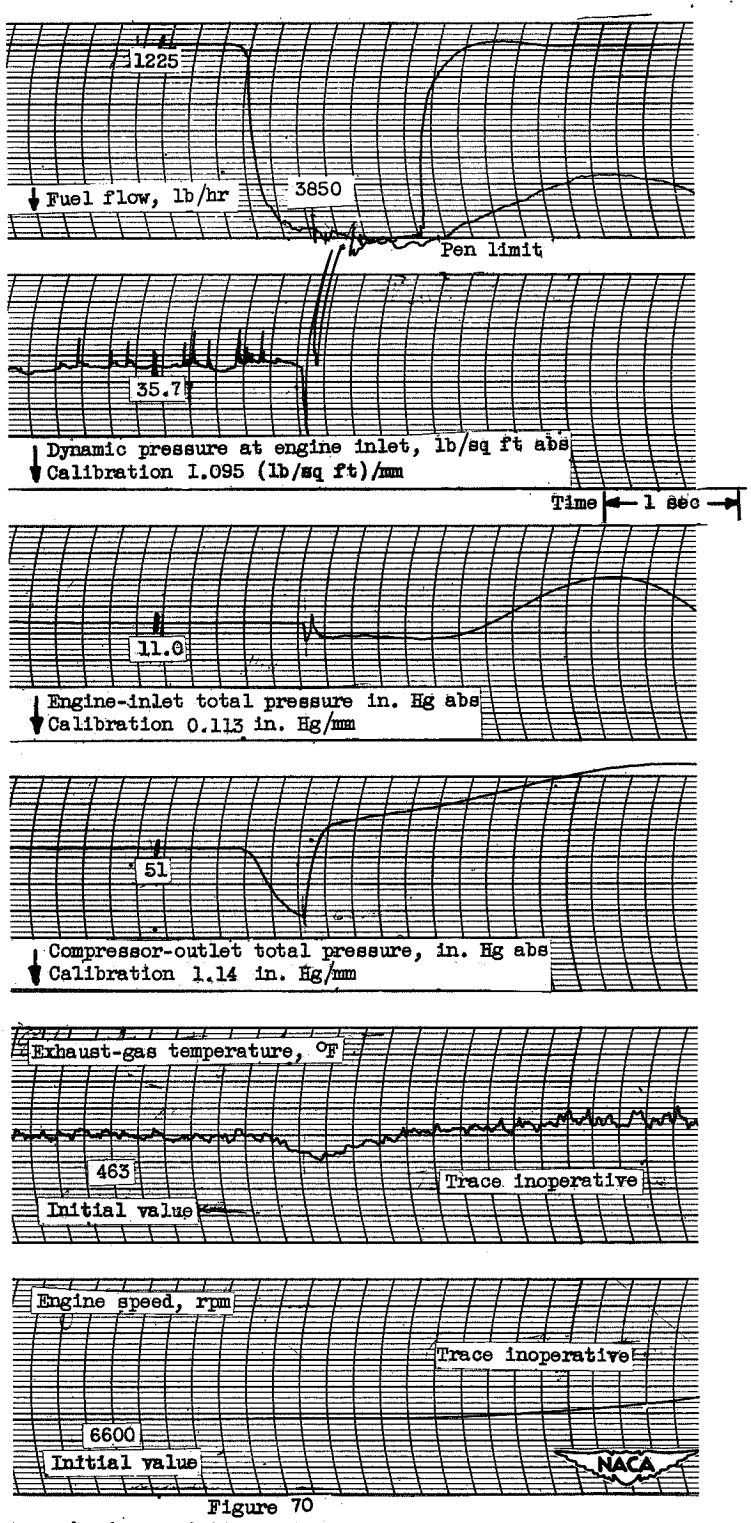

Figure 70

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

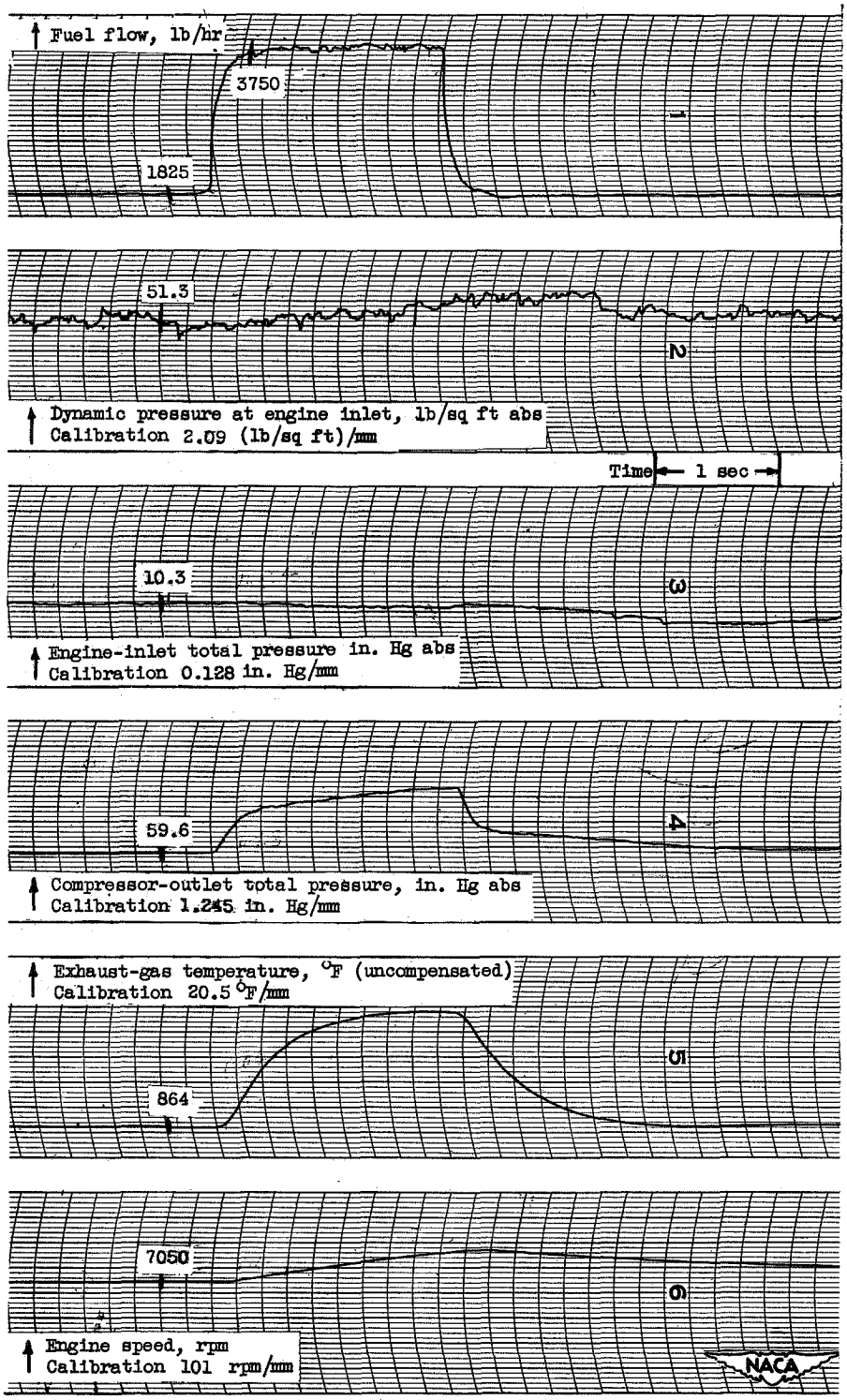

Figure 71

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

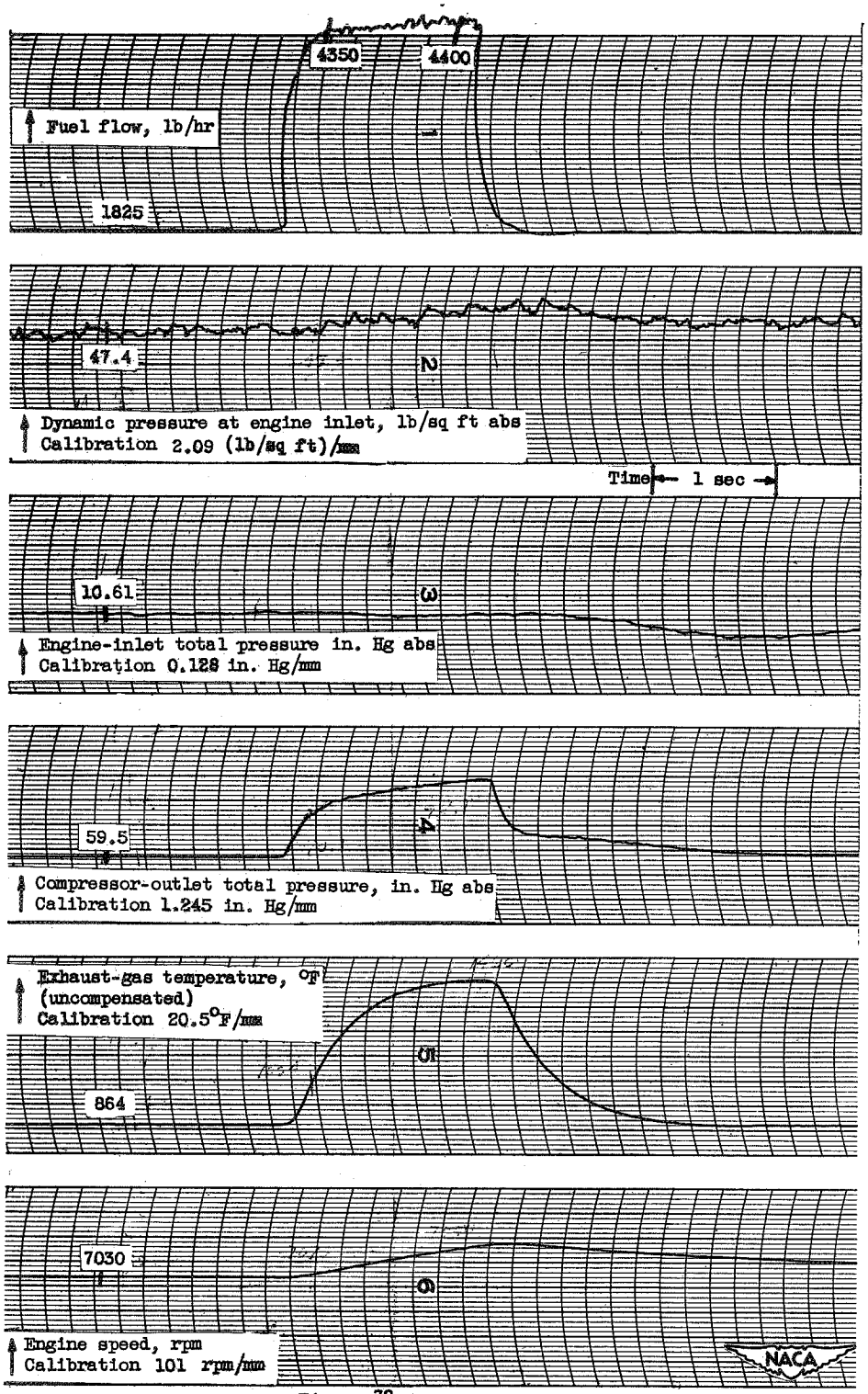

Figure 72

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

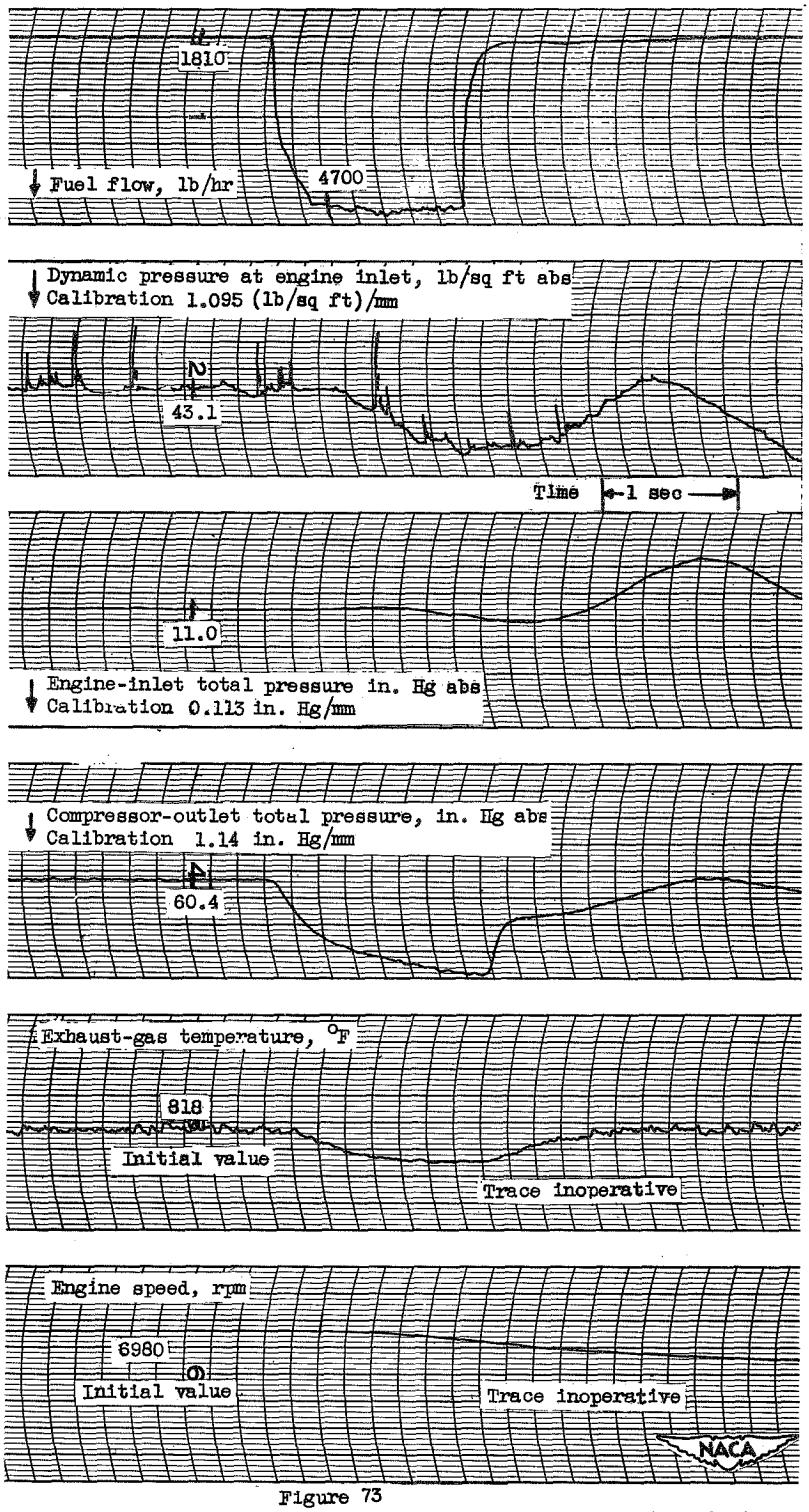

Figure 73

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8 ; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

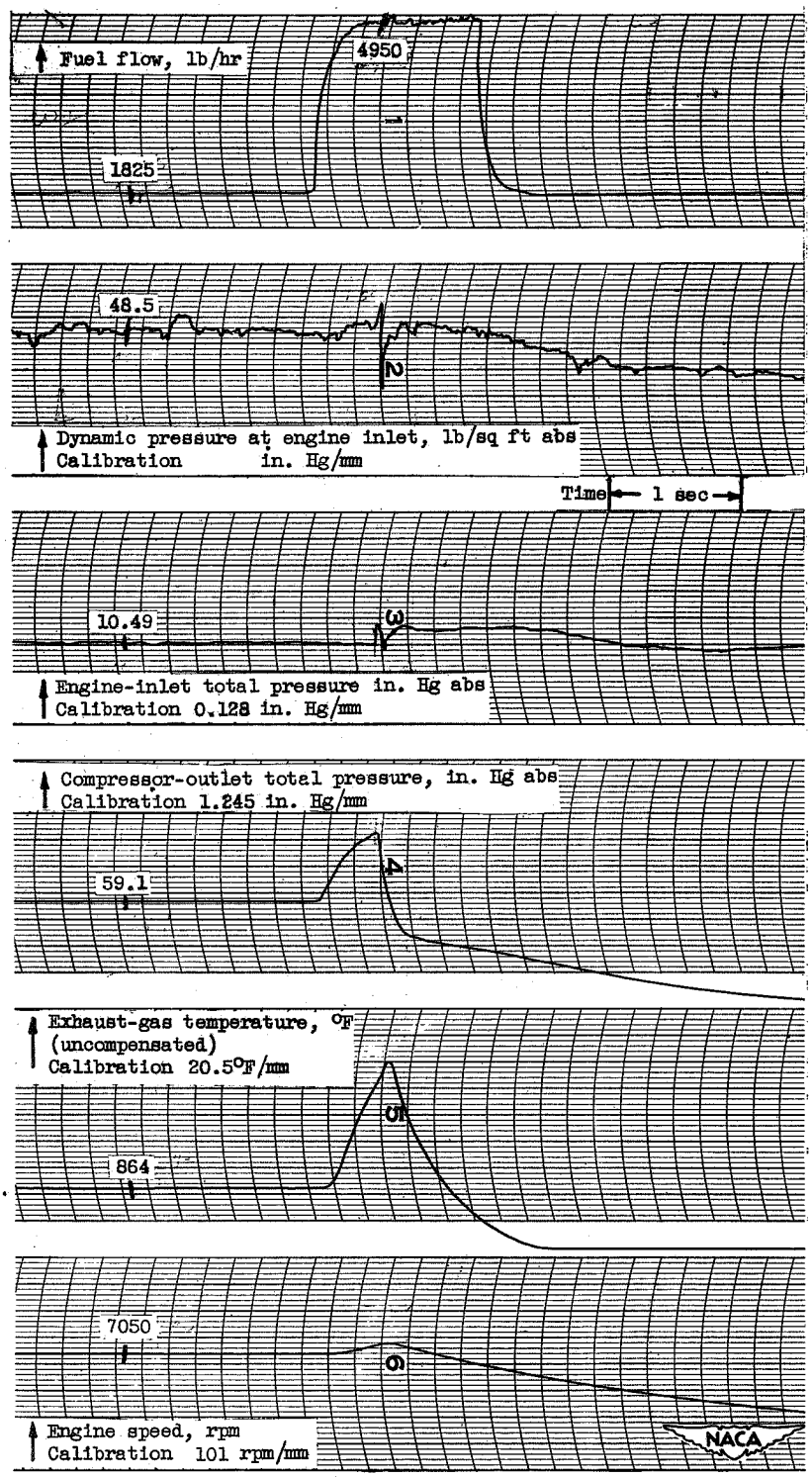

Figure 74

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

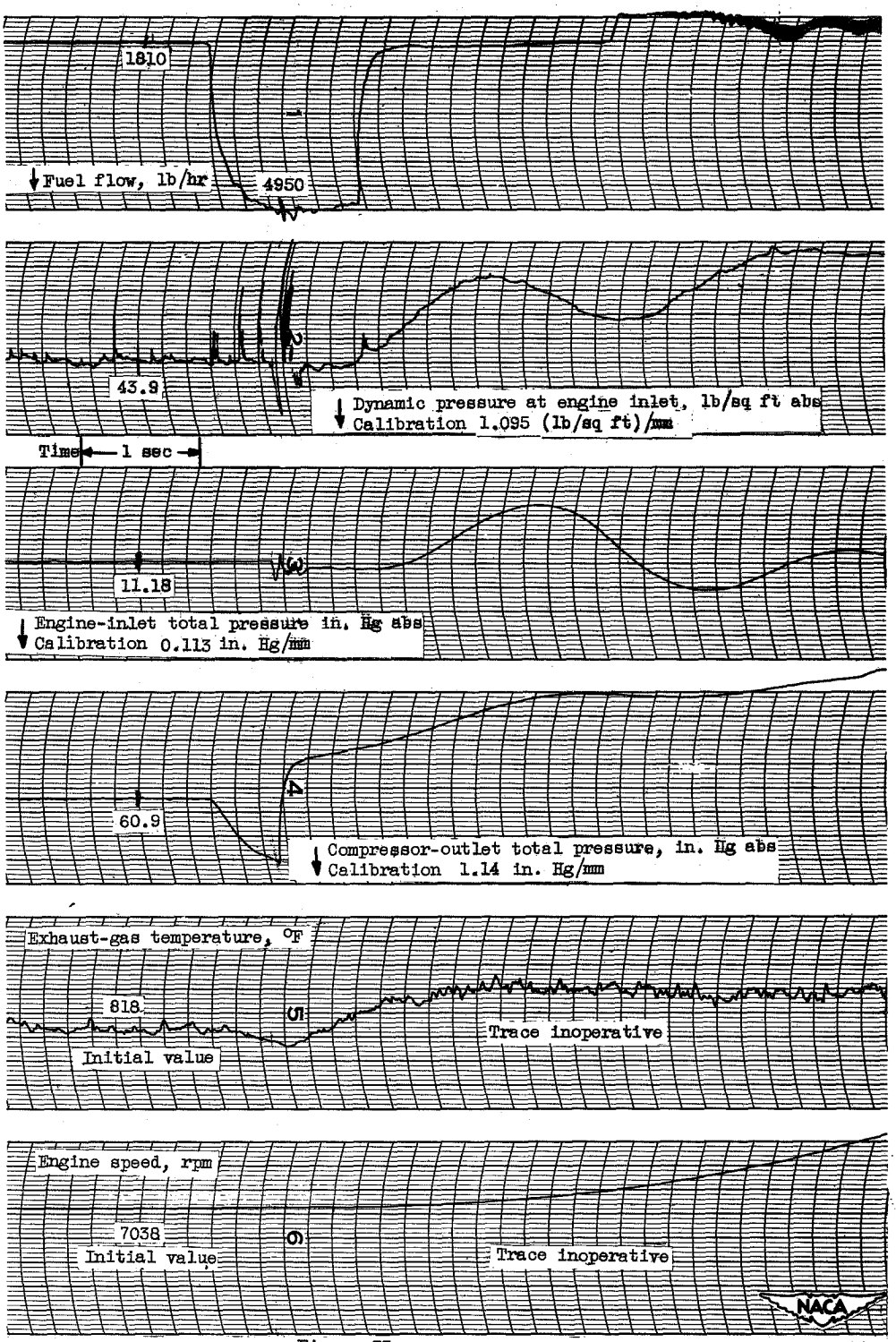

Figure 75

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

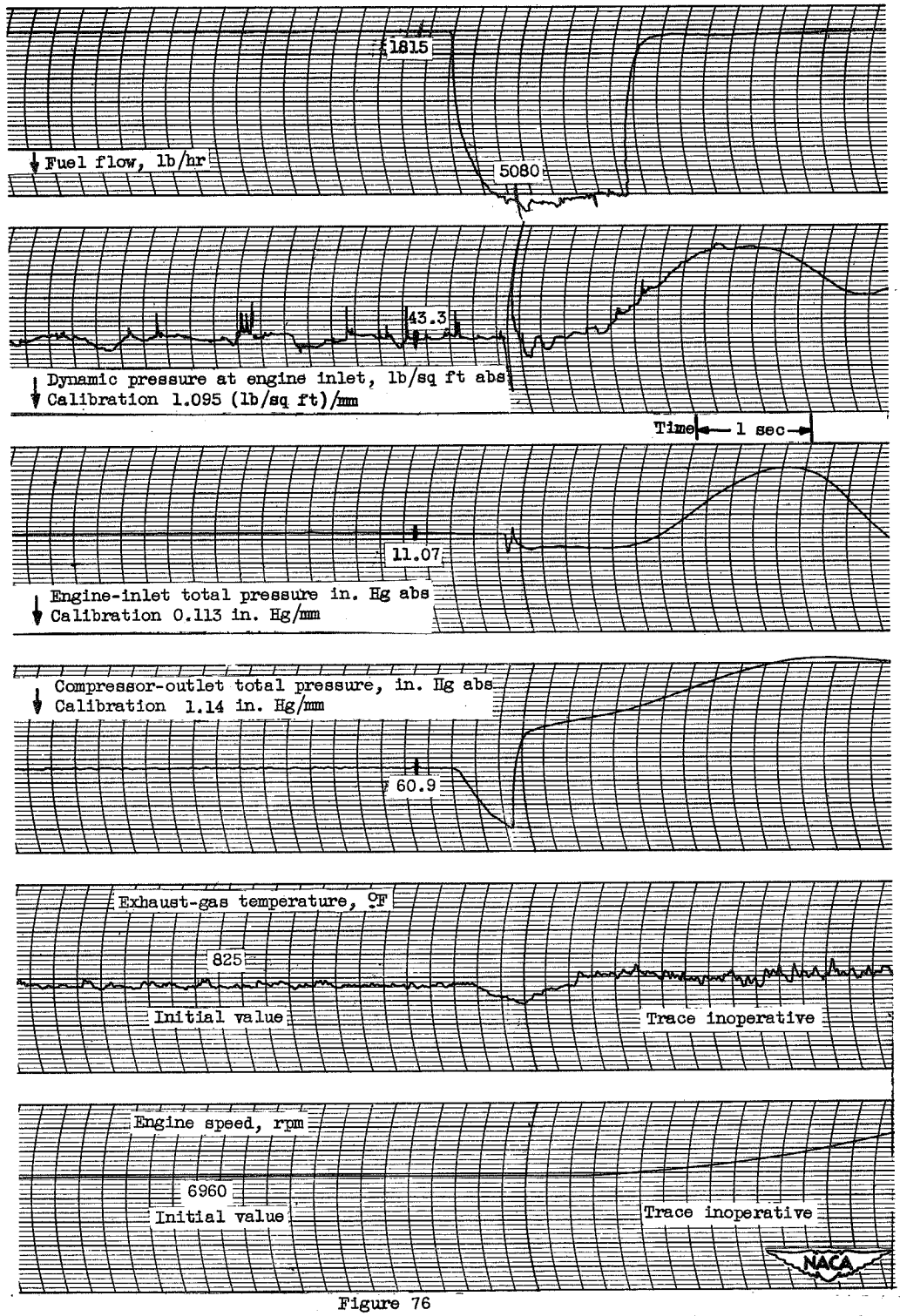

Figure 76

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 30° F; inlet guide vanes position, open.

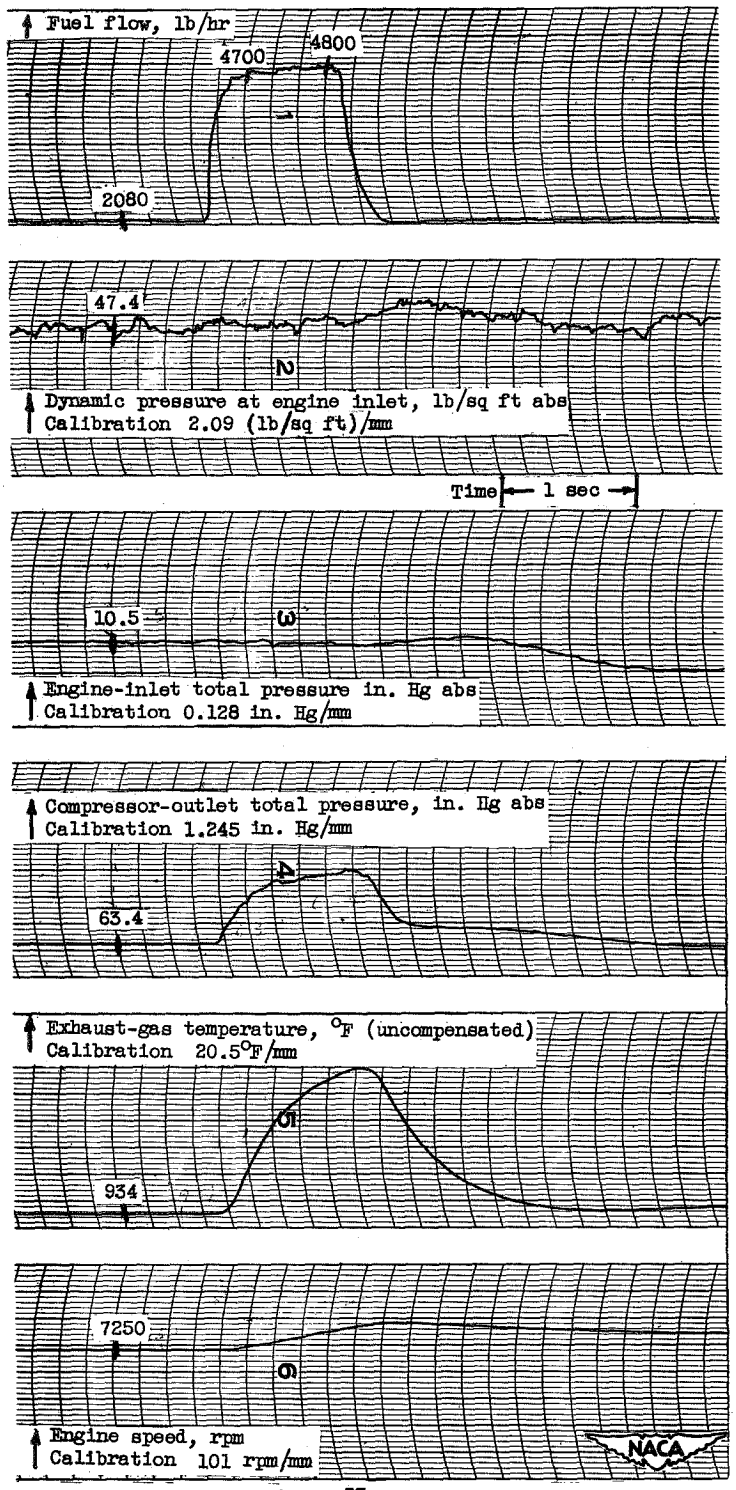

Figure 77

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39 ° F; inlet guide vanes position, open.

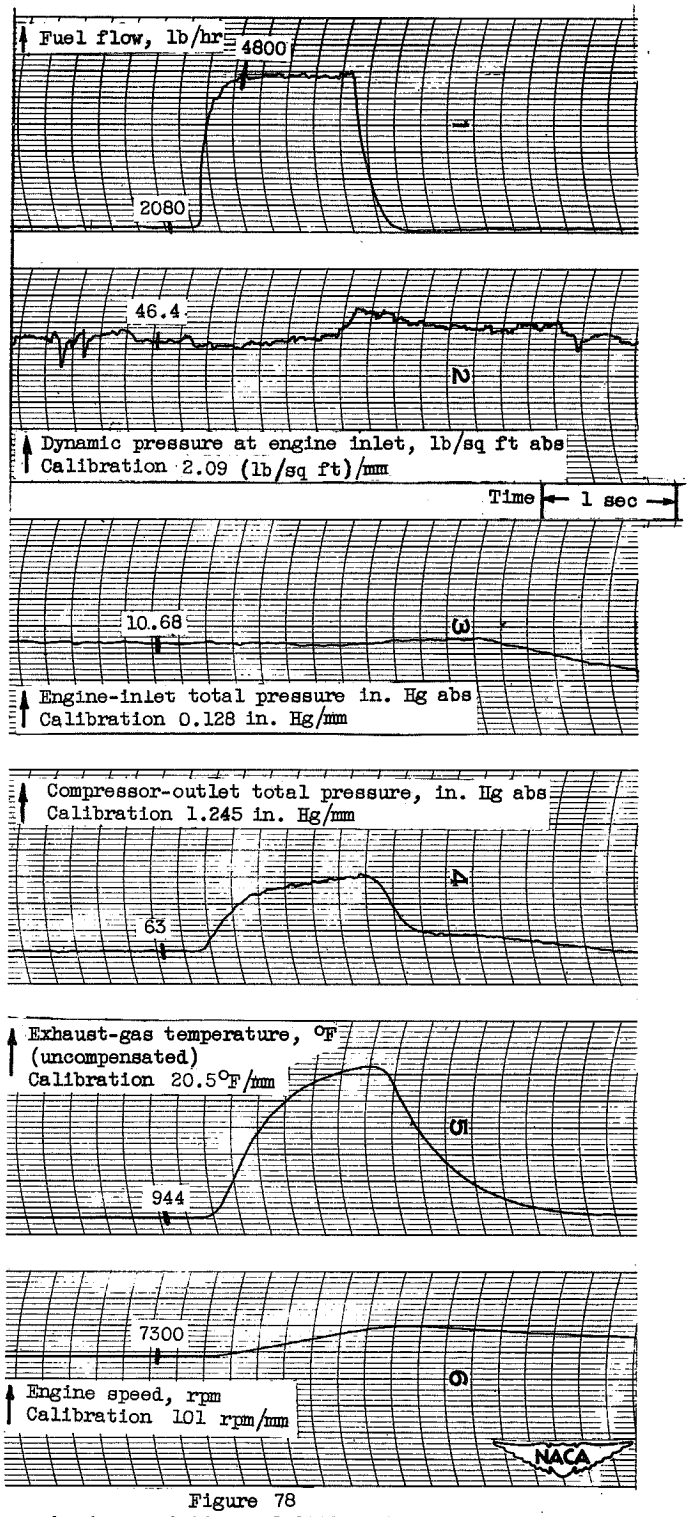

Figure 78

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

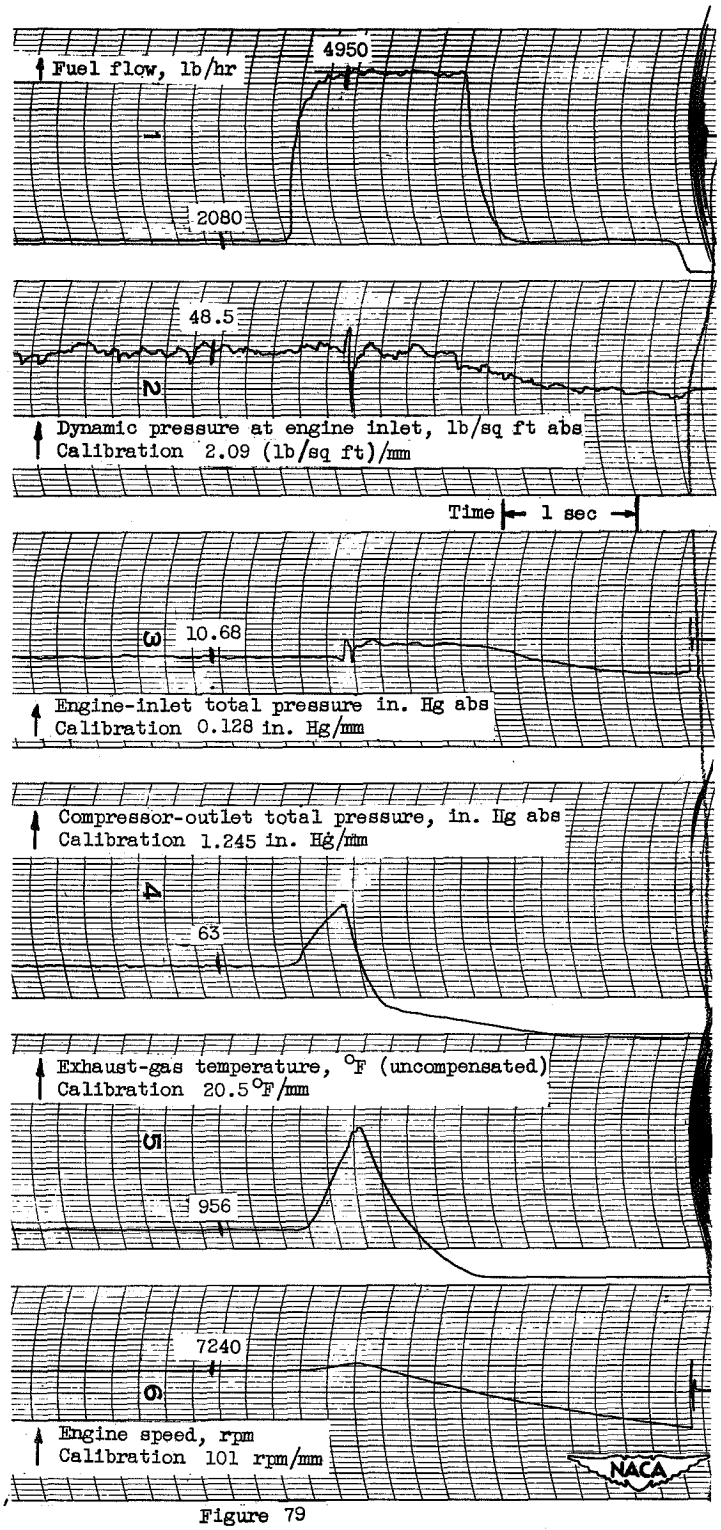

Figure 79

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 38° F; inlet guide vanes position, open.

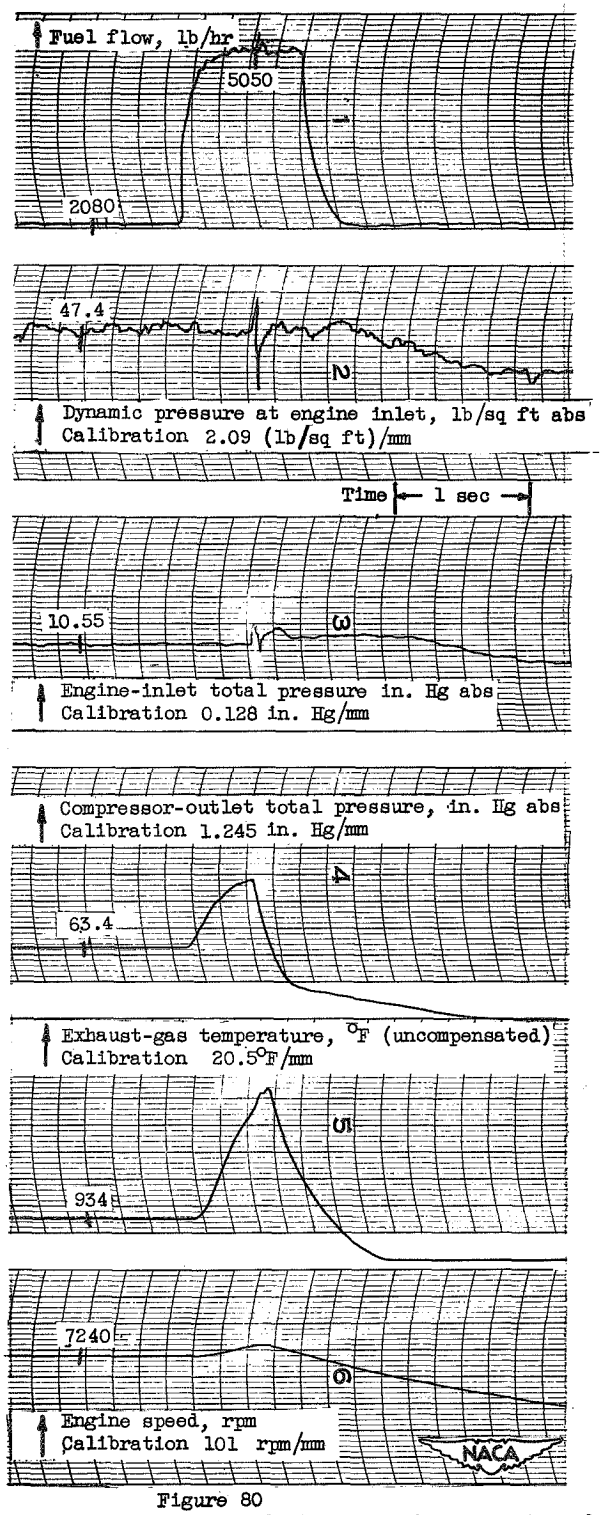

Figure 80

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

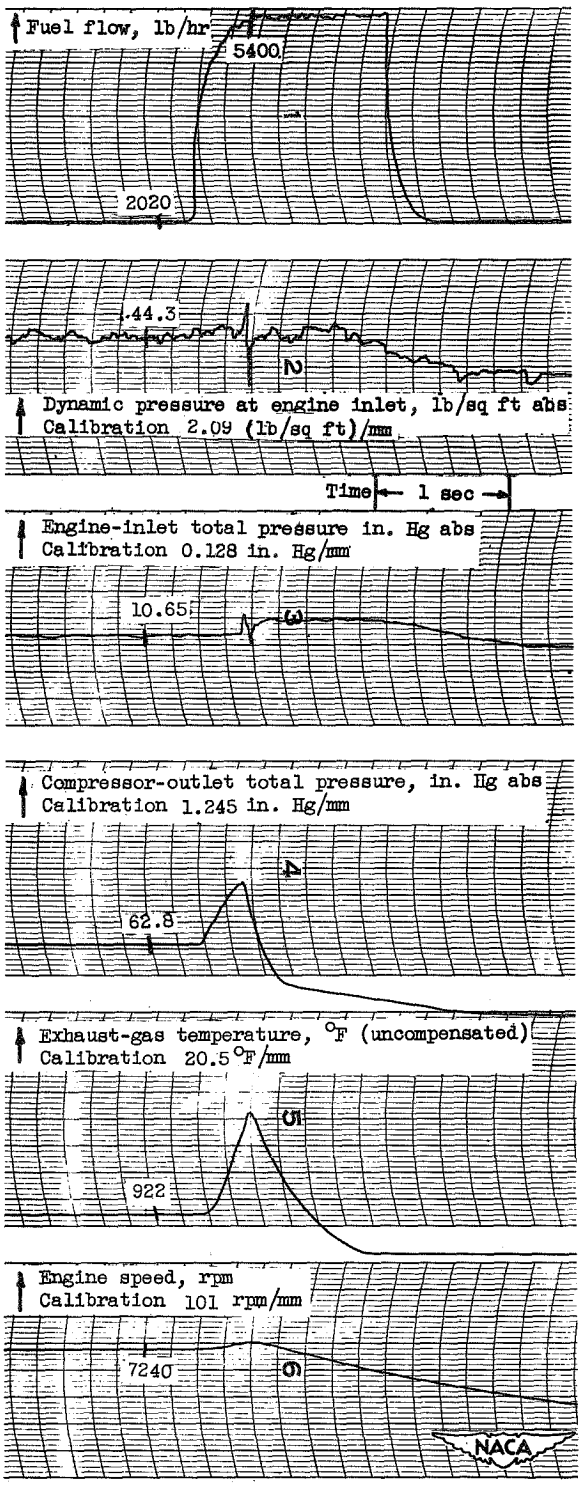

Figure 81

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

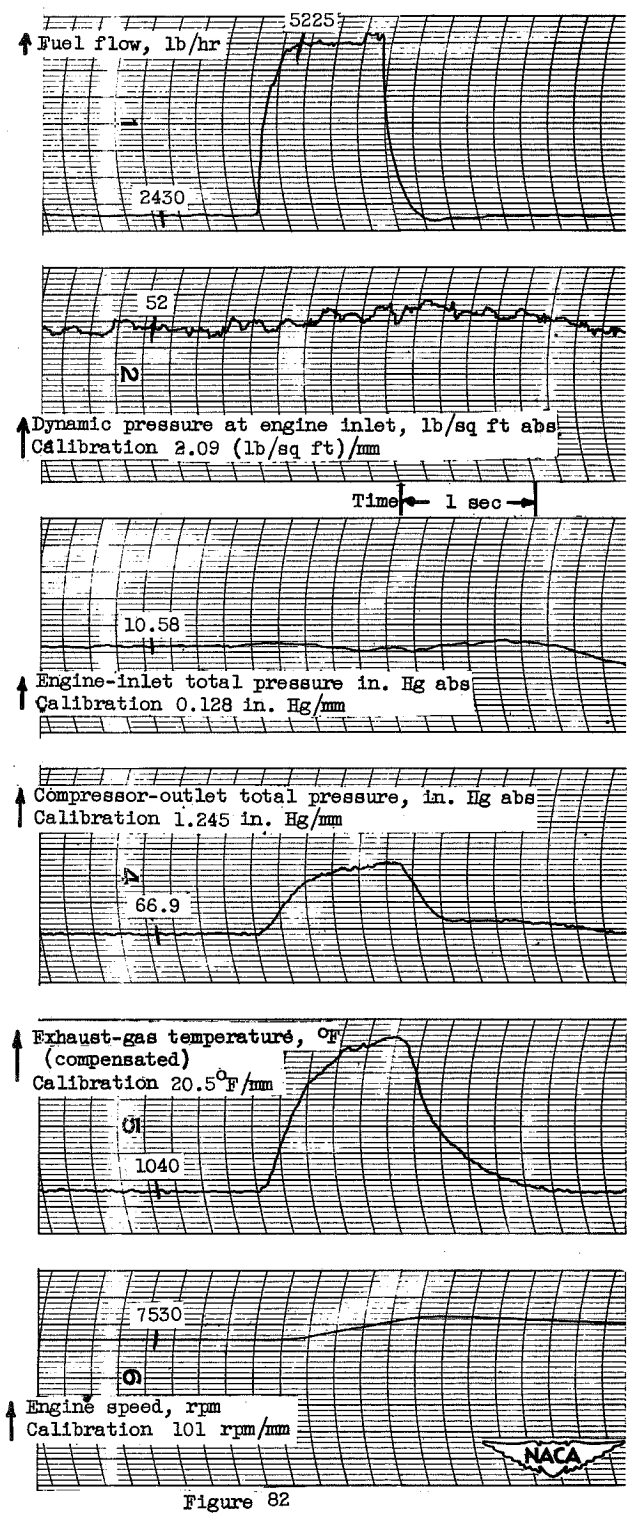

Figure 82

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

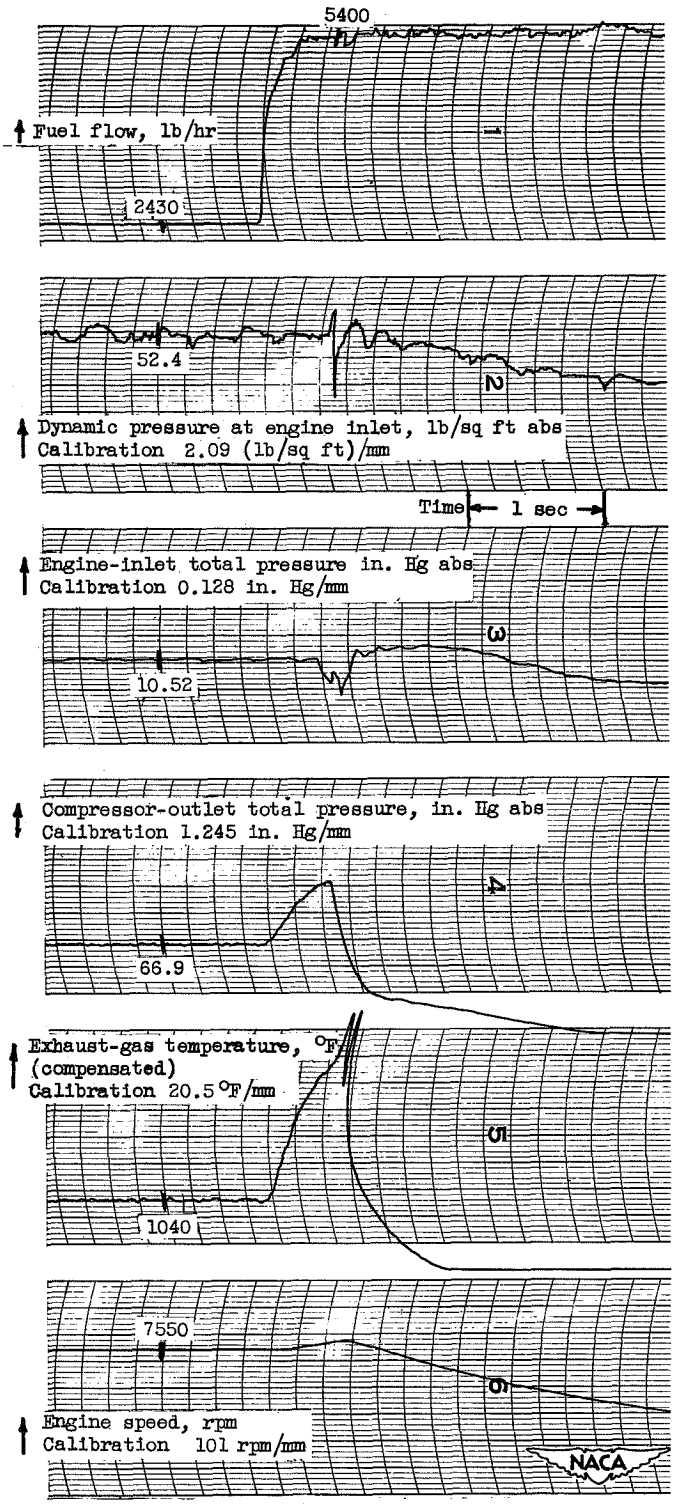

Figure 83

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 39° F; inlet guide vanes position, open.

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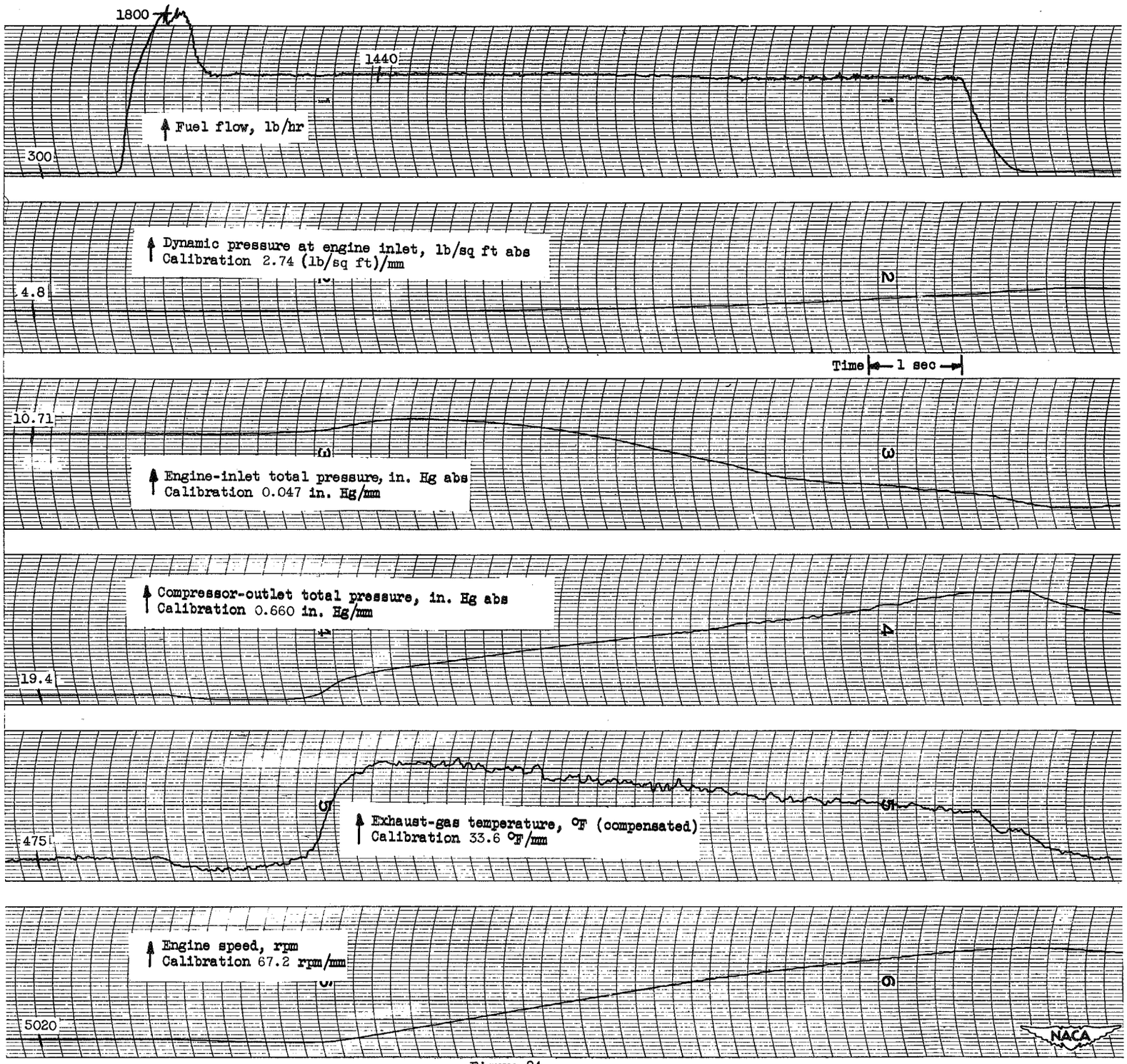

Figure 84

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 150° F; inlet guide vanes position, open.

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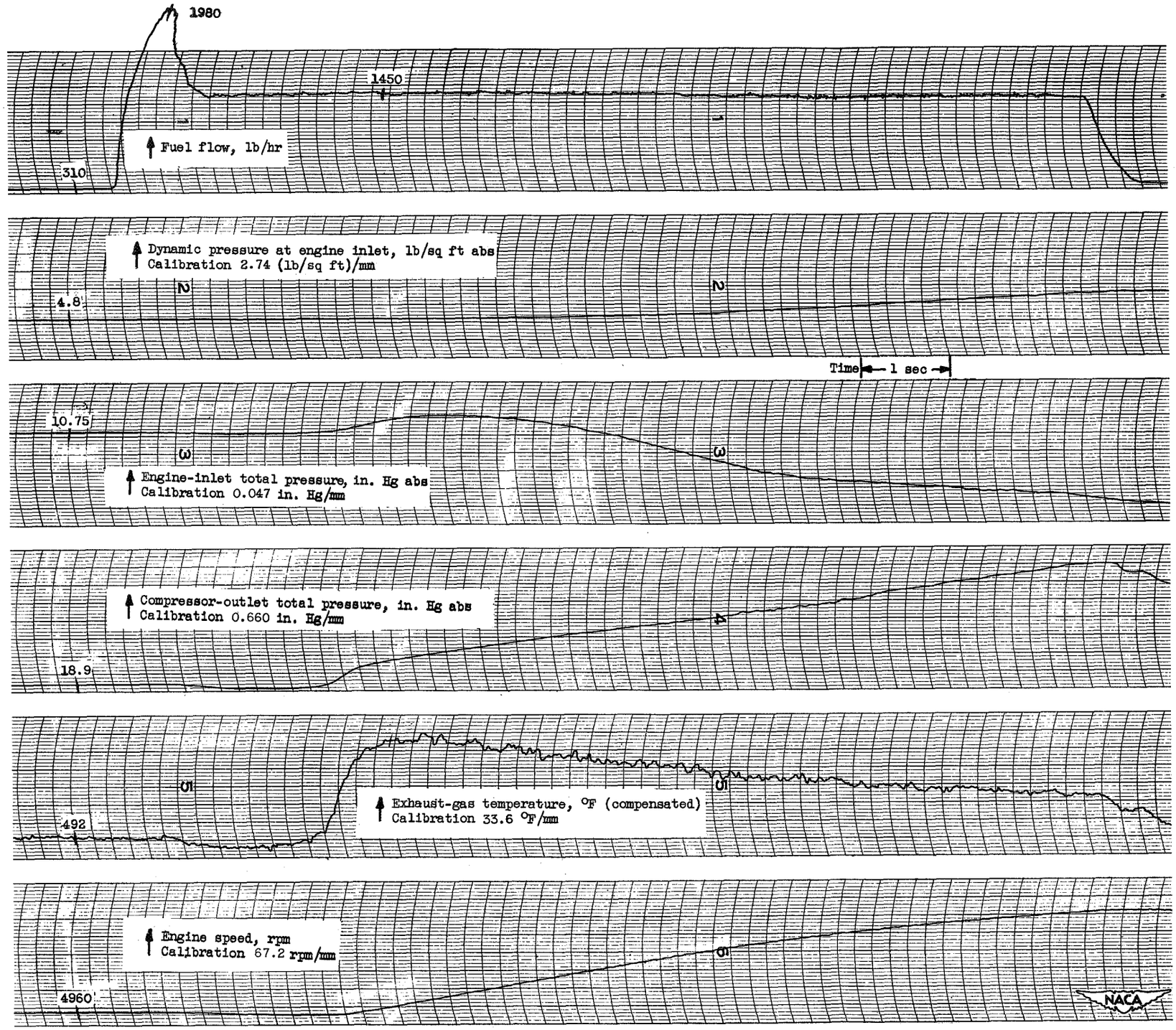

Figure 85

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 147° F; inlet guide vanes position, open.

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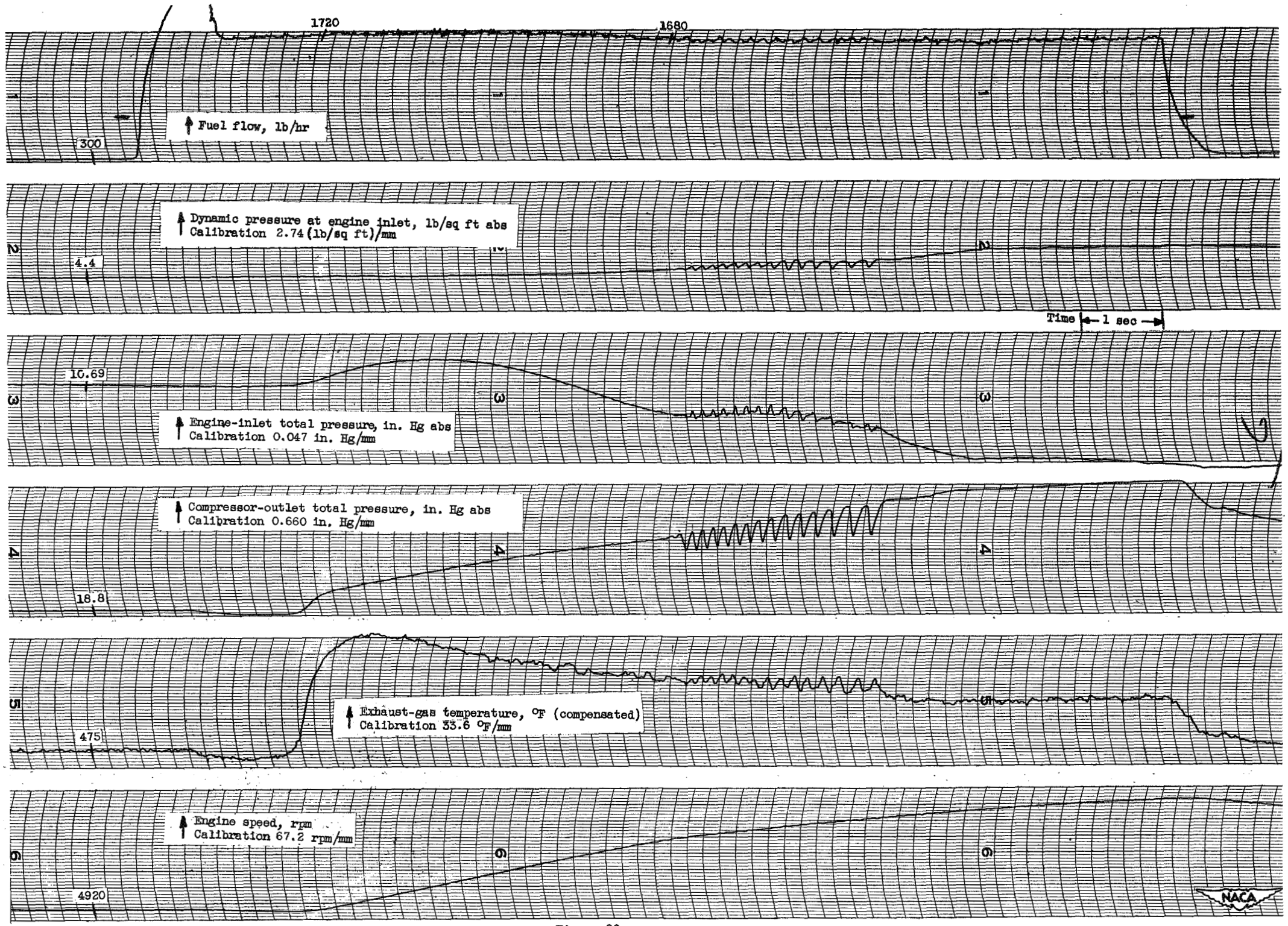

Figure 86

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 150° F; inlet guide vanes position, open.

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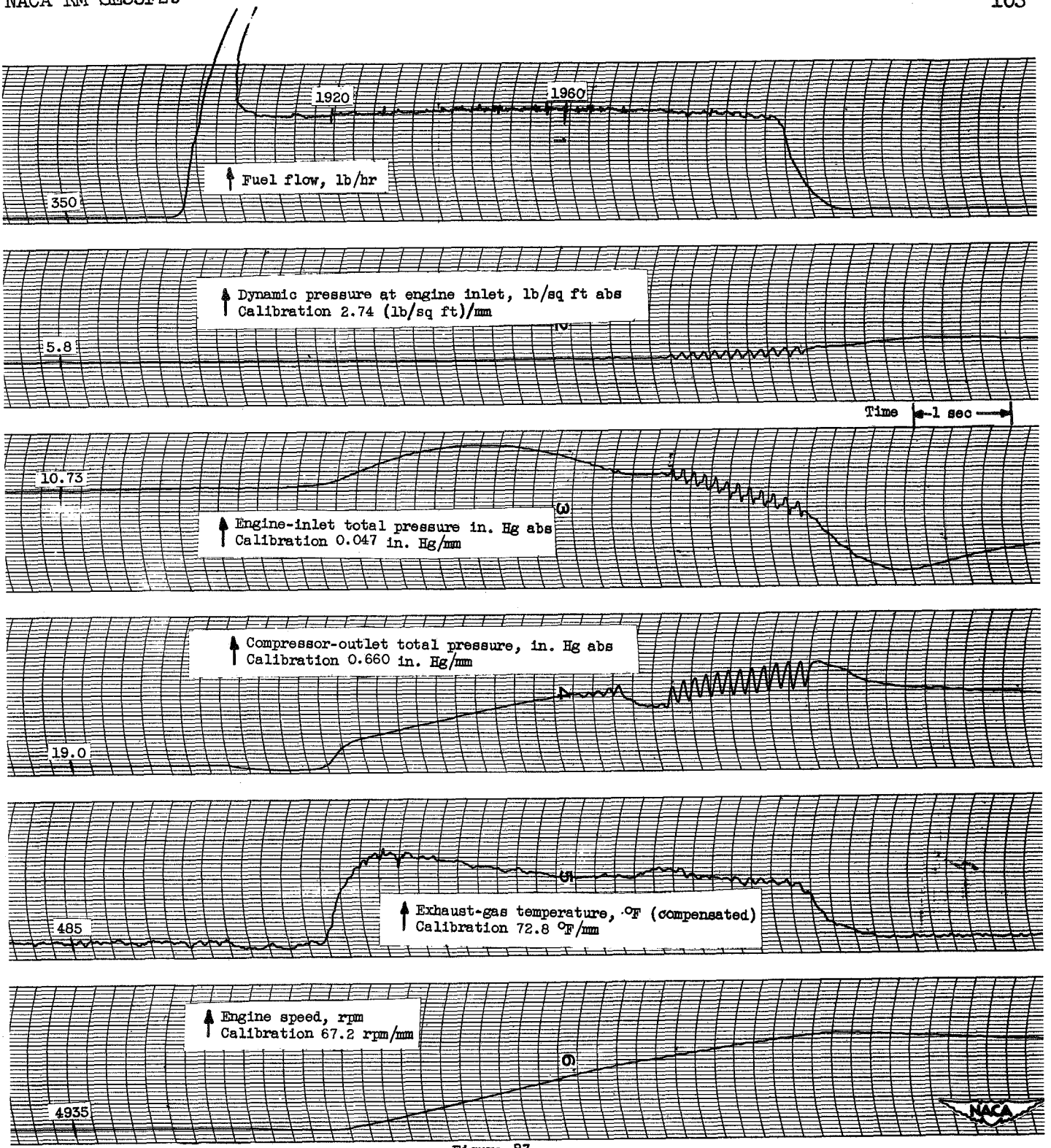

Figure 87

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 152° F; inlet guide vanes position, open.

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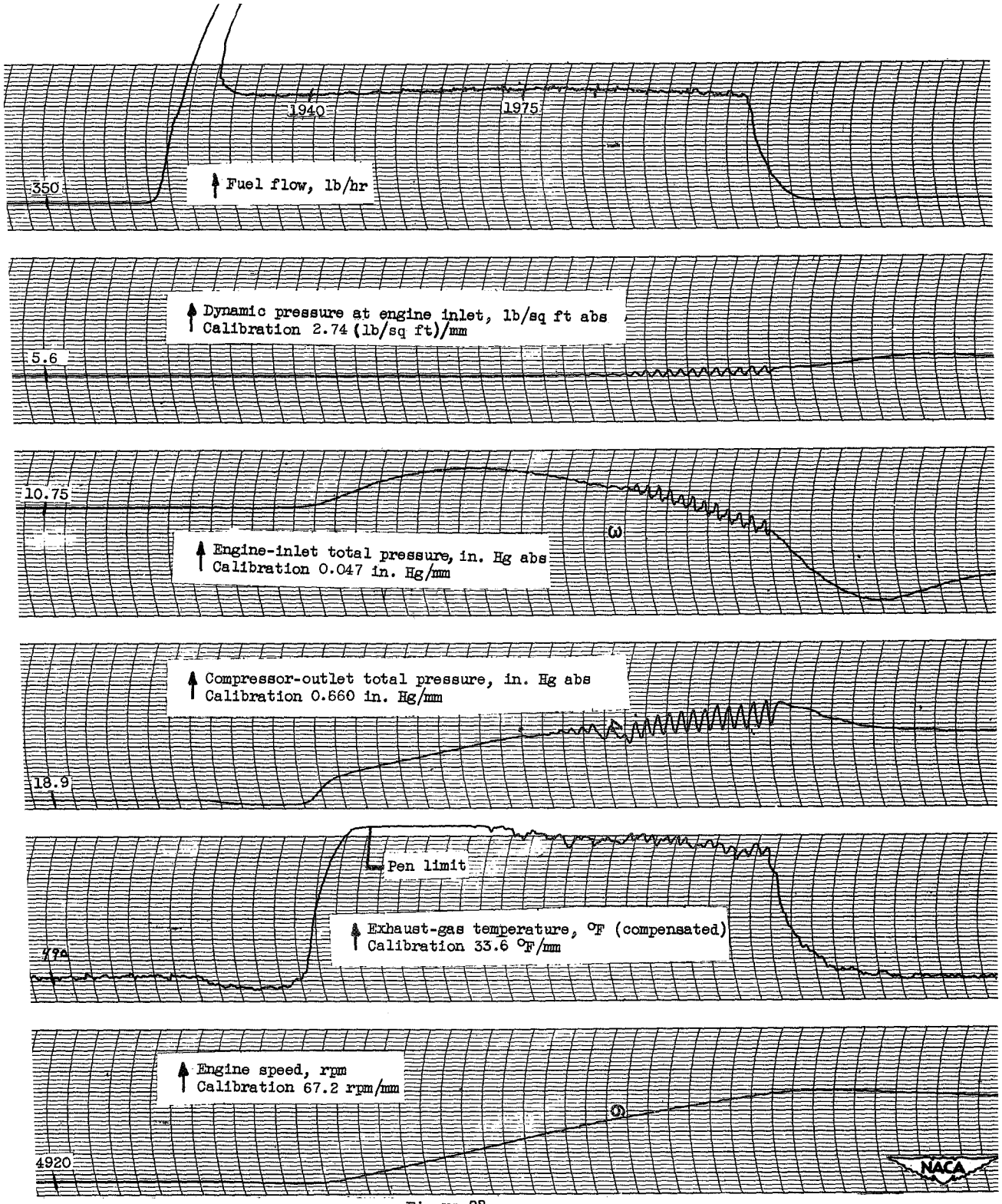

Figure 88

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 152° F; inlet guide vanes position, open.

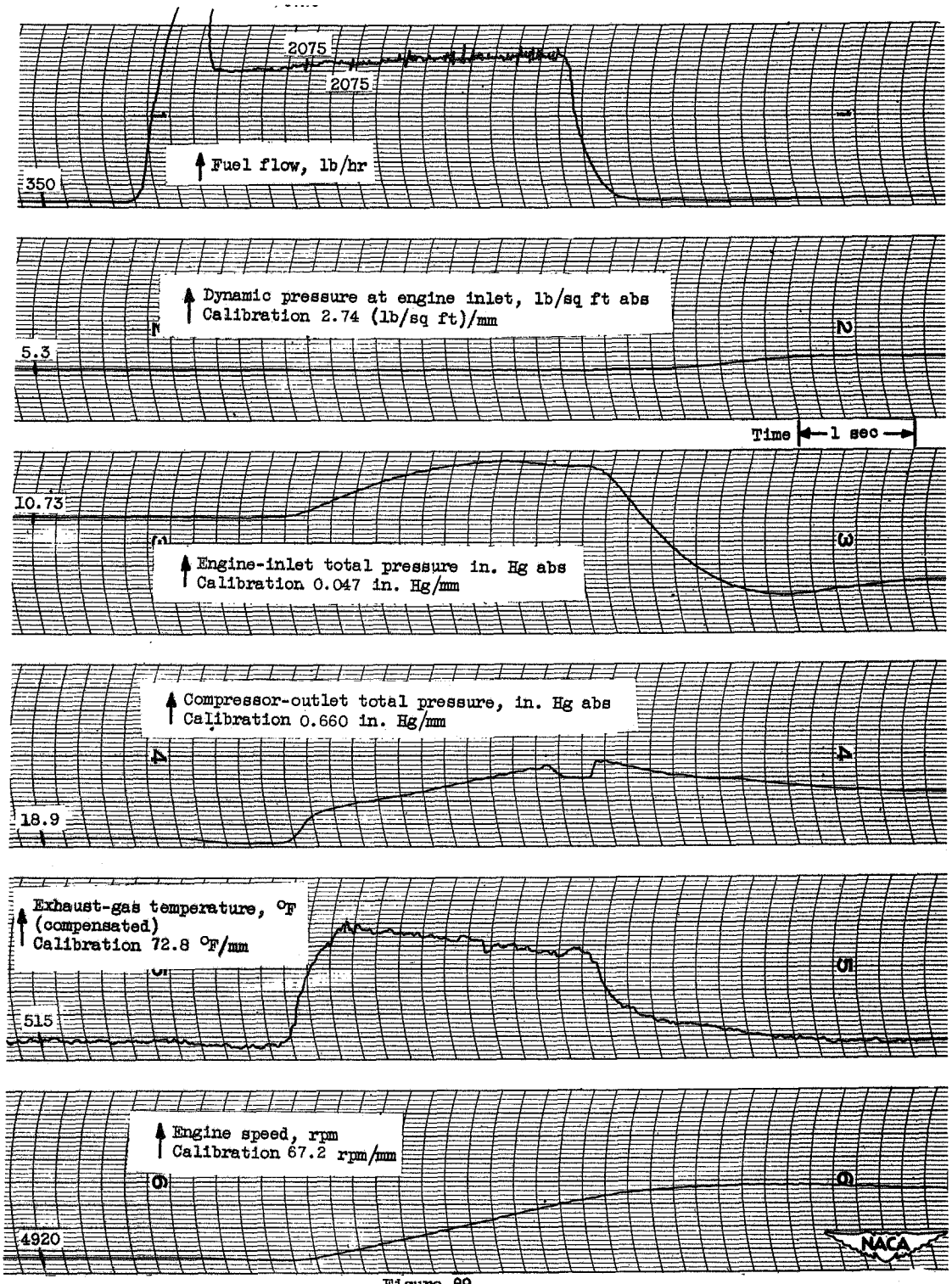

Figure 89

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 152° F; inlet guide vanes position, open.

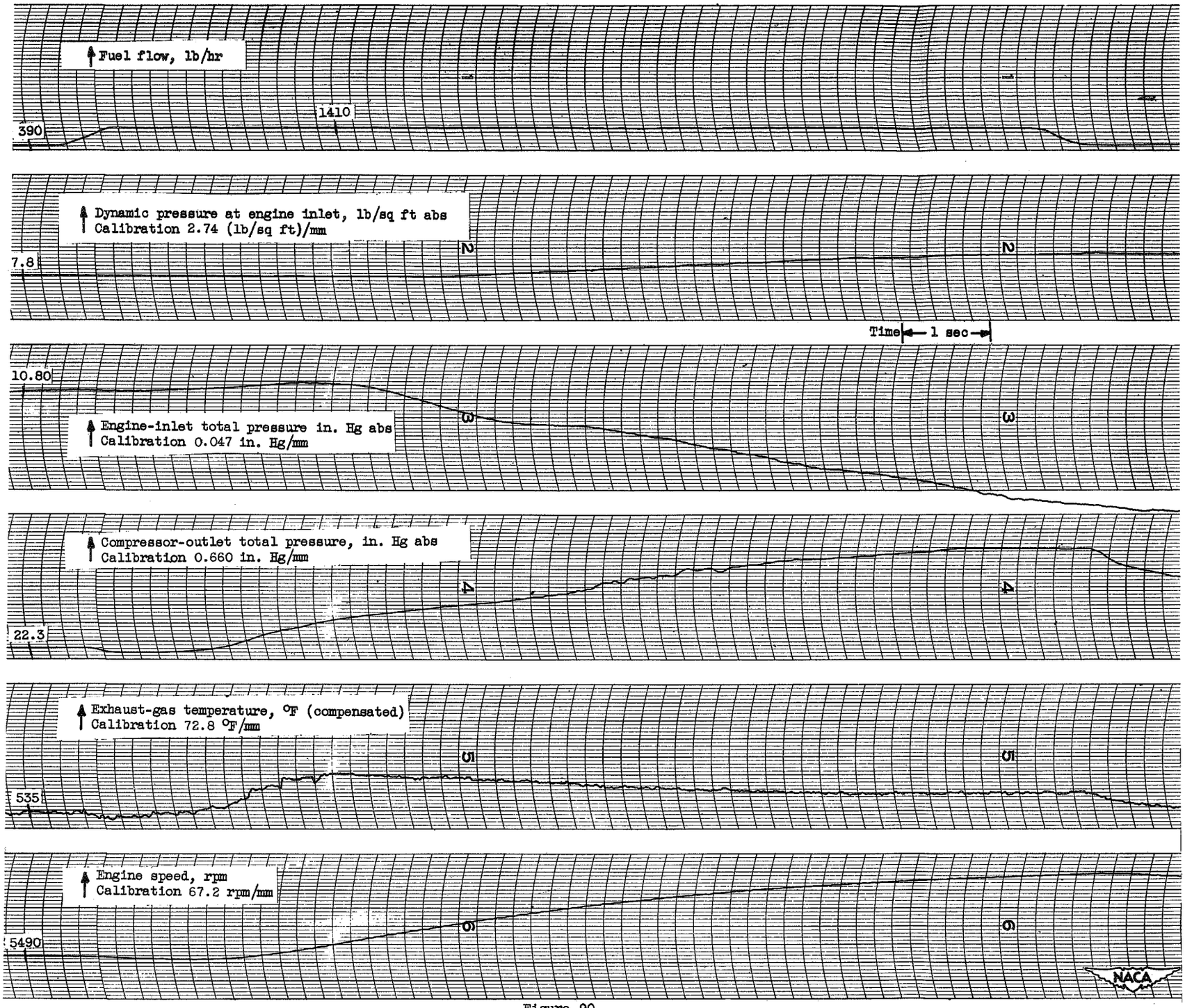

Figure 90

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 161° F; inlet guide vanes position, open.

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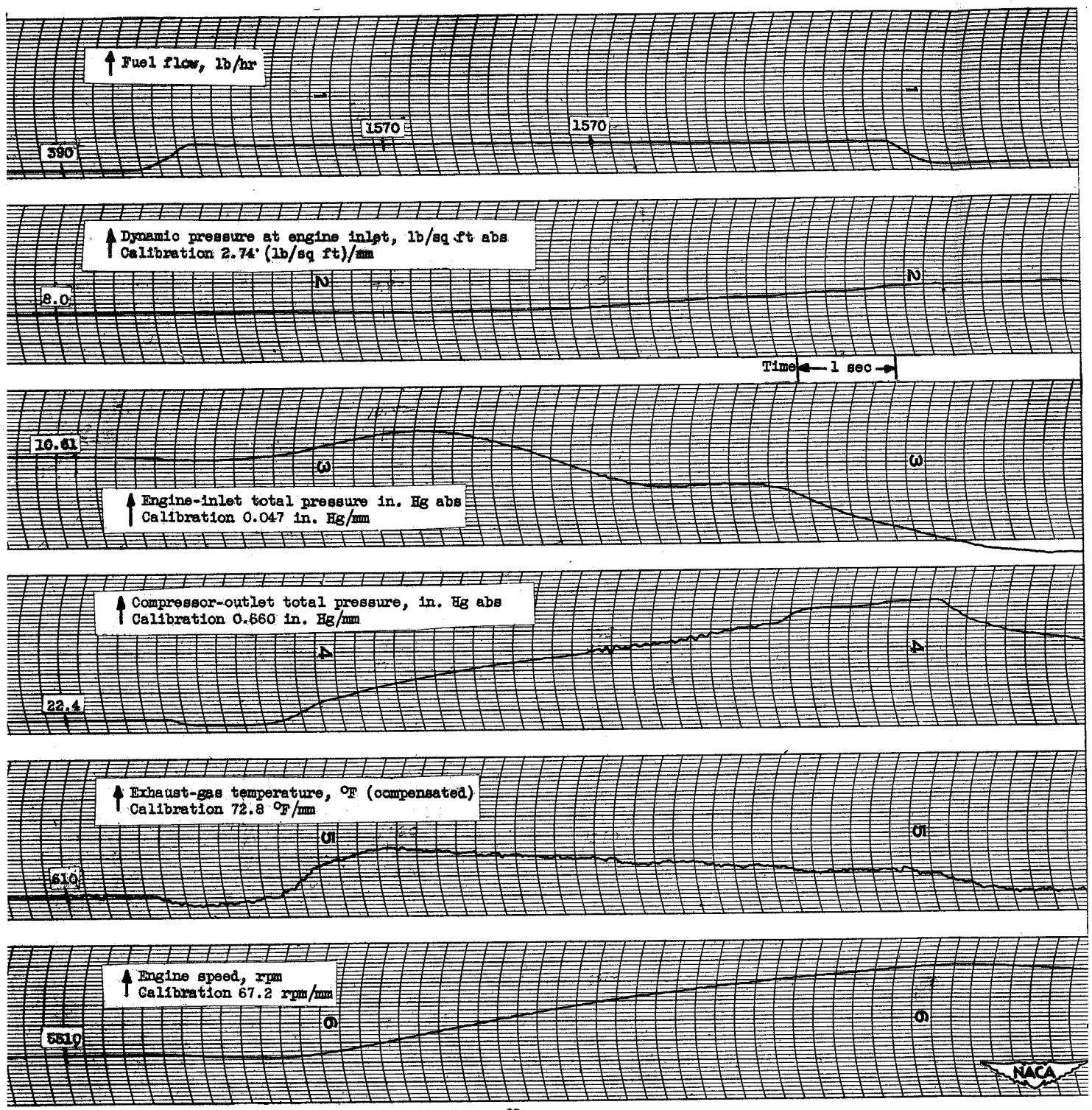

Figure 91

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 161° F; inlet guide vanes position, open.

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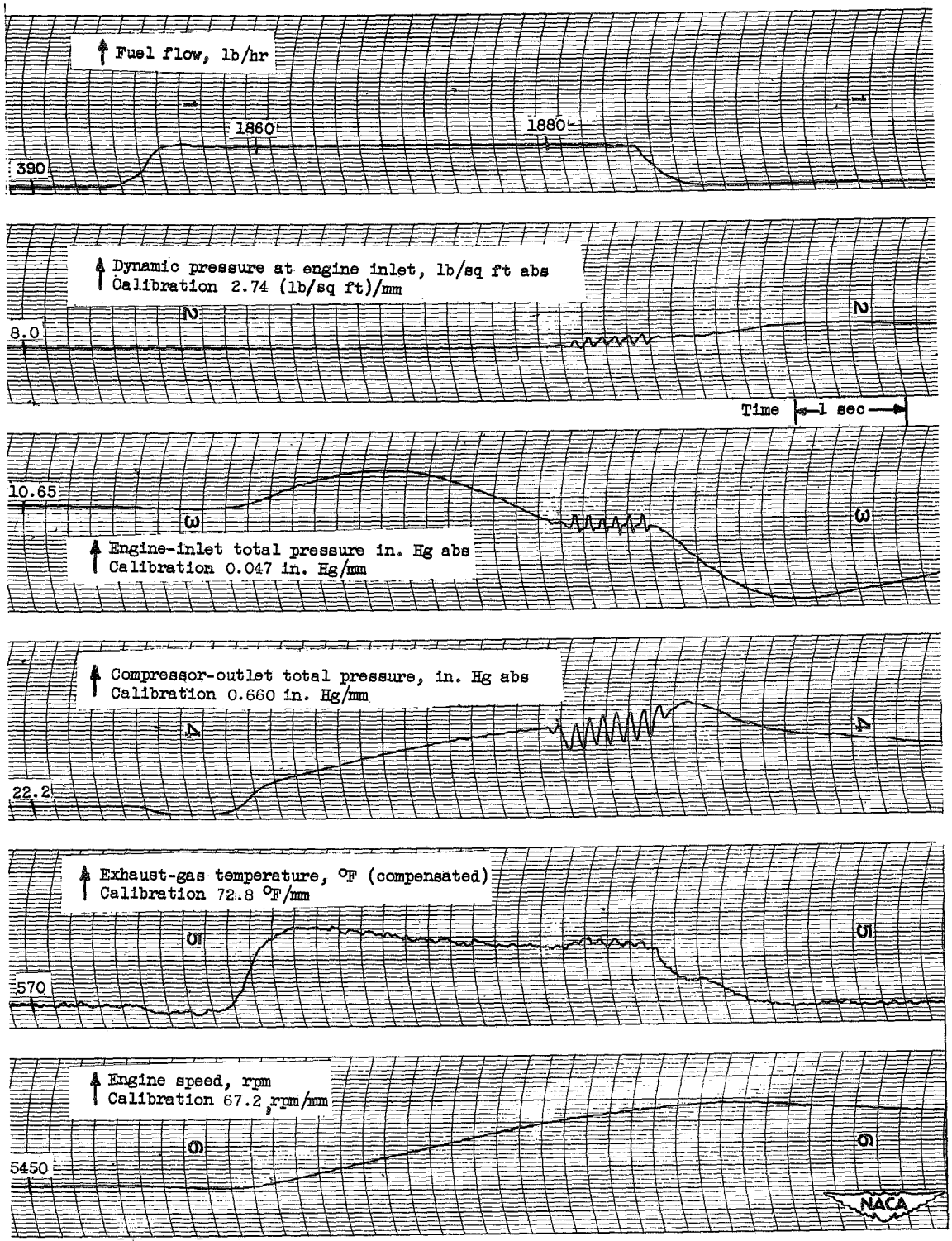

Figure 92

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 161° F; inlet guide vanes position, open.

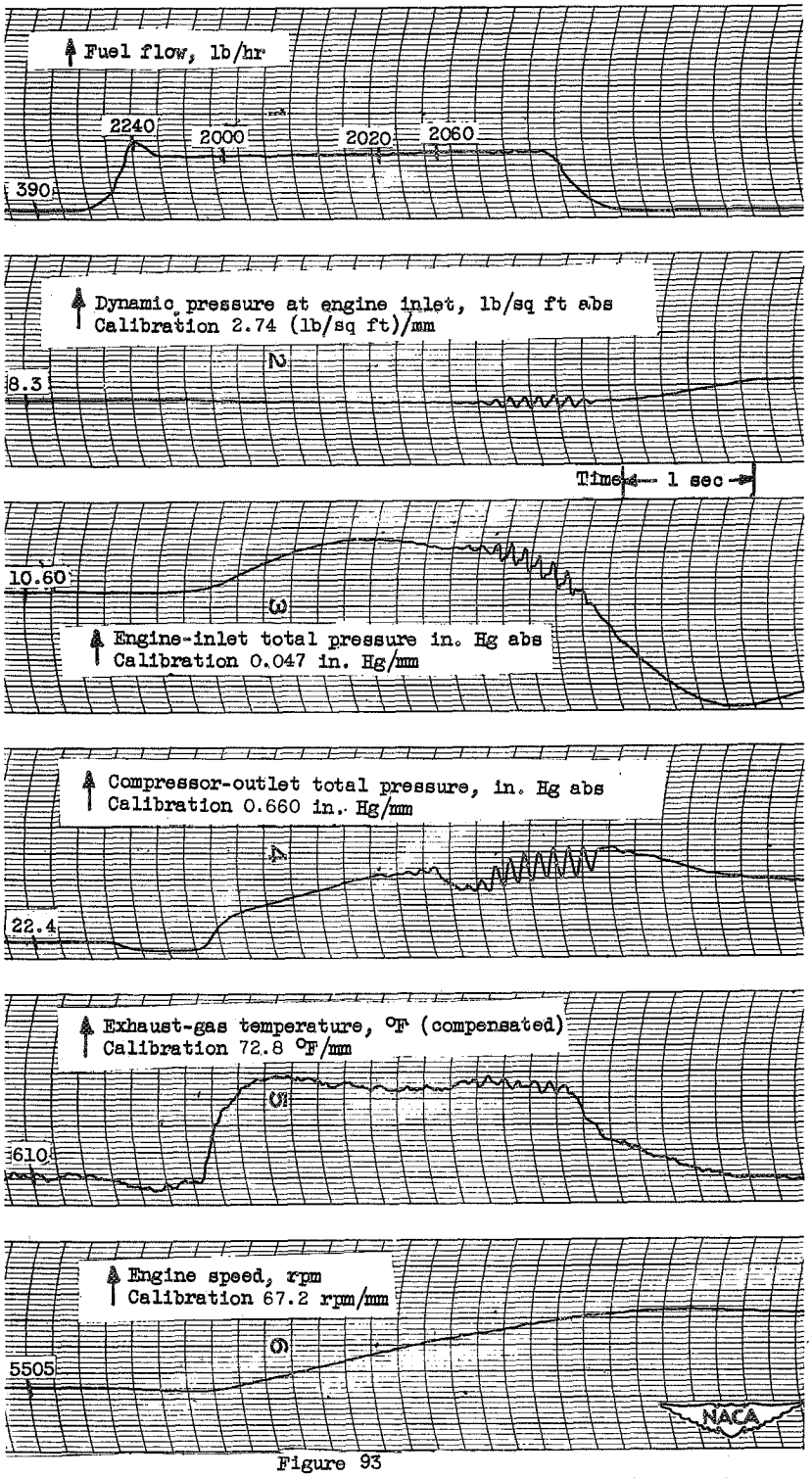

Figure 93

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 161° F; inlet guide vanes position, open.

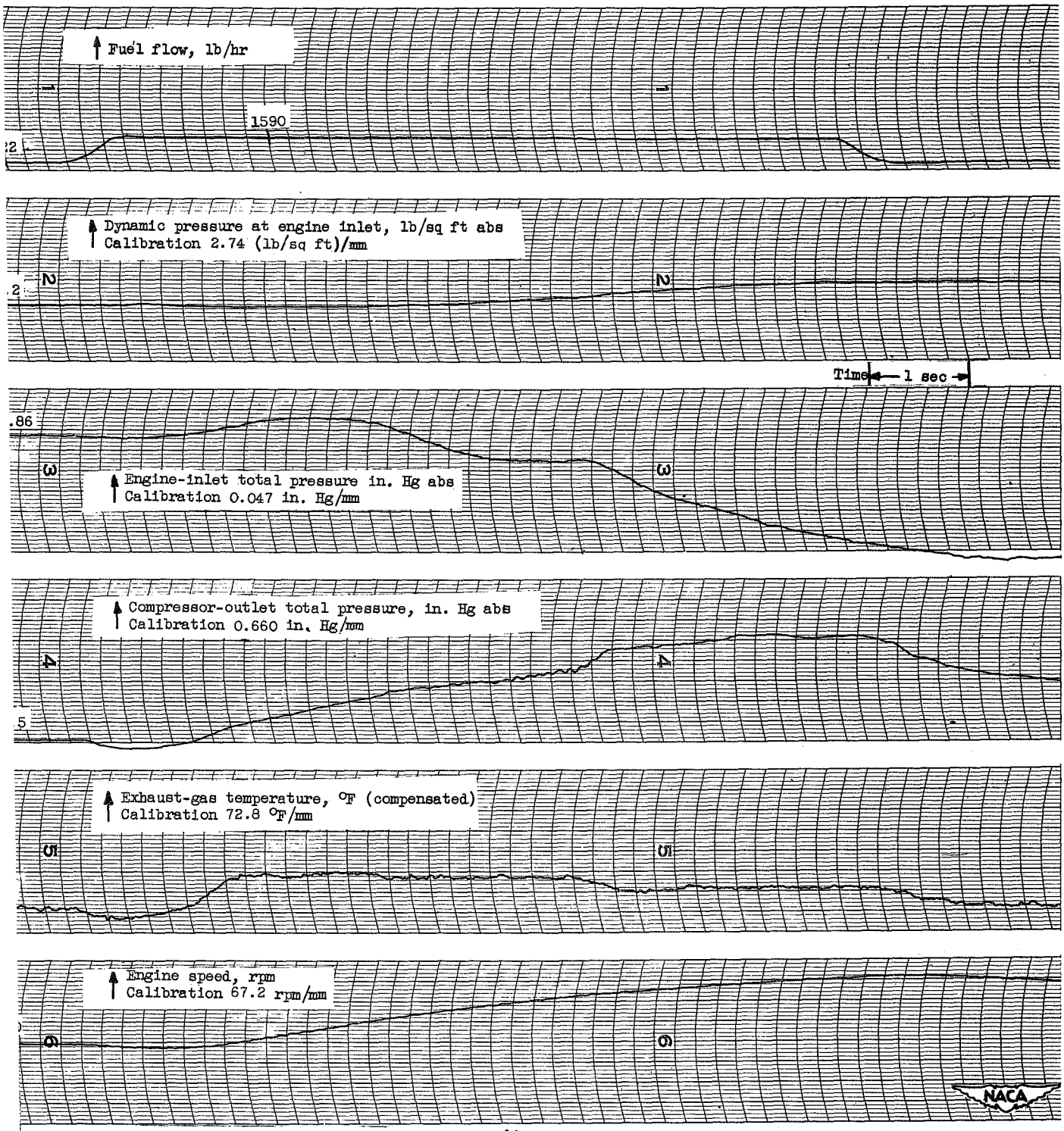

Figure 94

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, open.

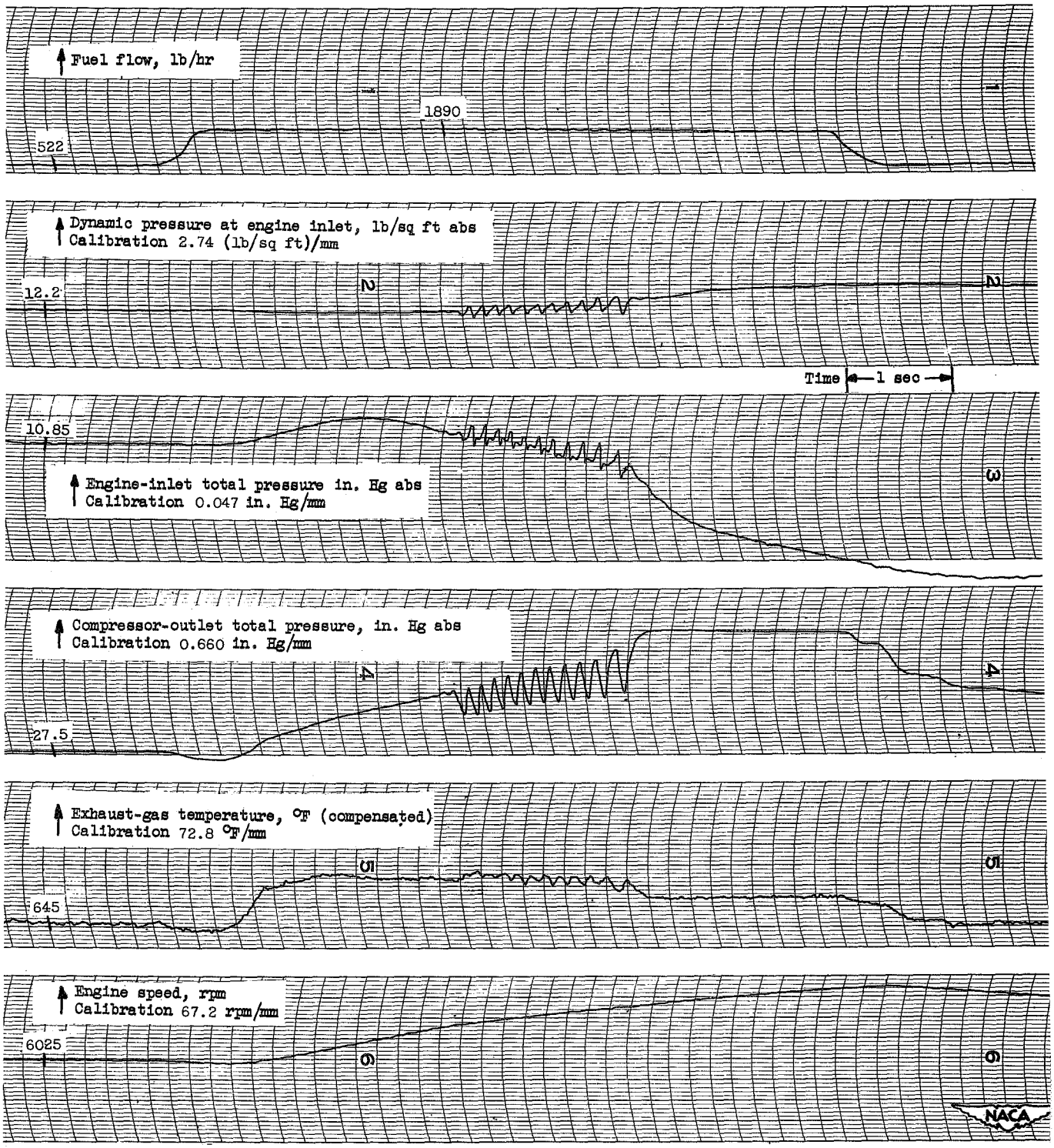

Figure 95
Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, open.

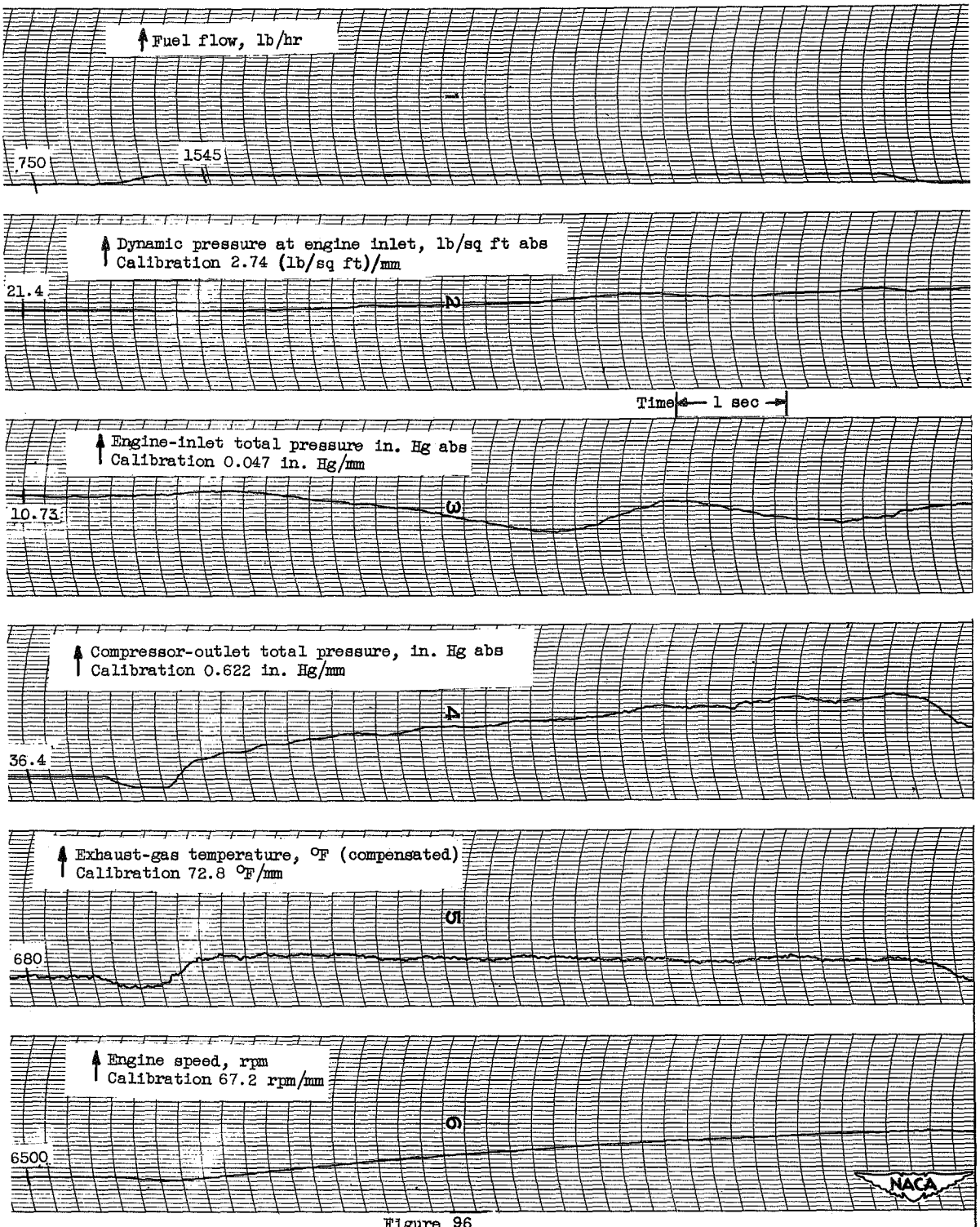

Figure 96

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 164° F; inlet guide vanes position, open.

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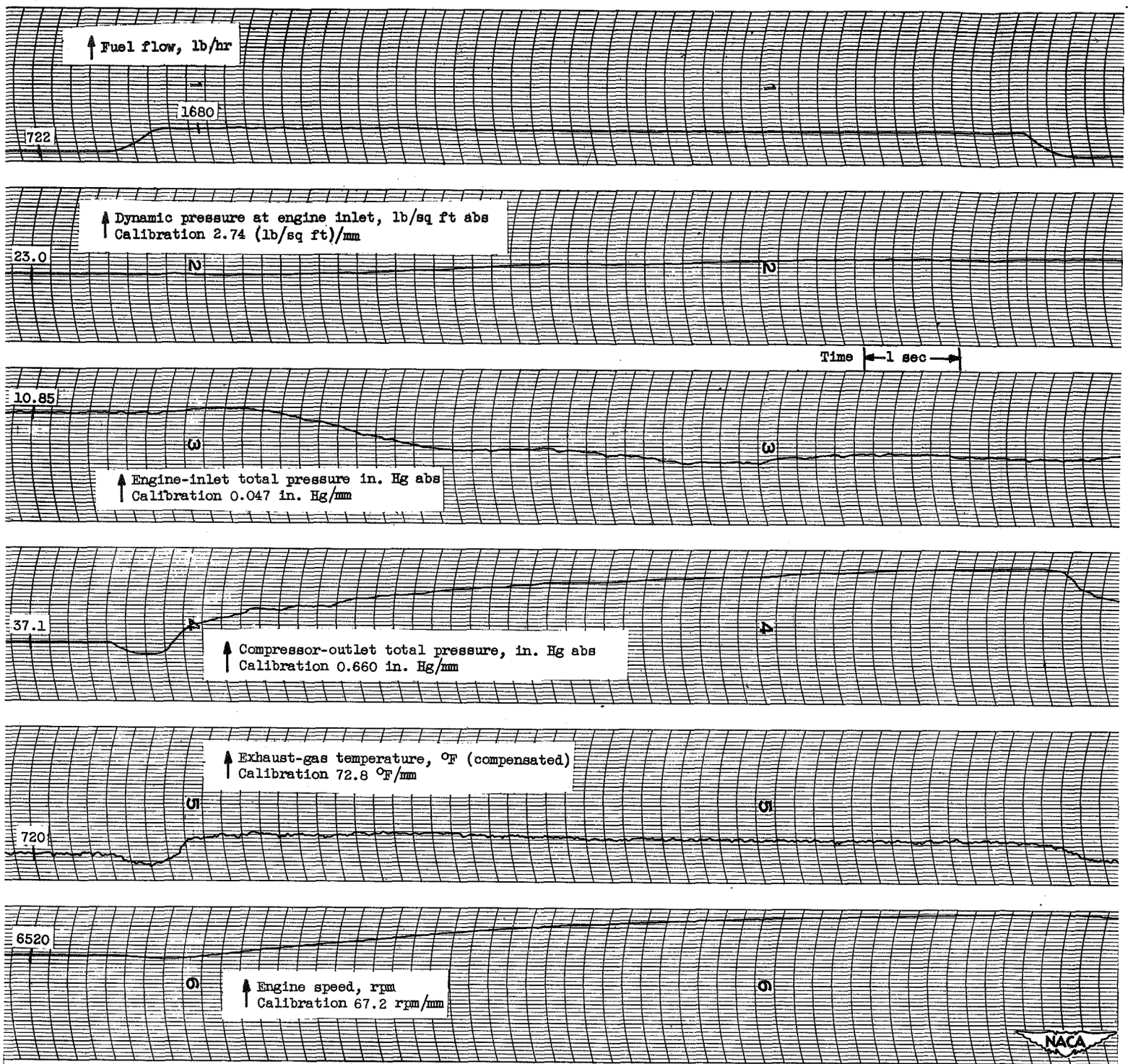

Figure 97

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 165° F; inlet guide vanes position, open.

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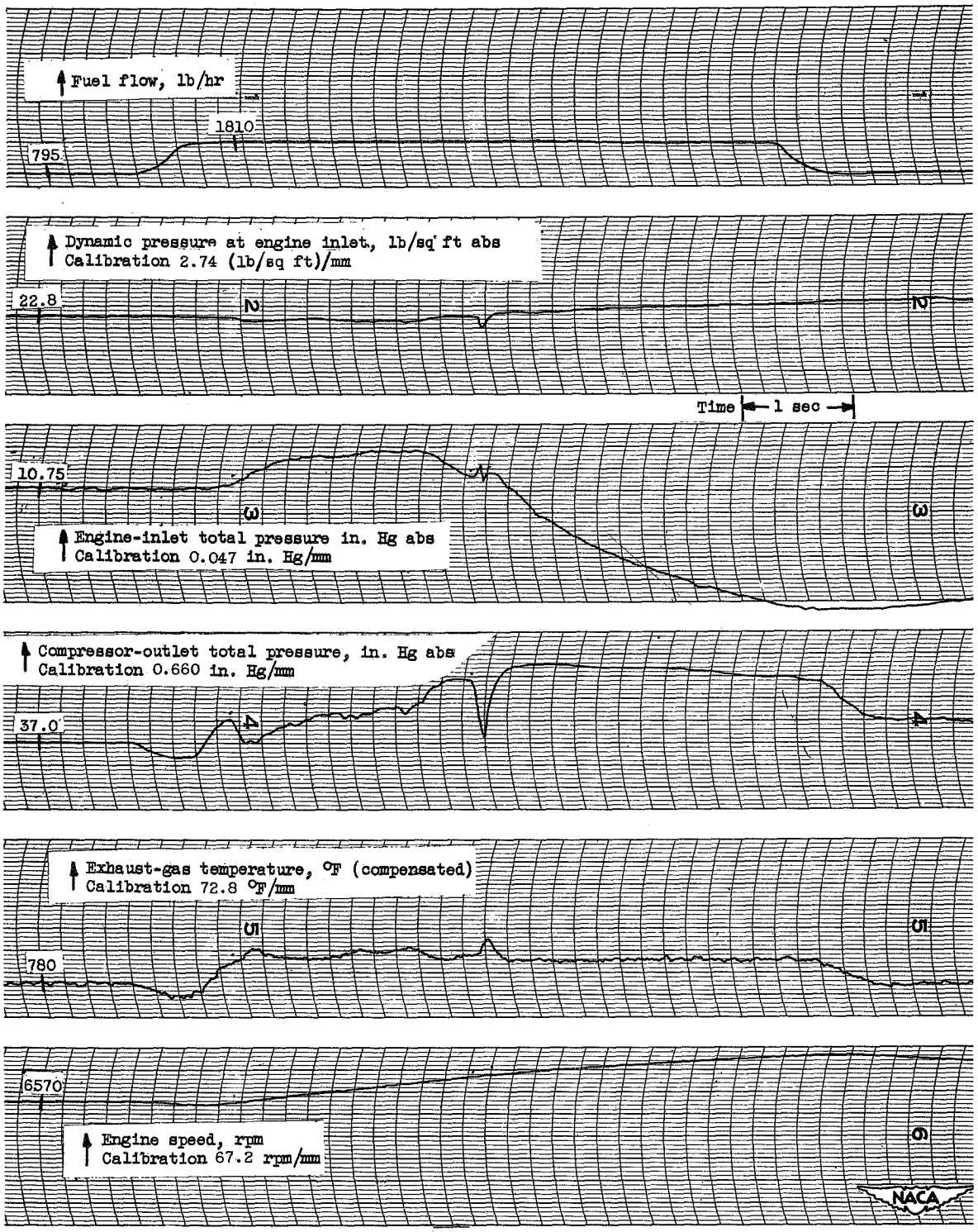

Figure 98

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 165° F; inlet guide vanes position, open.

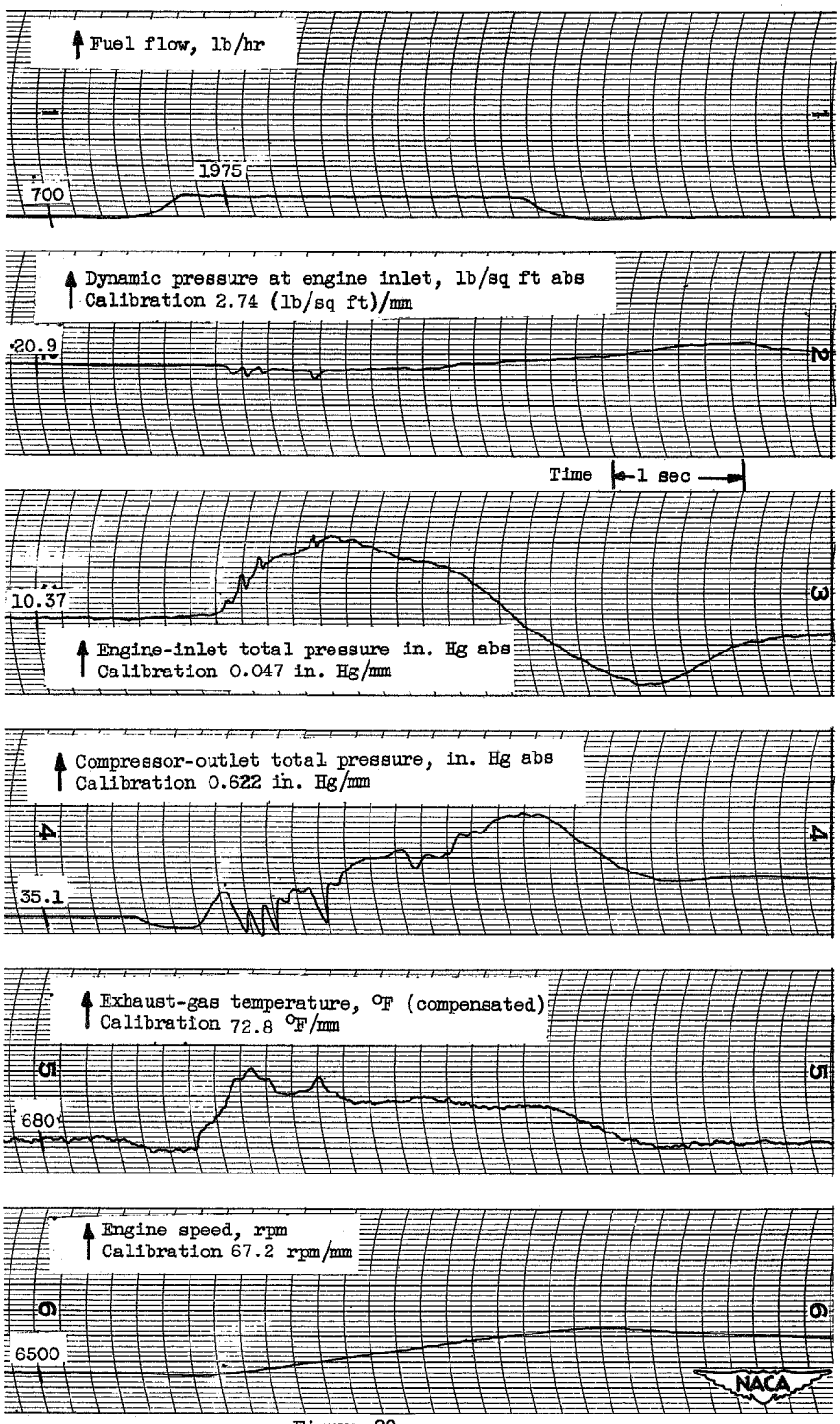

Figure 99

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 164° F; inlet guide vanes position, open.

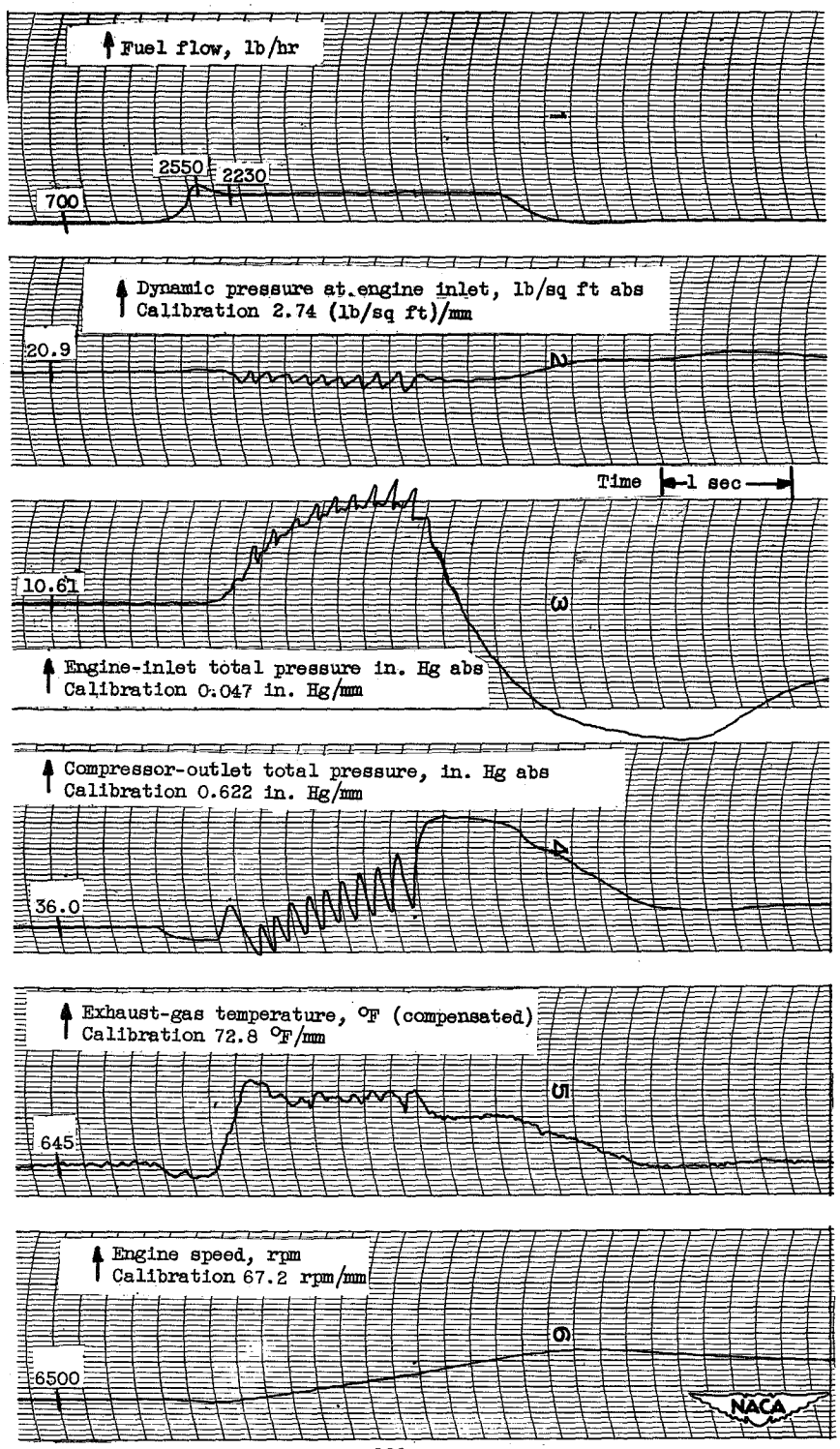

Figure 100

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 164° F; inlet guide vanes position, open.

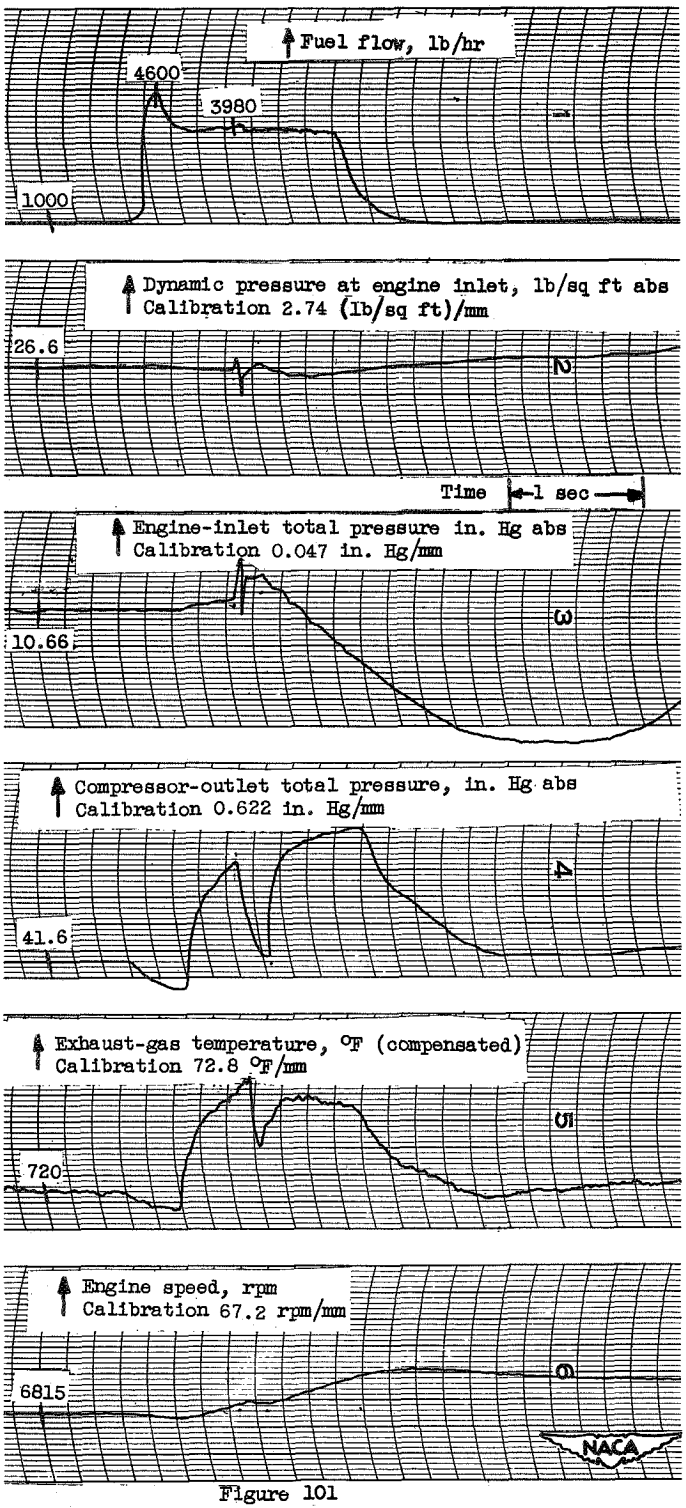

Figure 101

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, open.

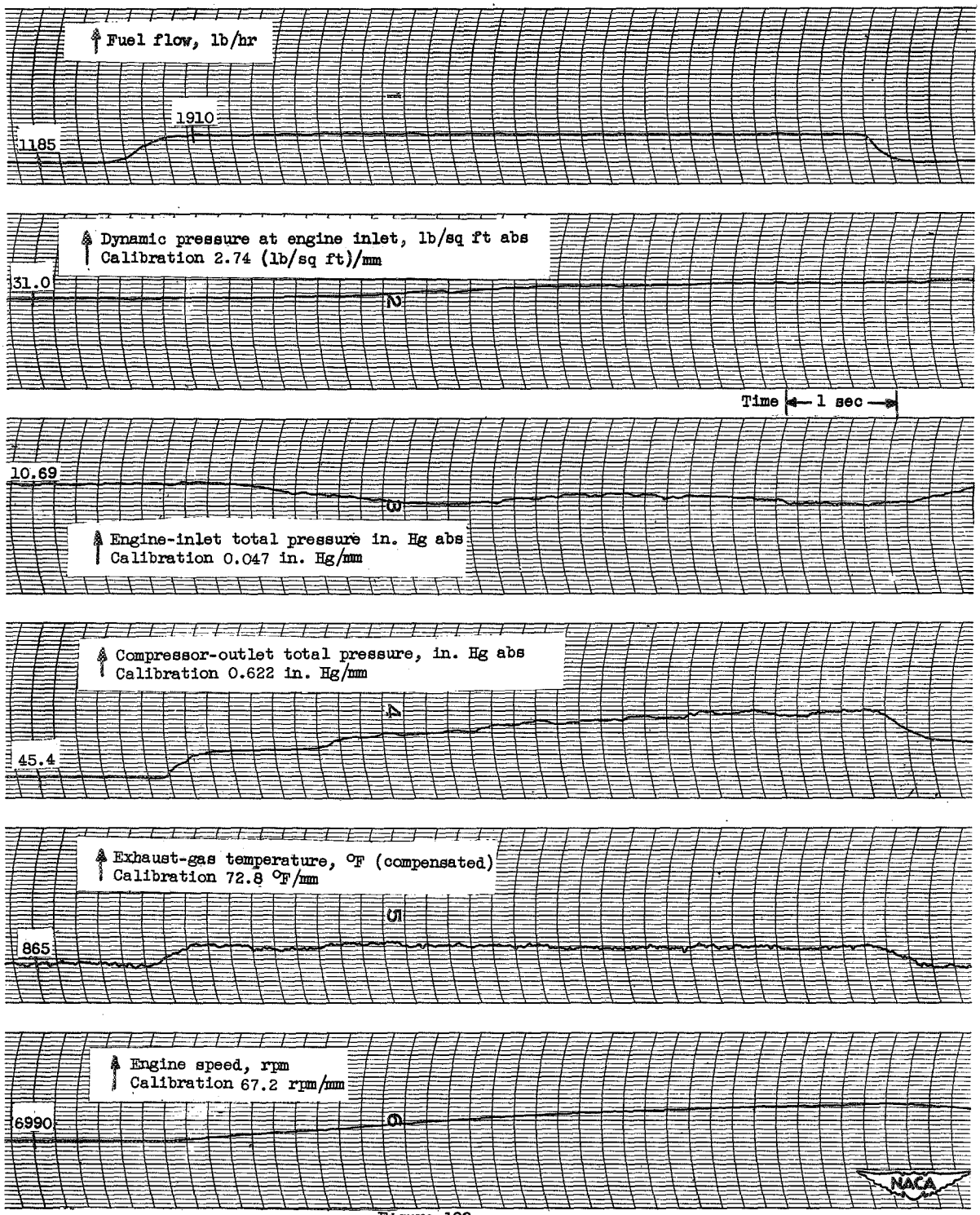

Figure 102

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 166° F; inlet guide vanes position, open.

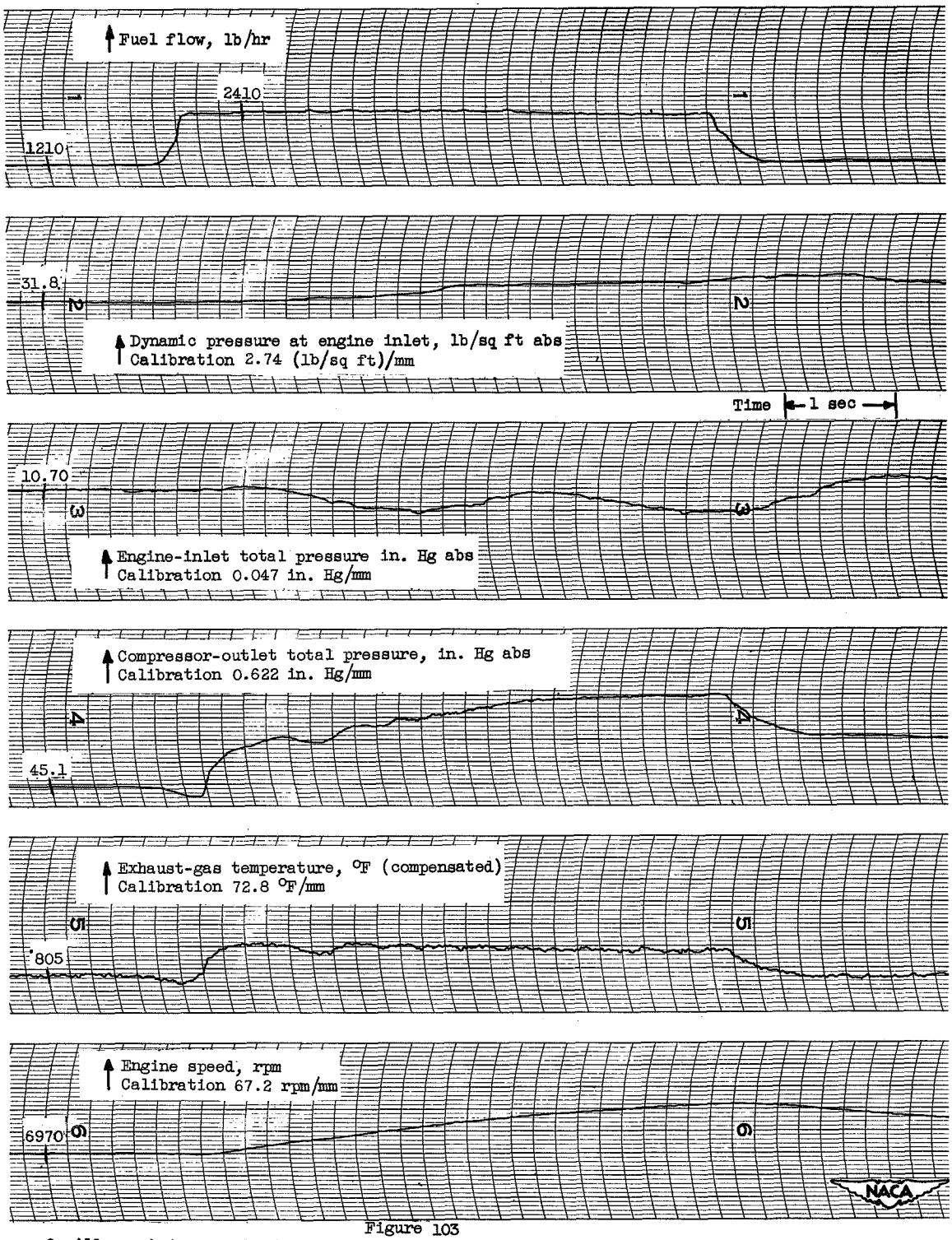

Figure 103

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 166° F; inlet guide vanes position, open.

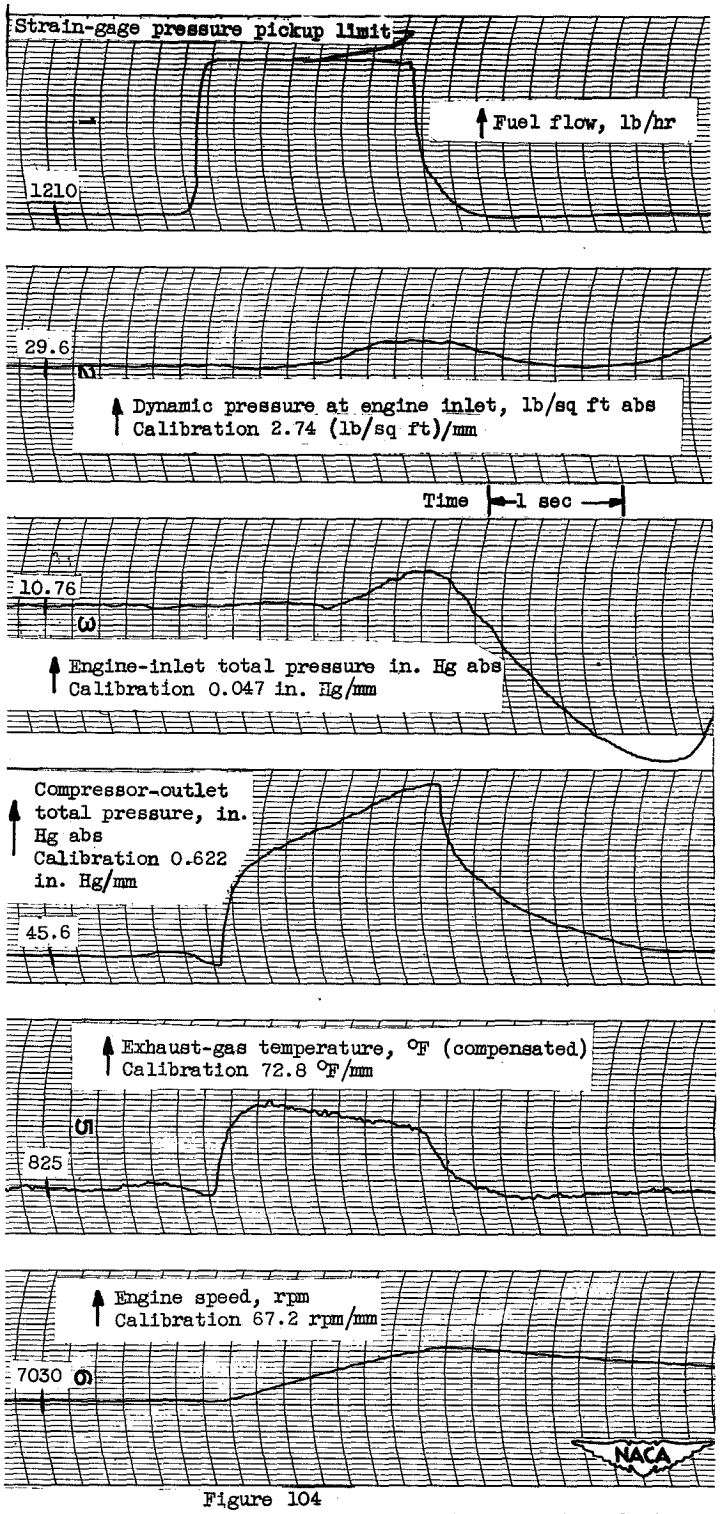

Figure 104

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 166° F; inlet guide vanes position, open.

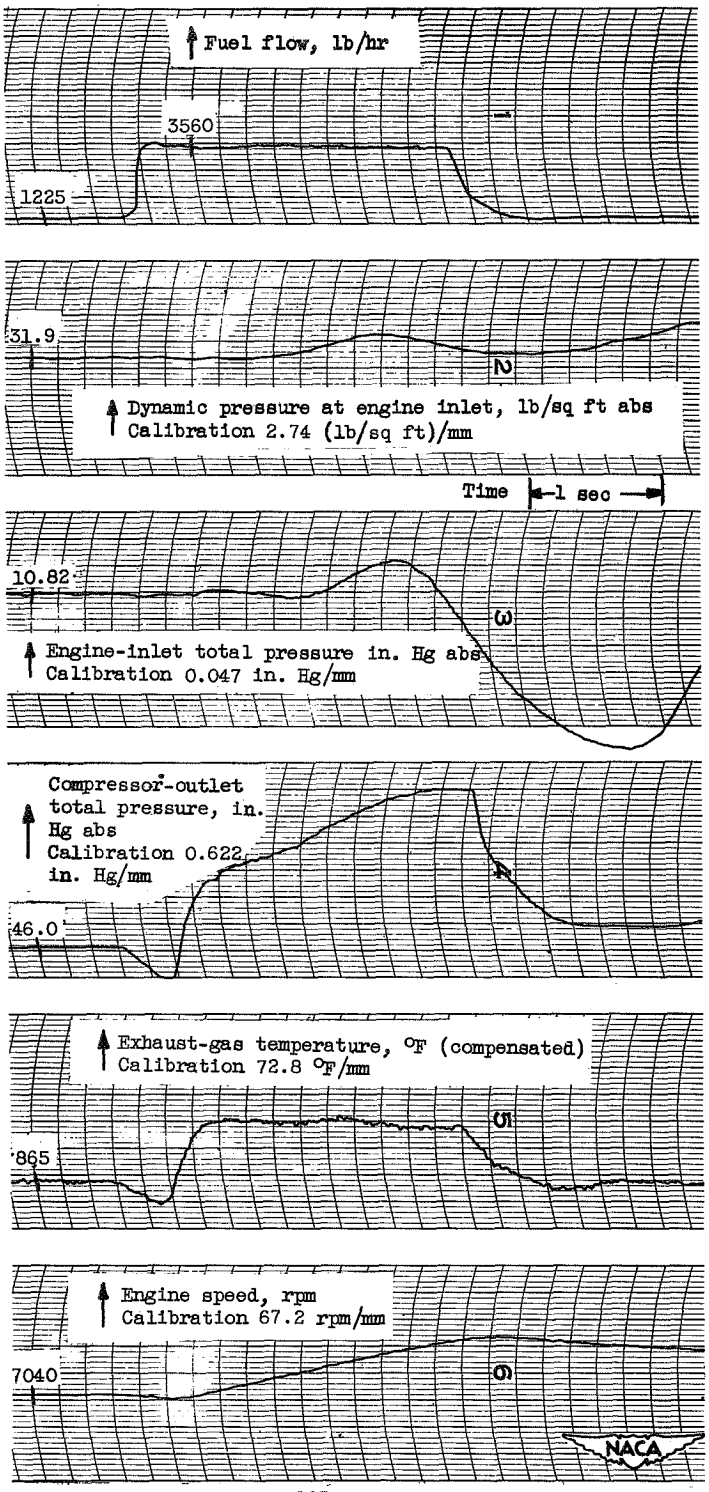

Figure 105

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 165° F; inlet guide vanes position, open.

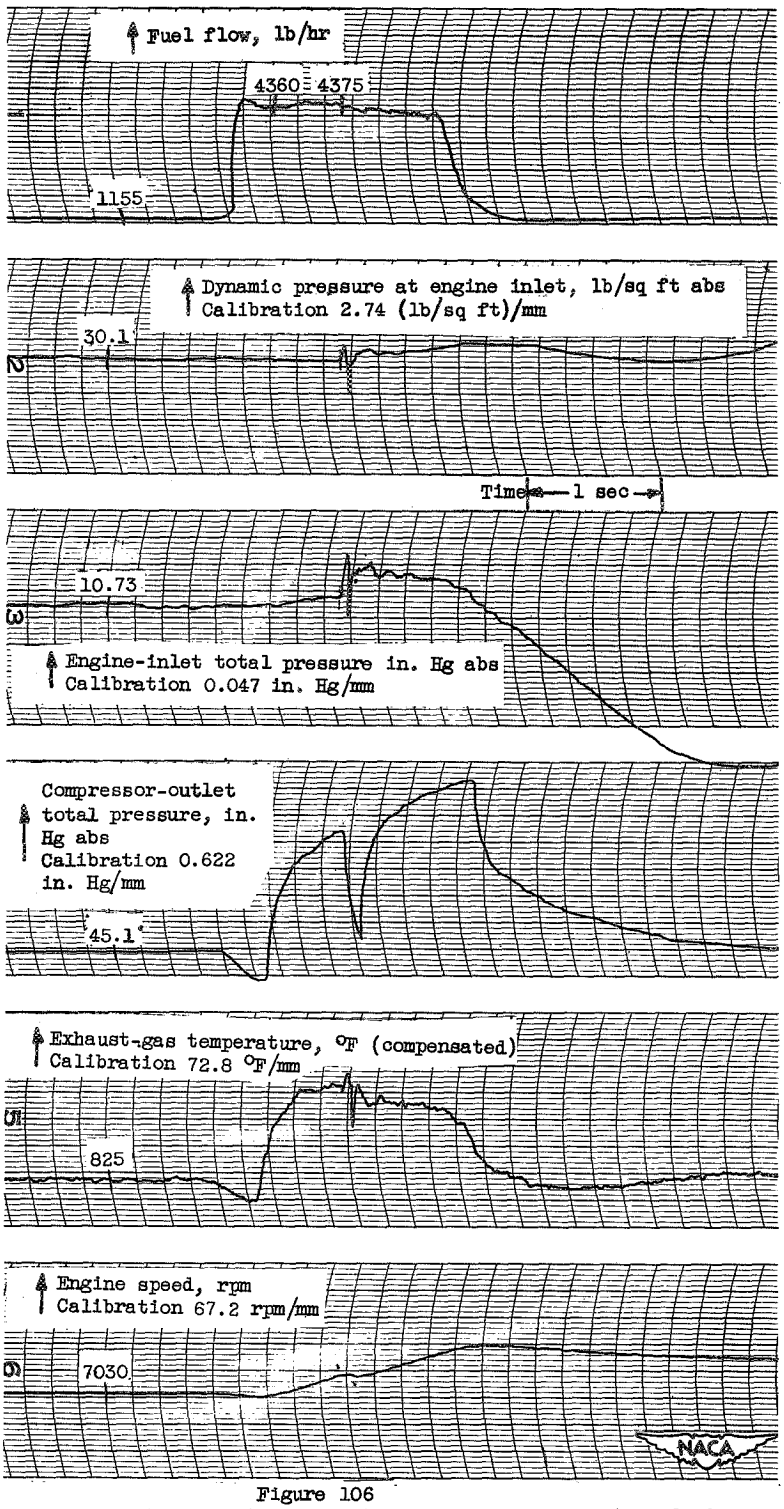

Figure 106

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 165° F; inlet guide vanes position, open.

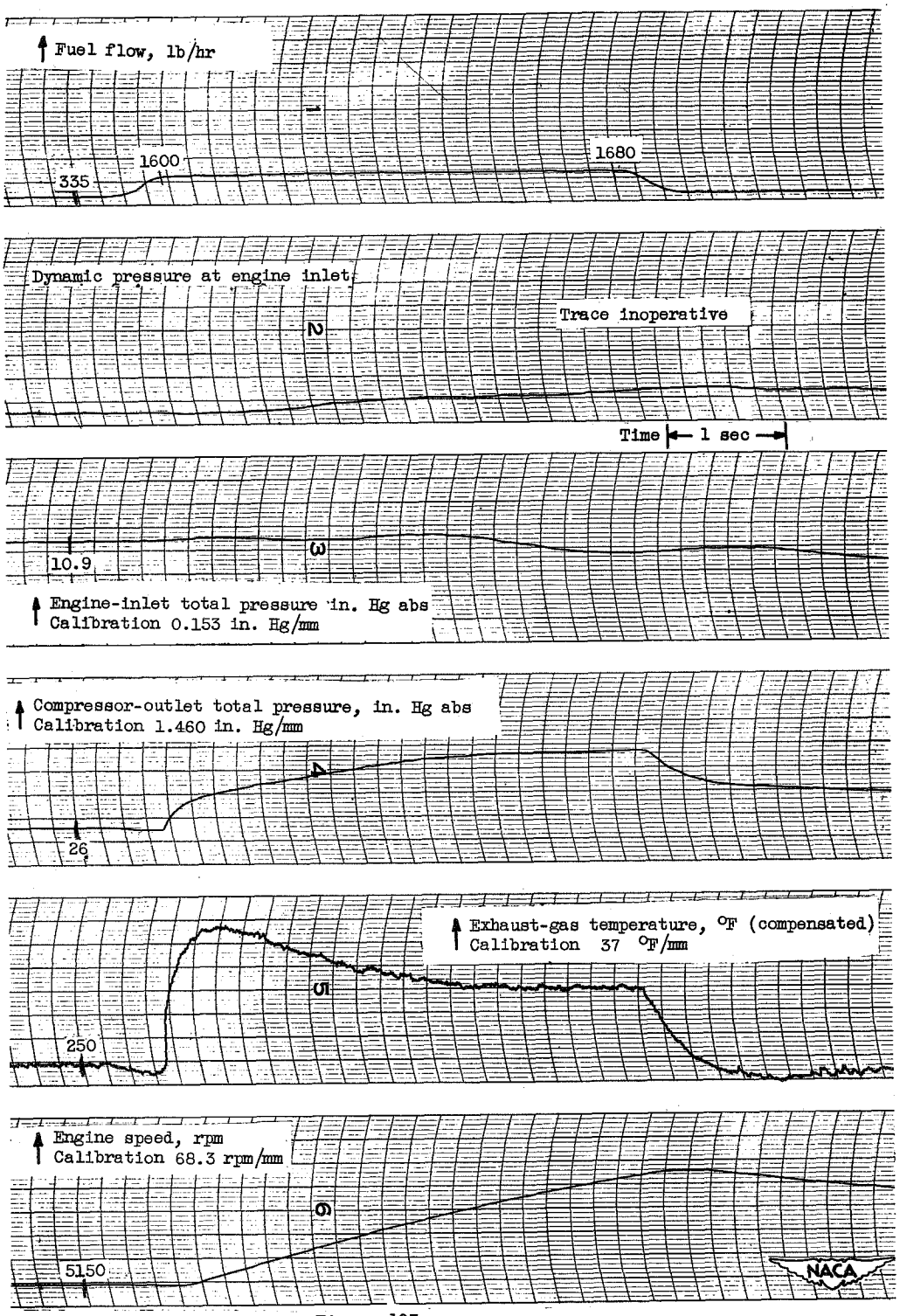

Figure 107

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8 ; engine-inlet air temperature, 17° F; inlet guide vanes position, closed.

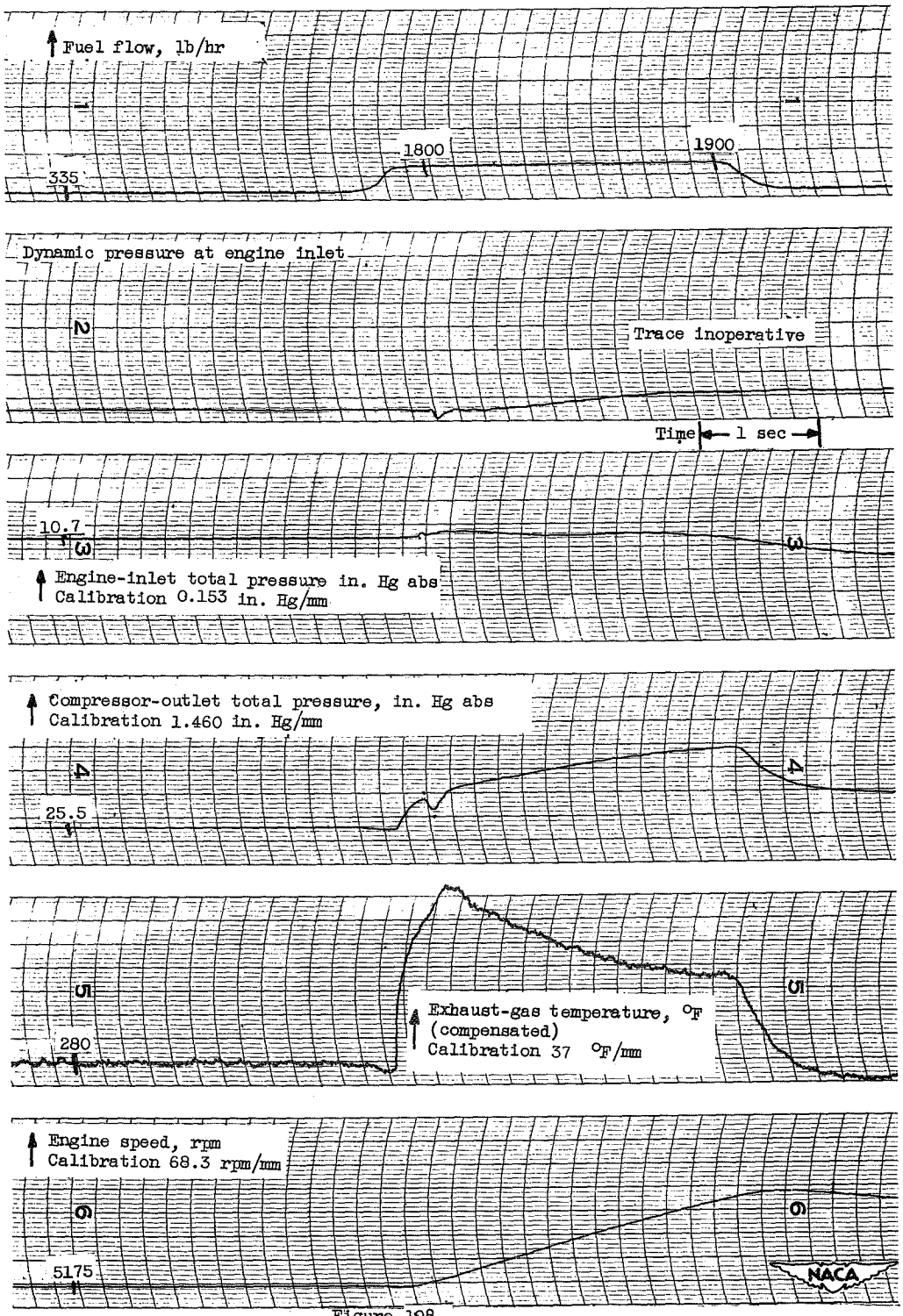

Figure 108

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 17.° F; inlet guide vanes position, closed.

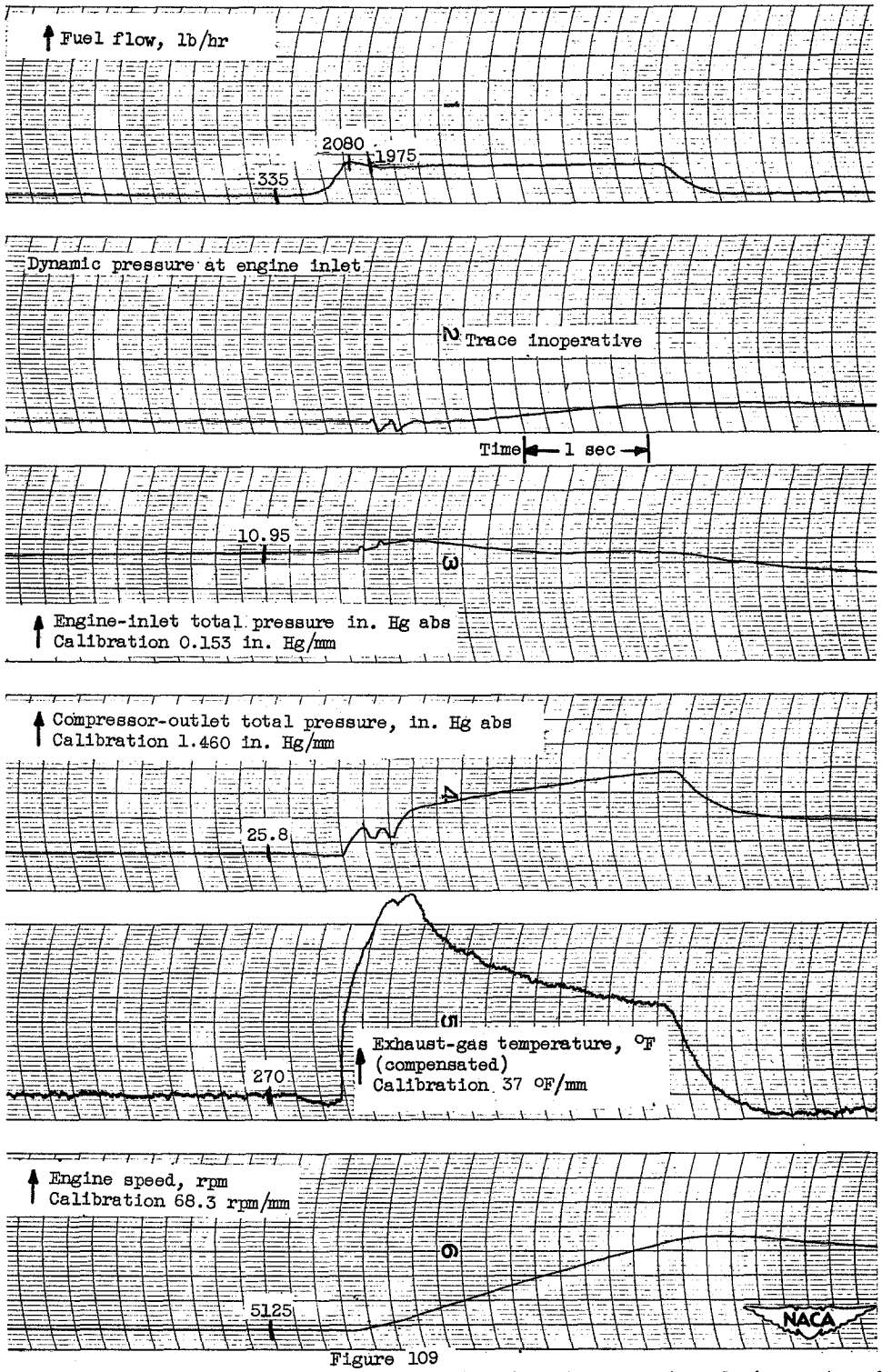

Figure 109

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 17 °F; inlet guide vanes position, closed.

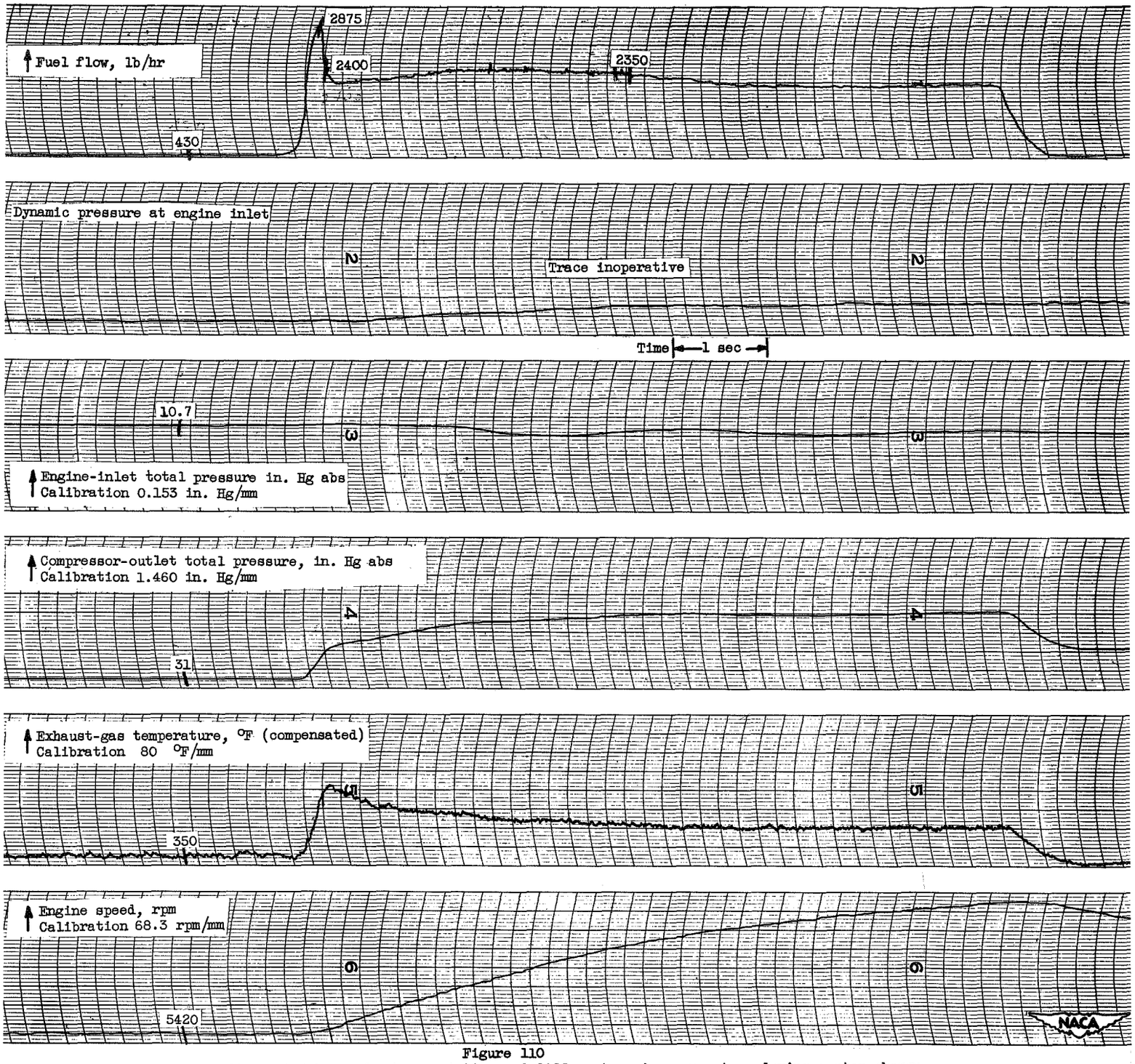

Figure 110

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -2 °F; inlet guide vanes position, closed.

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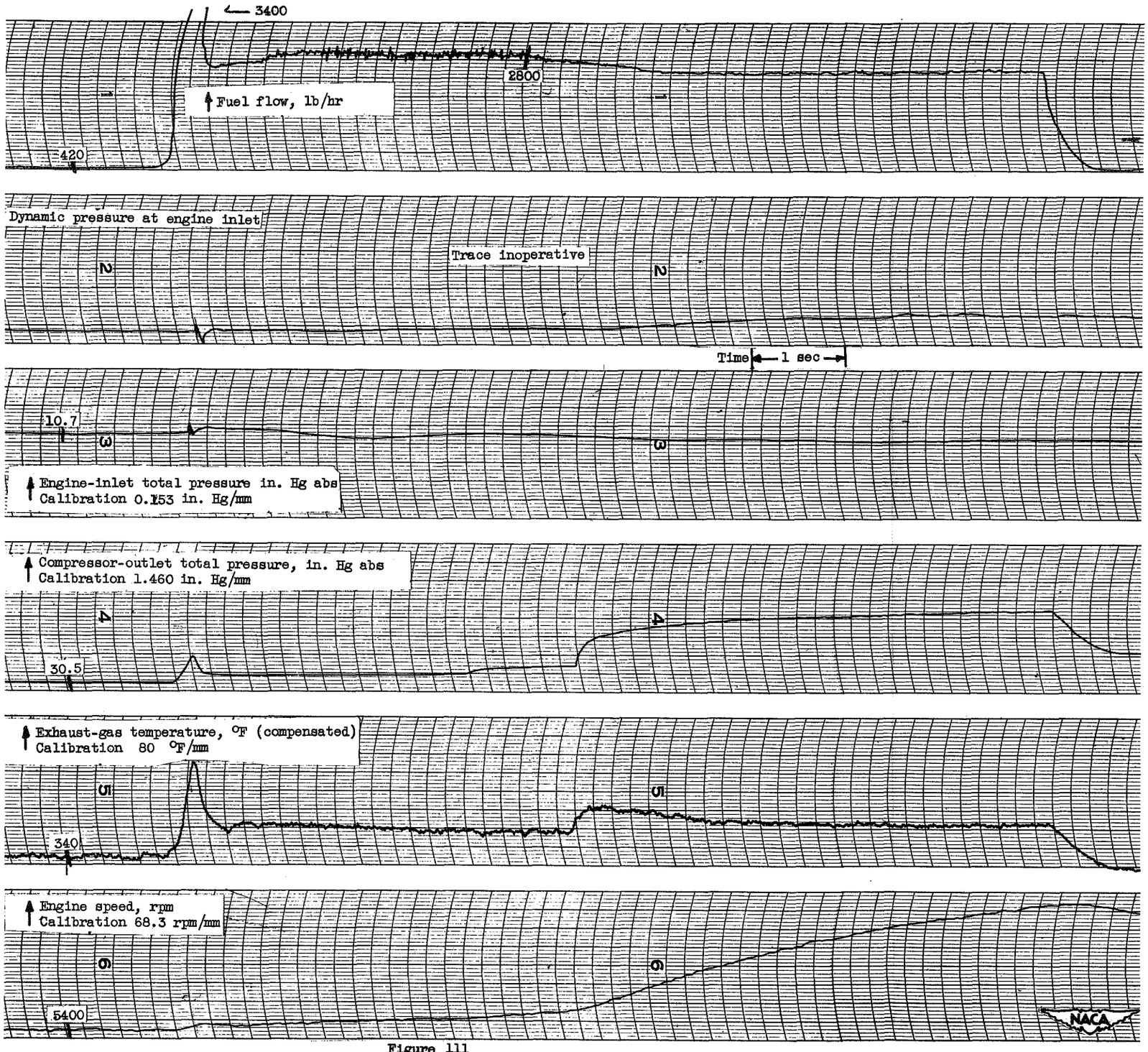

Figure 111

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8 ; engine-inlet air temperature, -3 ° F; inlet guide vanes position, closed.

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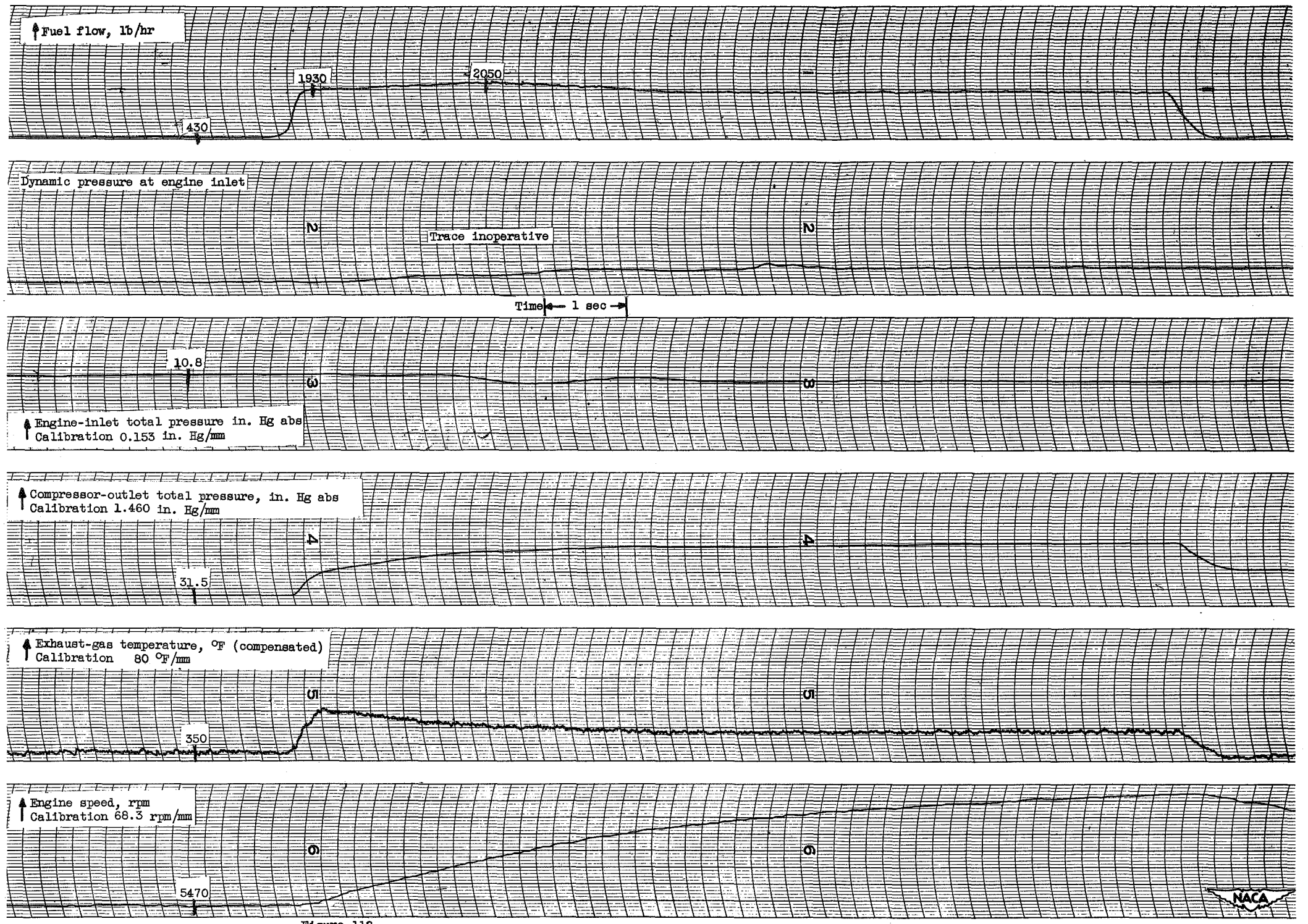

Figure 112

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, -2 °F; inlet guide vanes position, closed.

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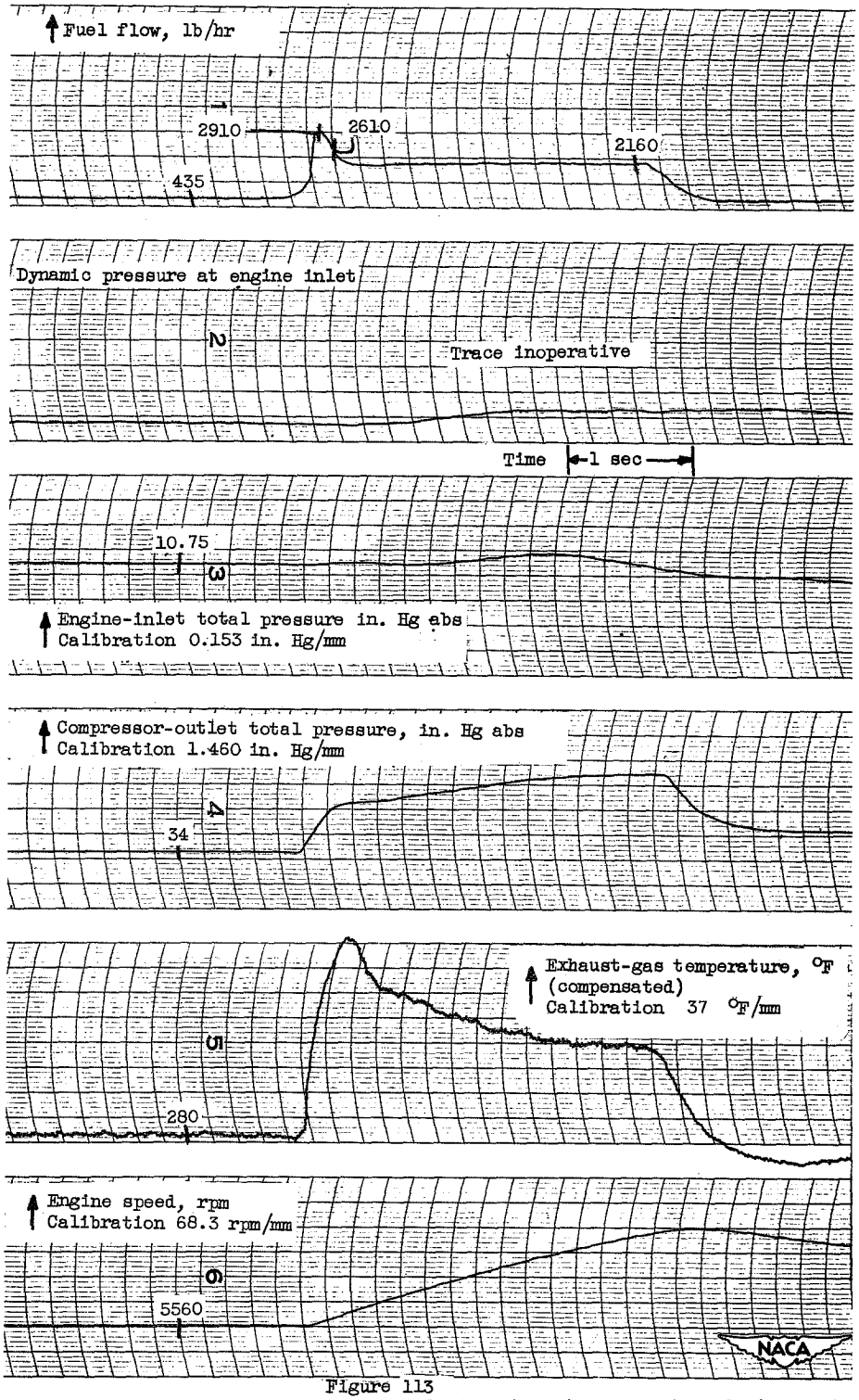

Figure 113

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8 ; engine-inlet air temperature, 14 ° F; inlet guide vanes position, closed.

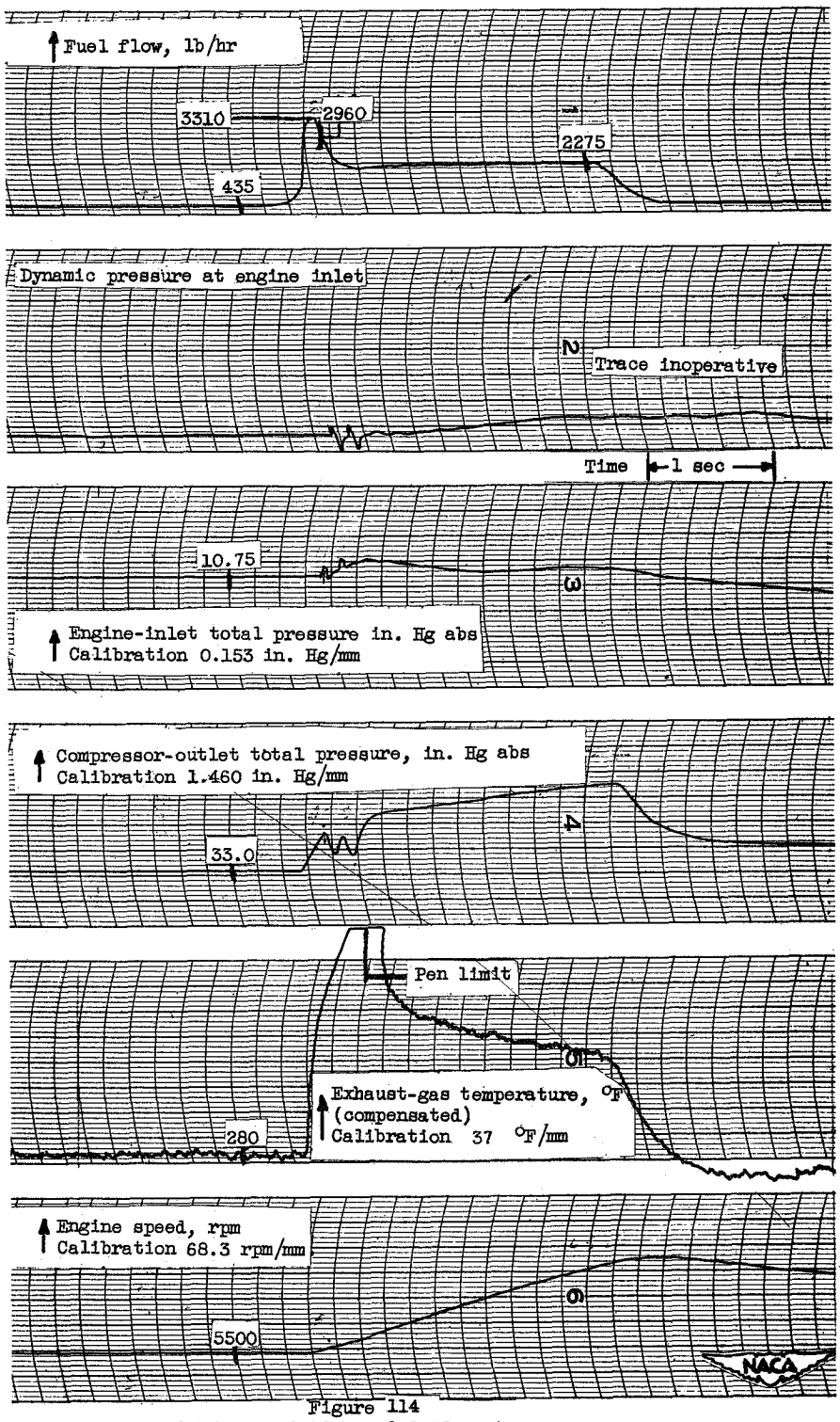

Figure 114

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 14 °F; inlet guide vanes position, closed.

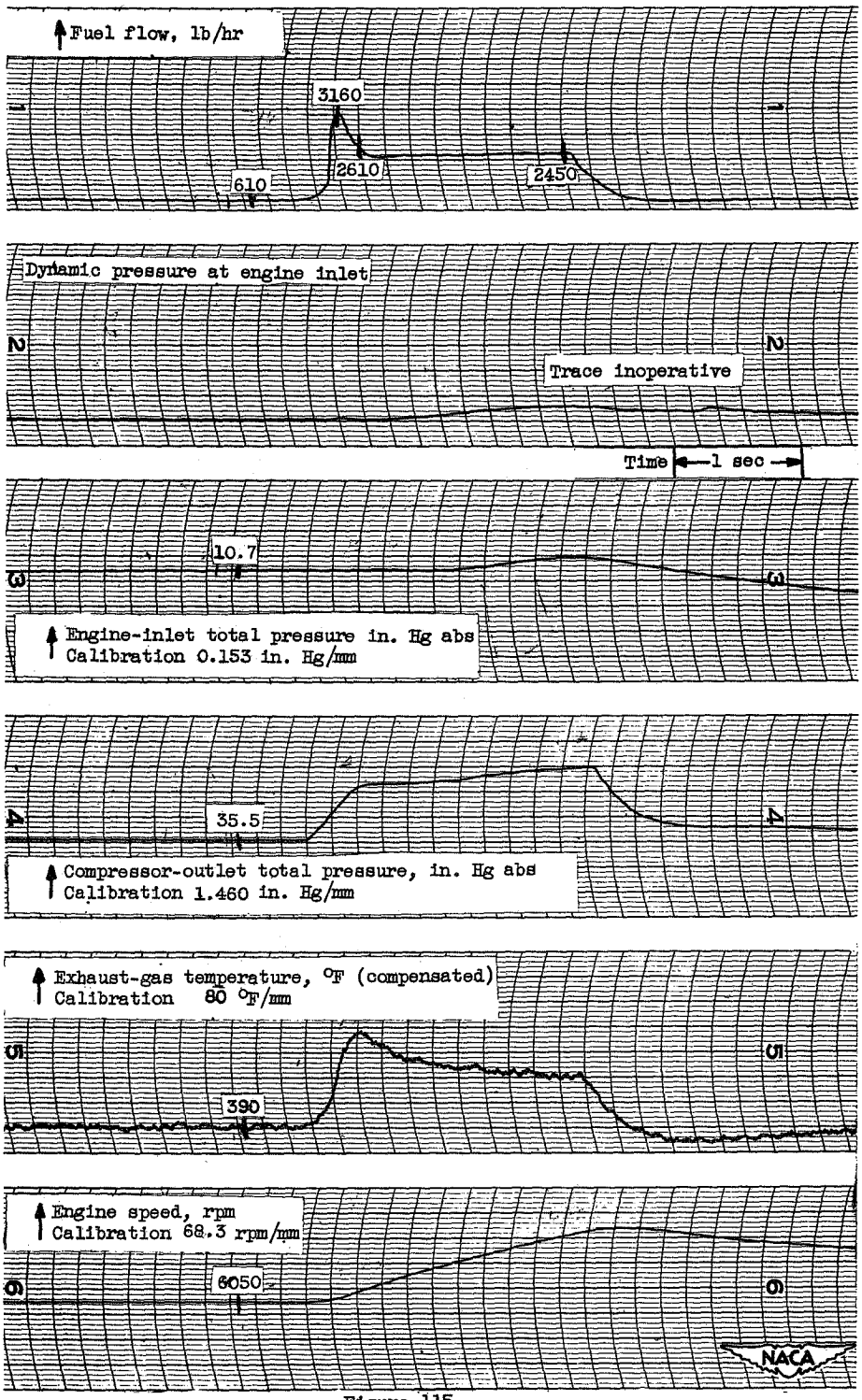

Figure 115

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, .08; engine-inlet air temperature, 11 ° F; inlet guide vanes position, closed.

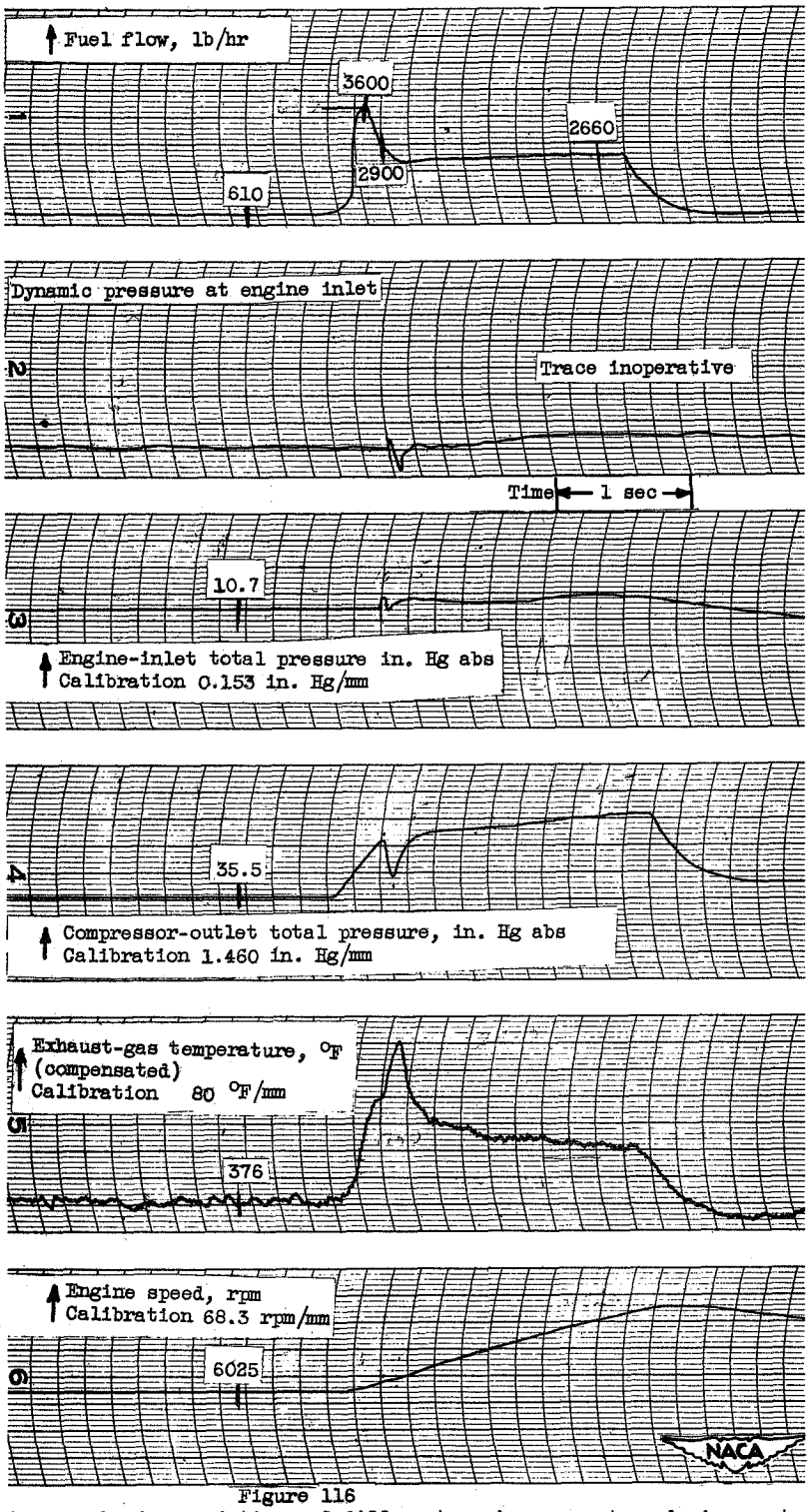

Figure 116

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 14 °F; inlet guide vanes position, closed.

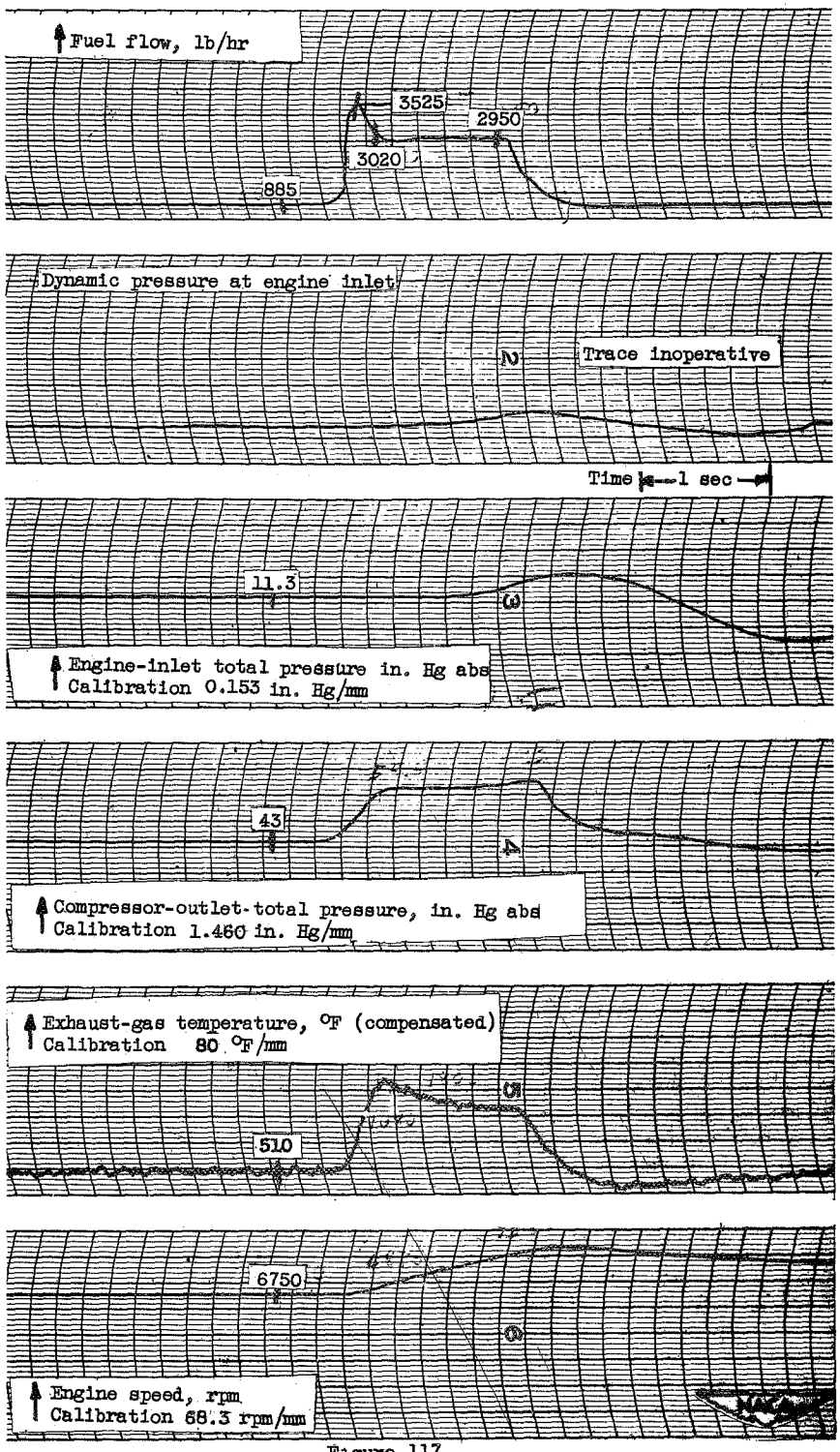

Figure 117

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 9 °F; inlet guide vanes position, closed.

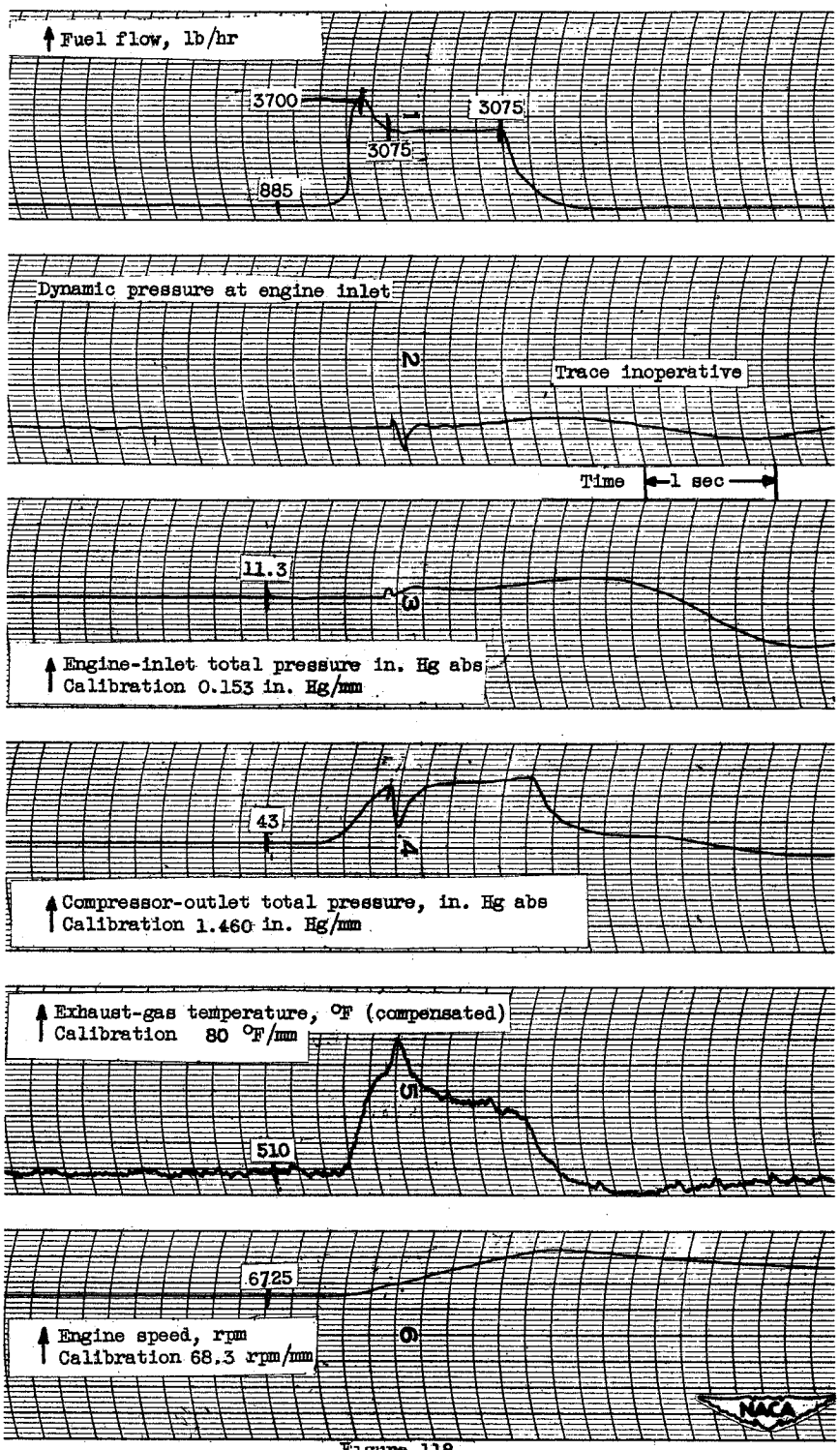

Figure 118

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 9 °F; inlet guide vanes position, closed.

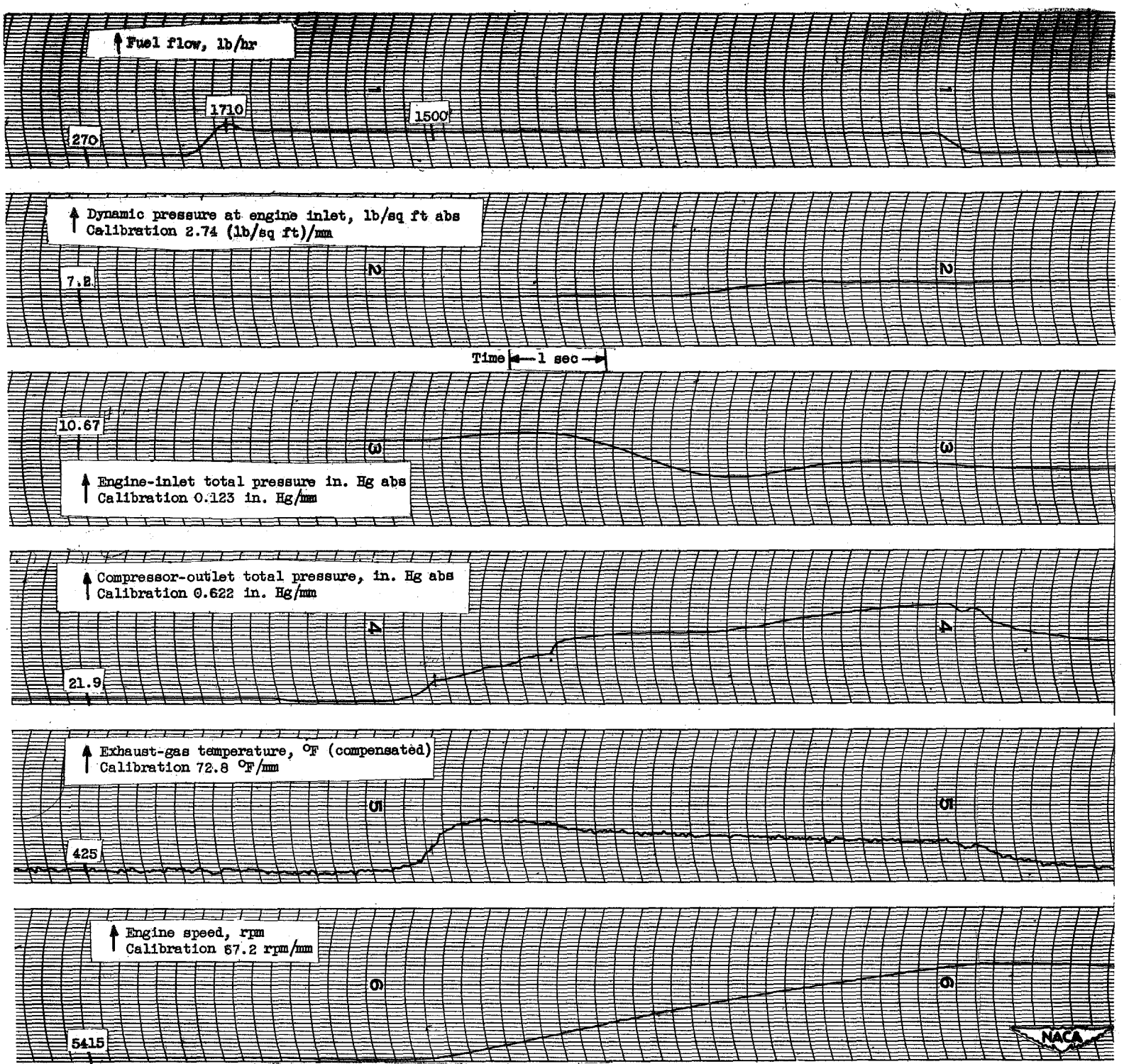

Figure 119

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 167° F; inlet guide vanes position, closed.

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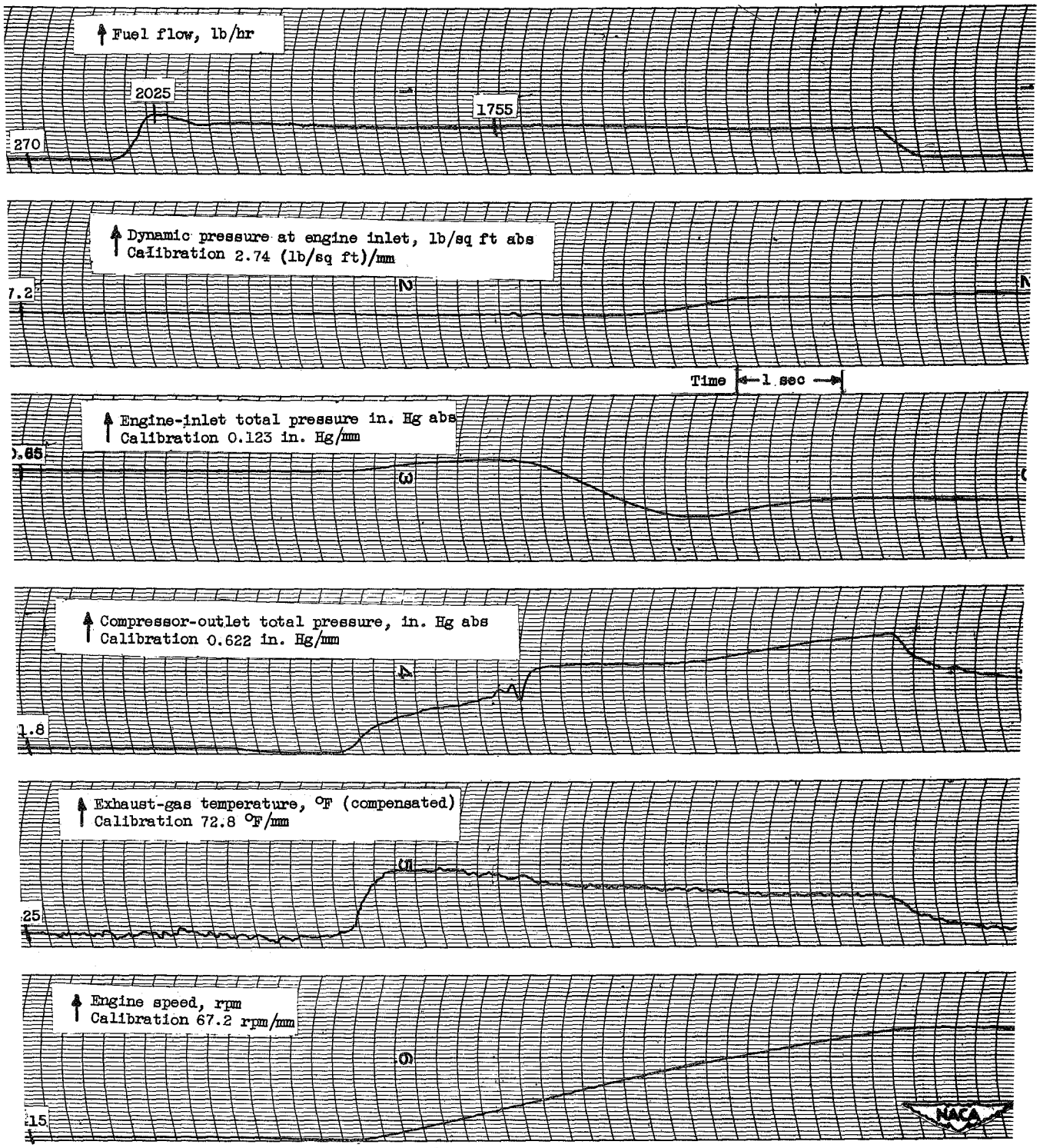

Figure 120

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 167 °F; inlet guide vanes position, closed.

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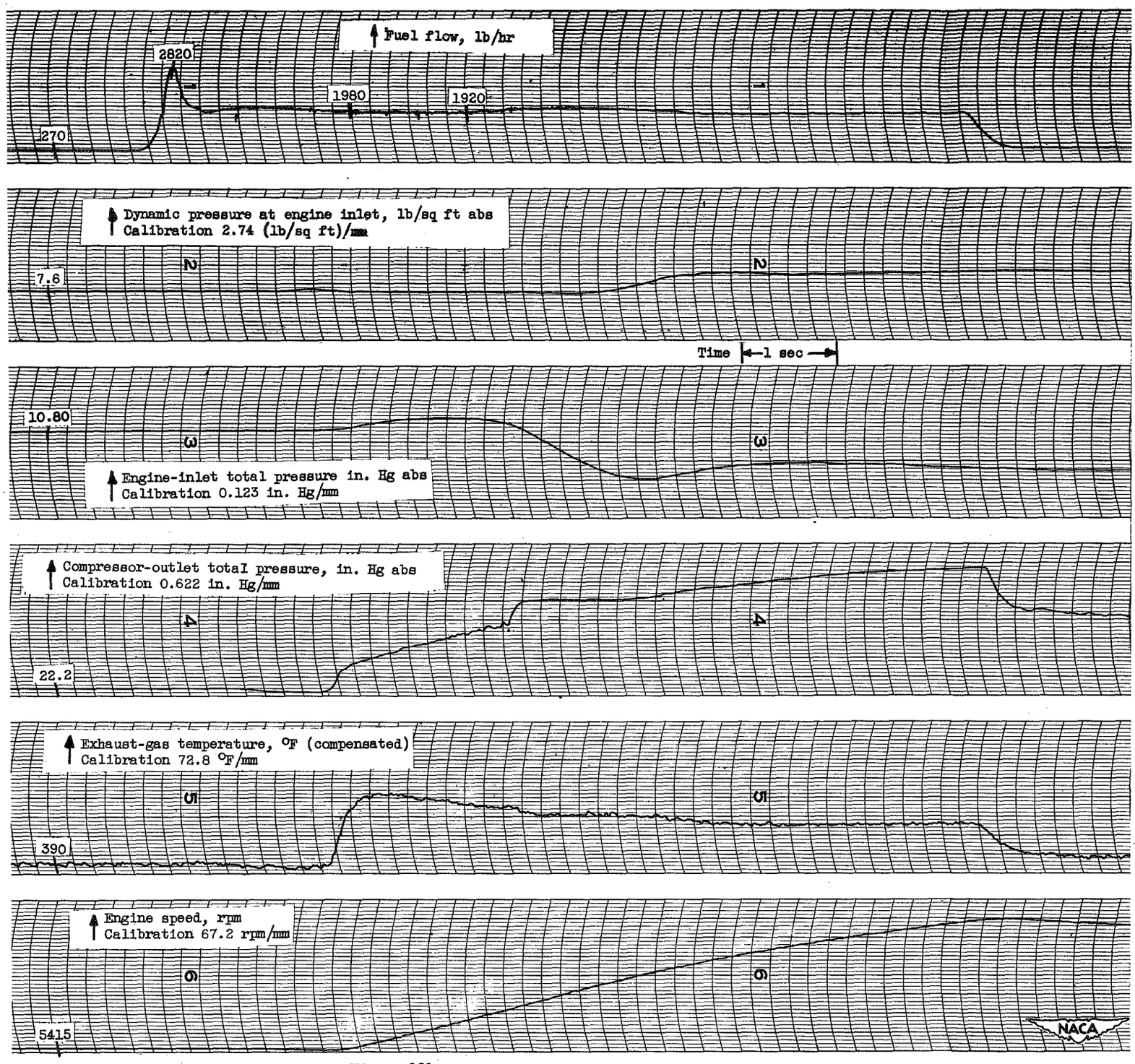

Figure 121

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 **feet; flight Mach number,** 0.8; **engine-inlet air temperature,** 167° **F; inlet guide vanes position, closed.**

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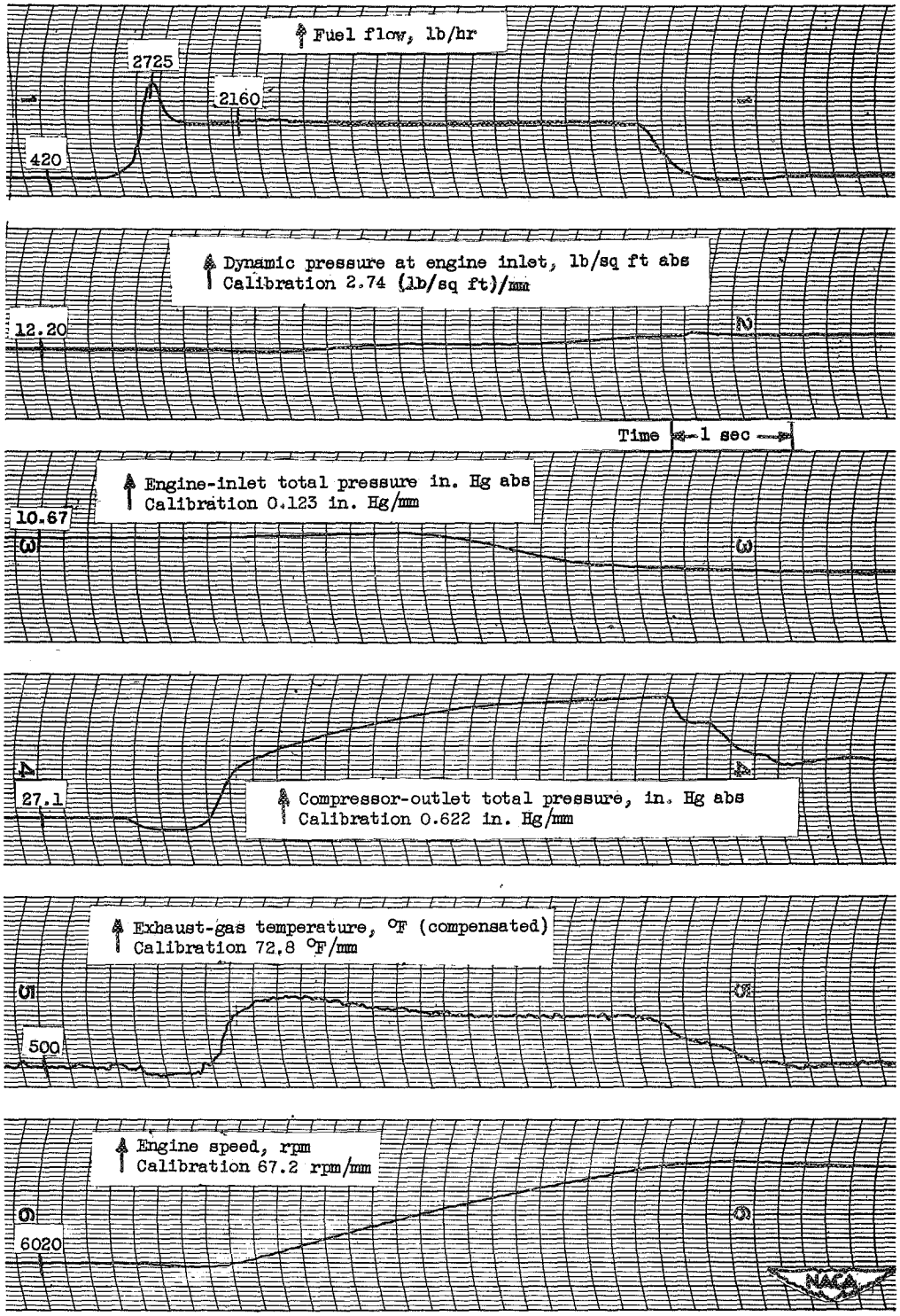

Figure 122

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

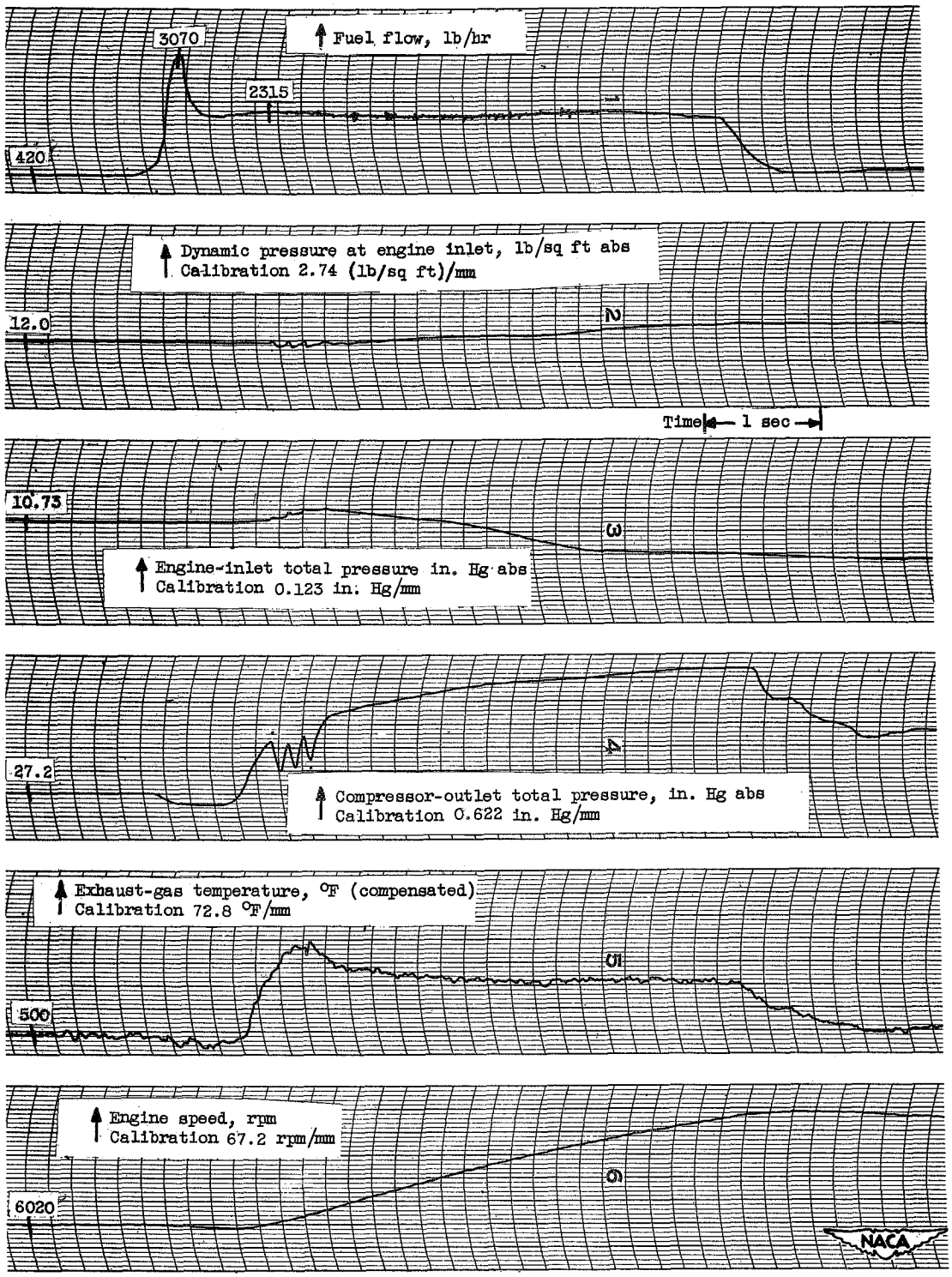

Figure 123

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

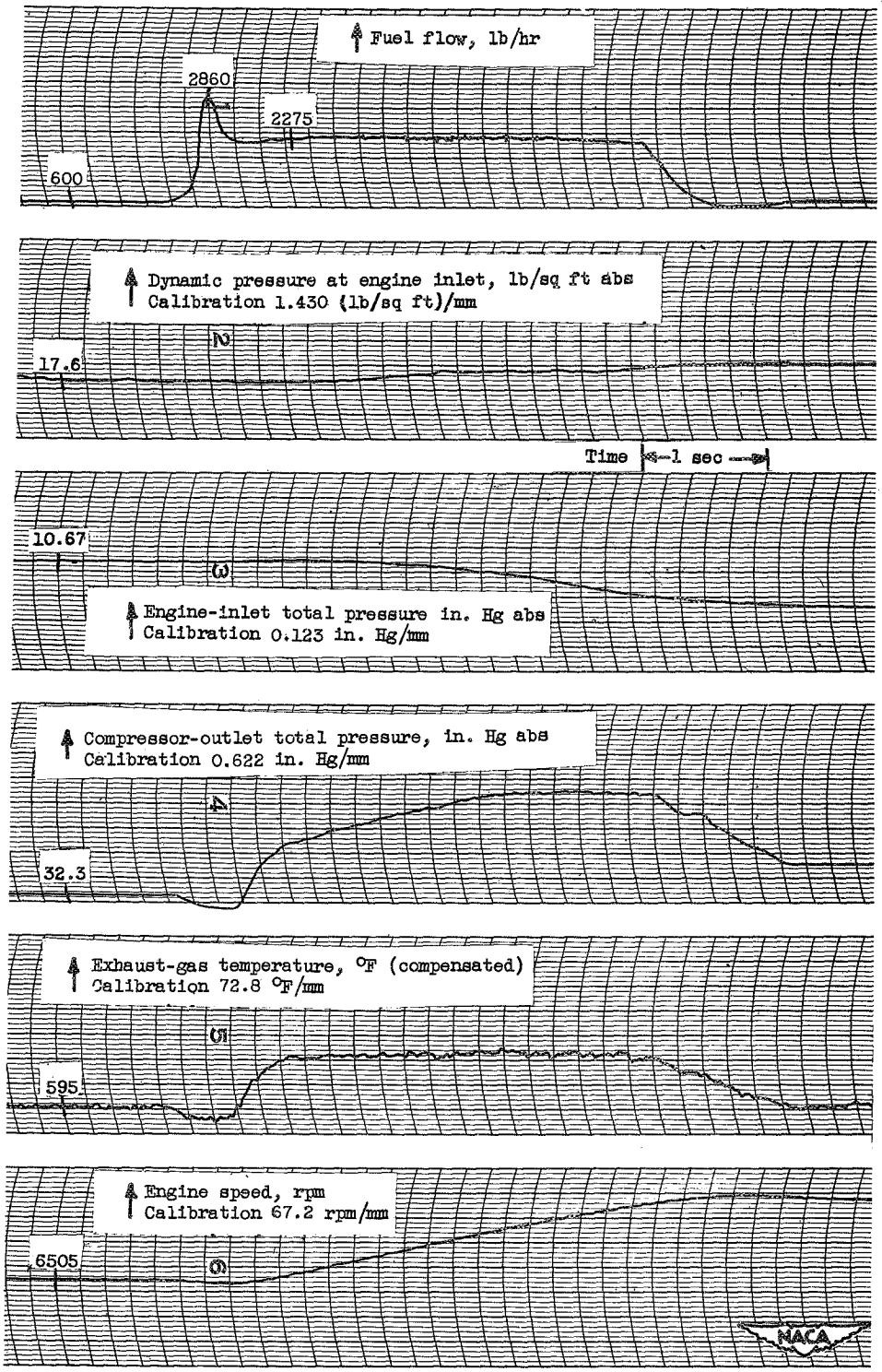

Figure 124

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 164° F; inlet guide vanes position, closed.

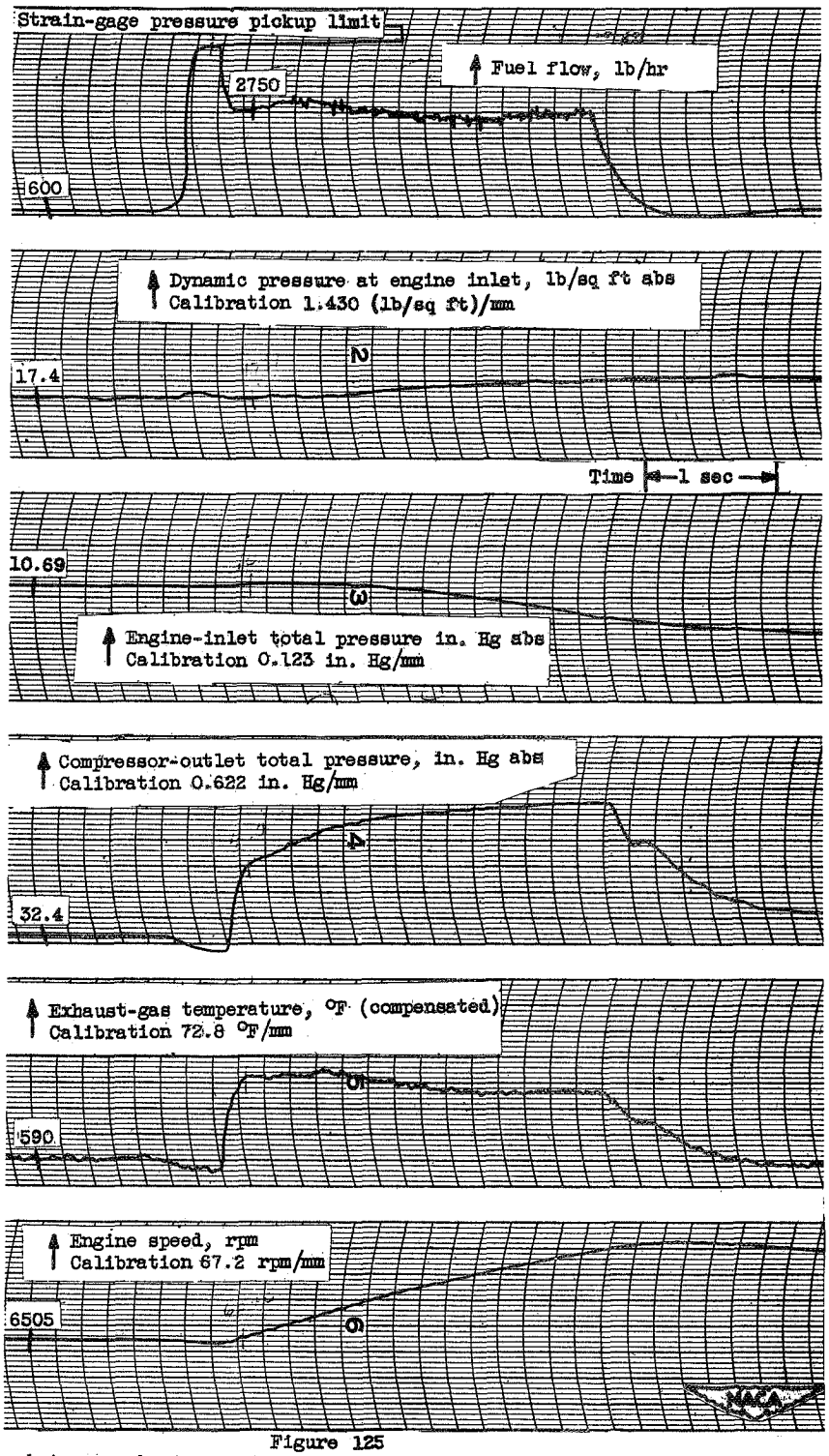

Figure 125

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 164° F; inlet guide vanes position, closed.

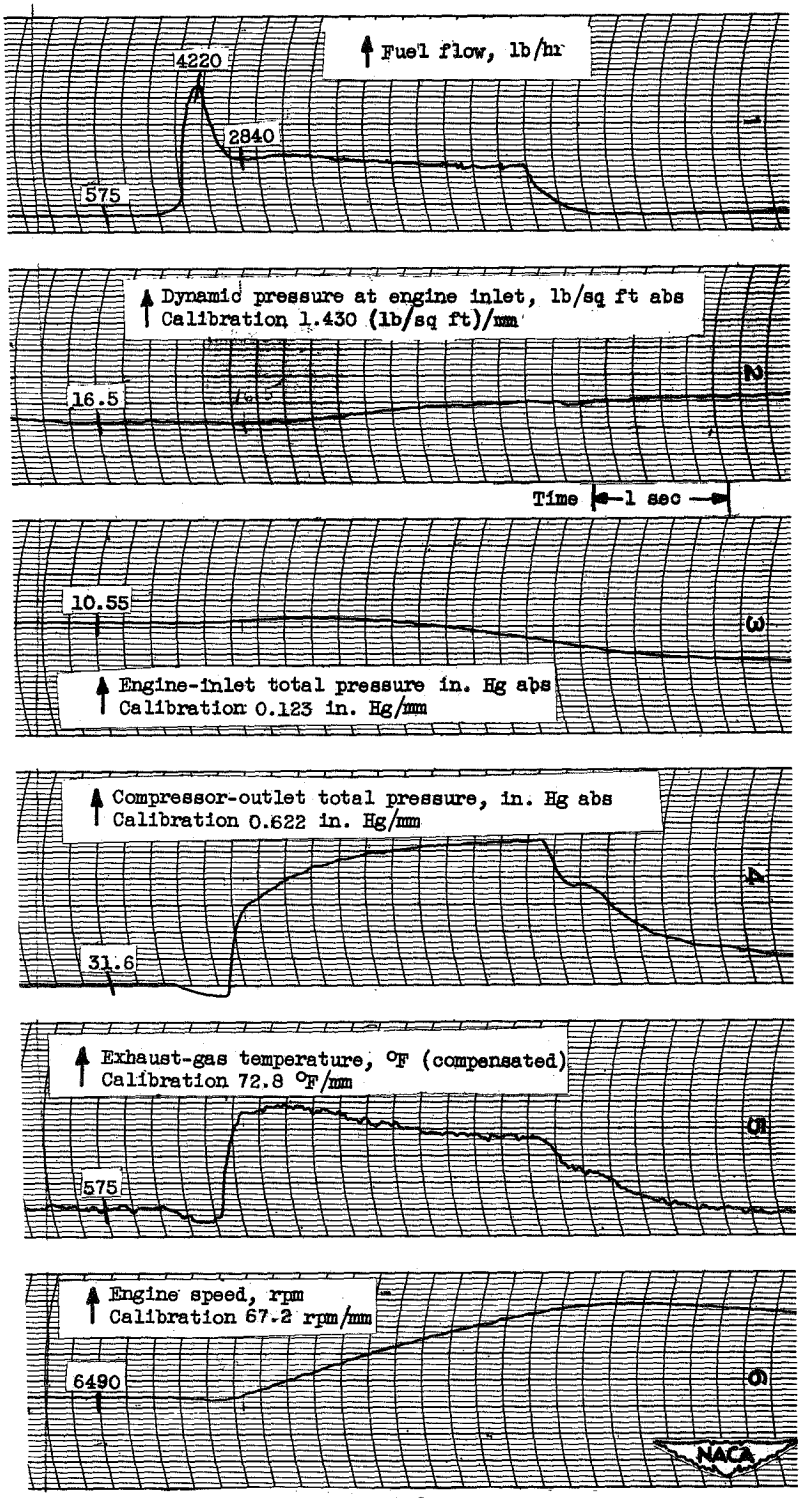

Figure 126

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

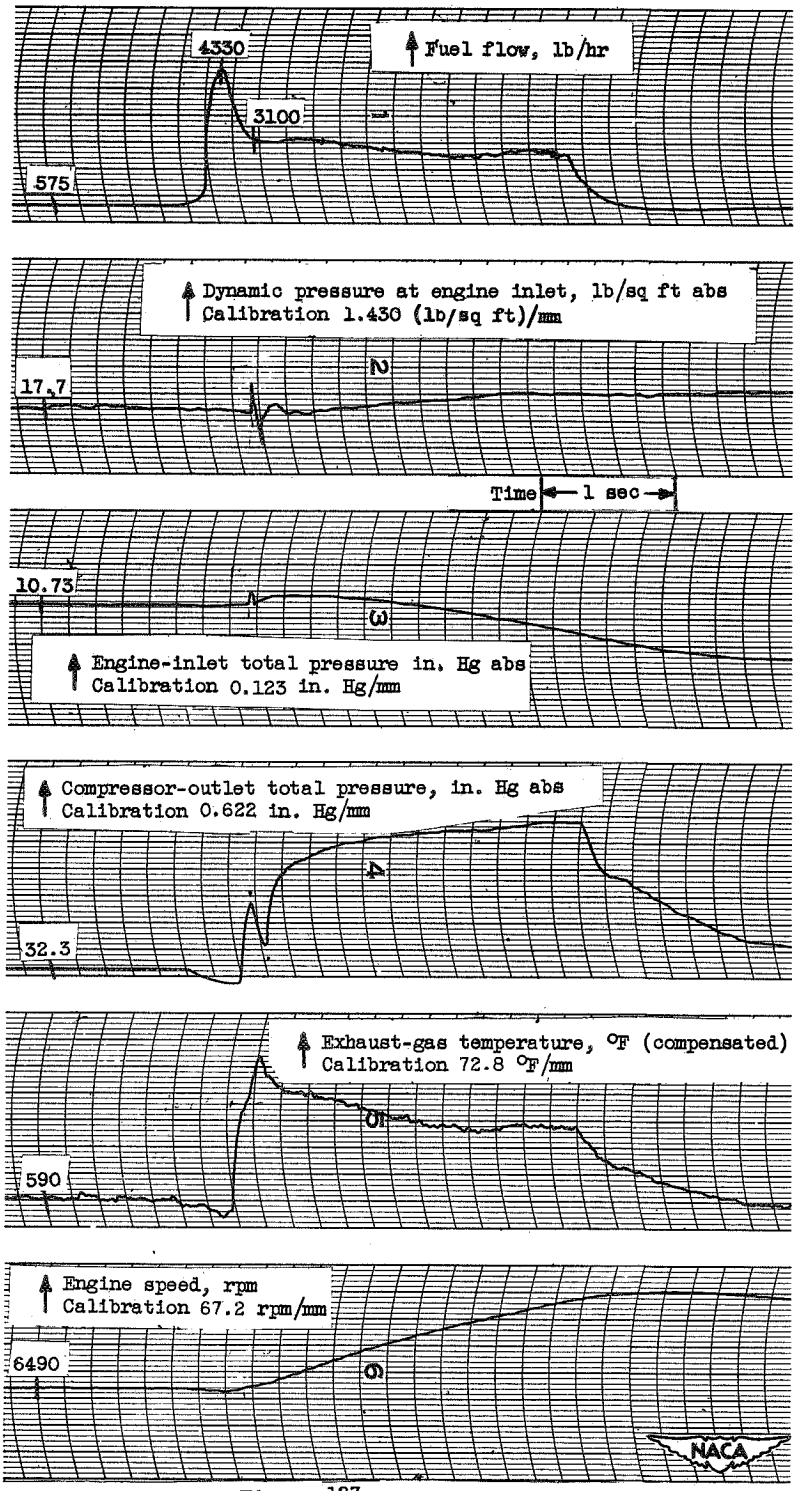

Figure 127

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

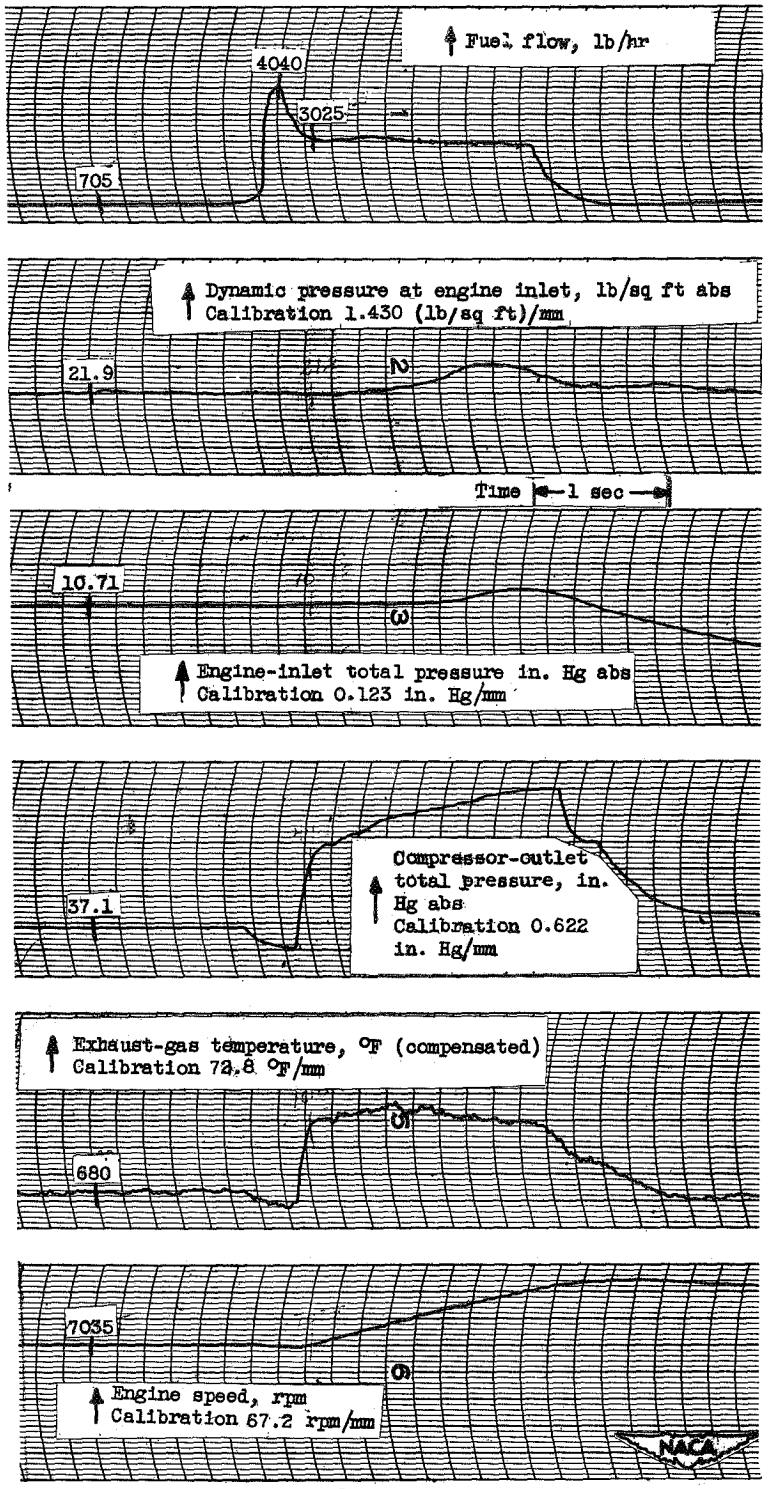

Figure 128

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

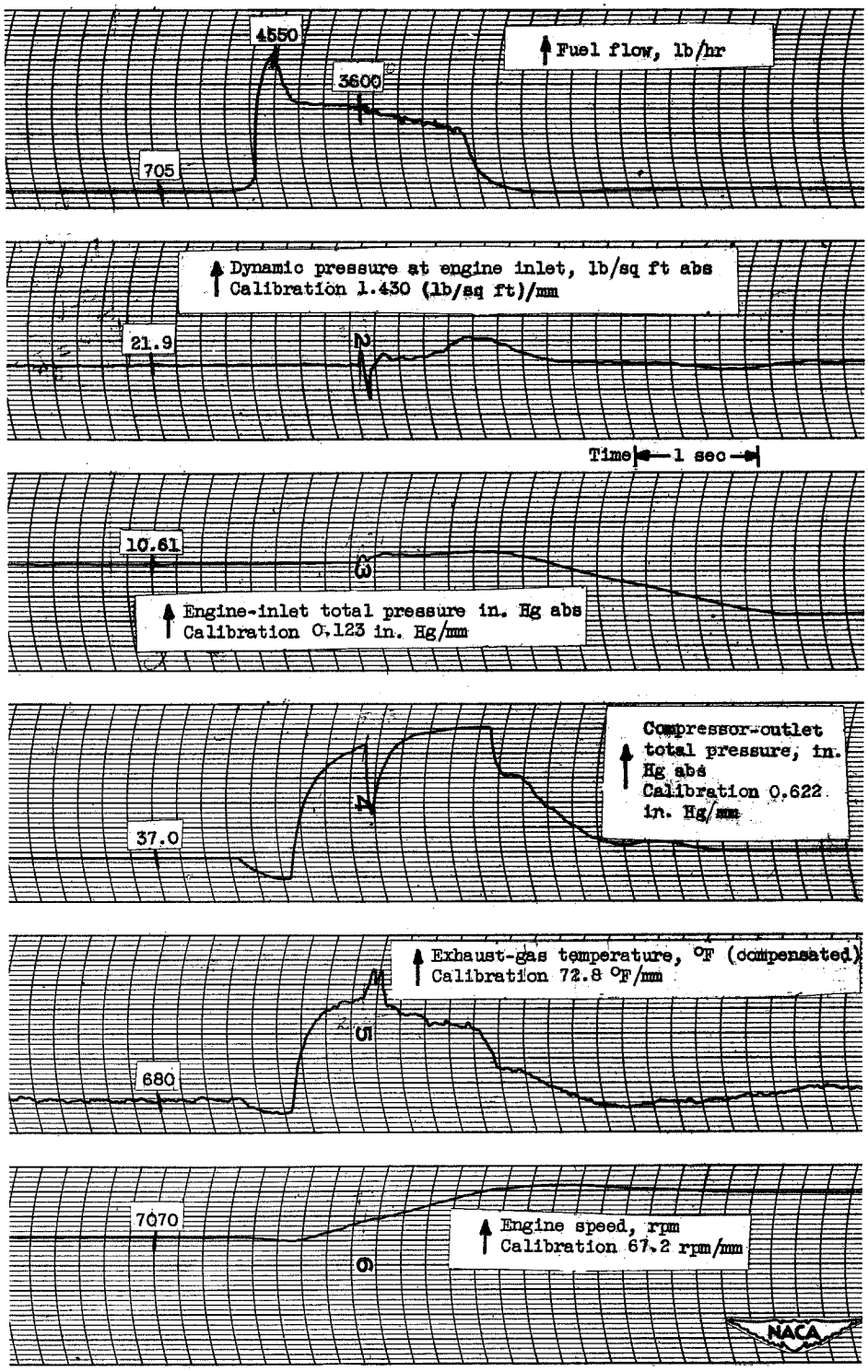

Figure 129

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 0.8; engine-inlet air temperature, 163° F; inlet guide vanes position, closed.

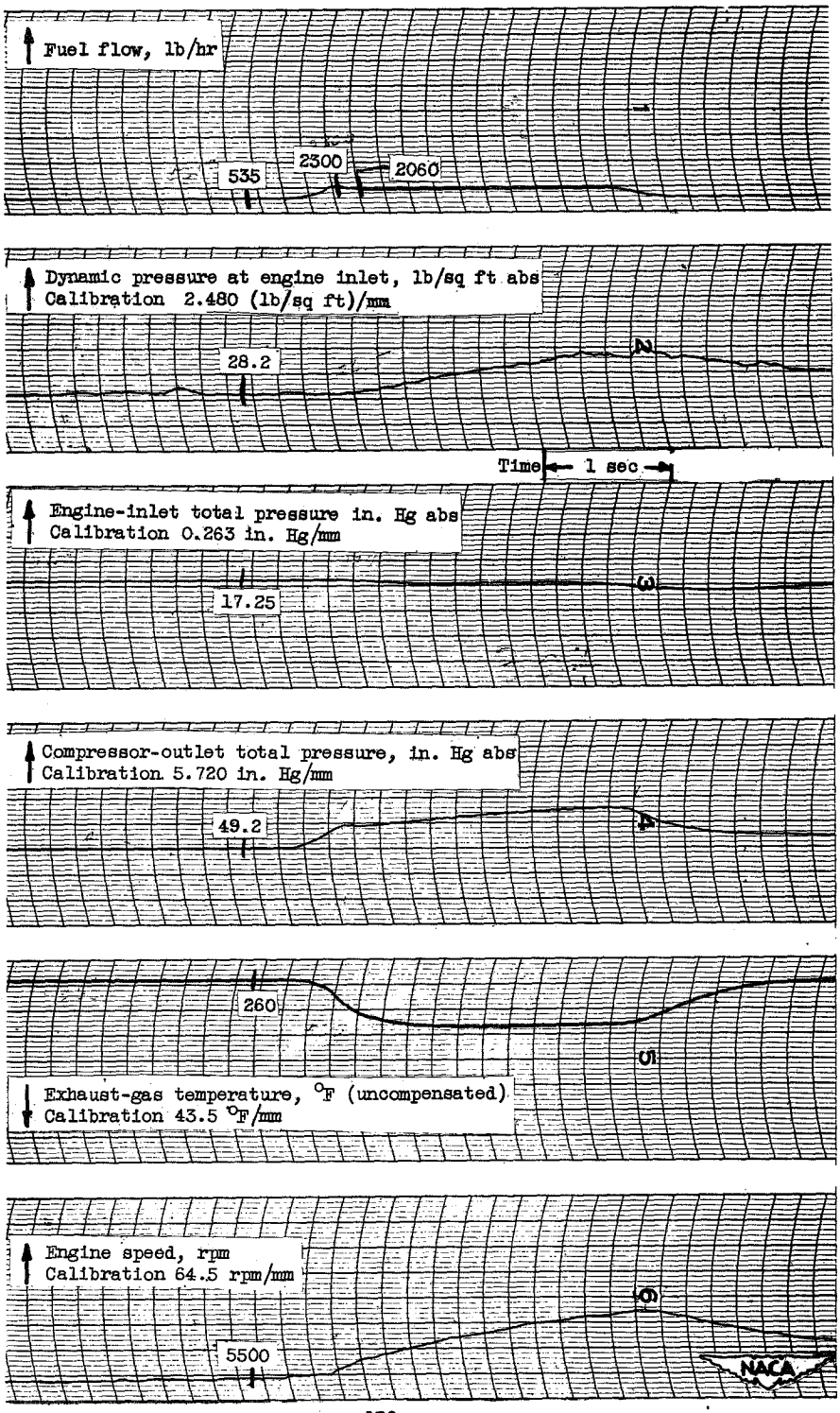

Figure 130

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 32° F; inlet guide vanes position, open.

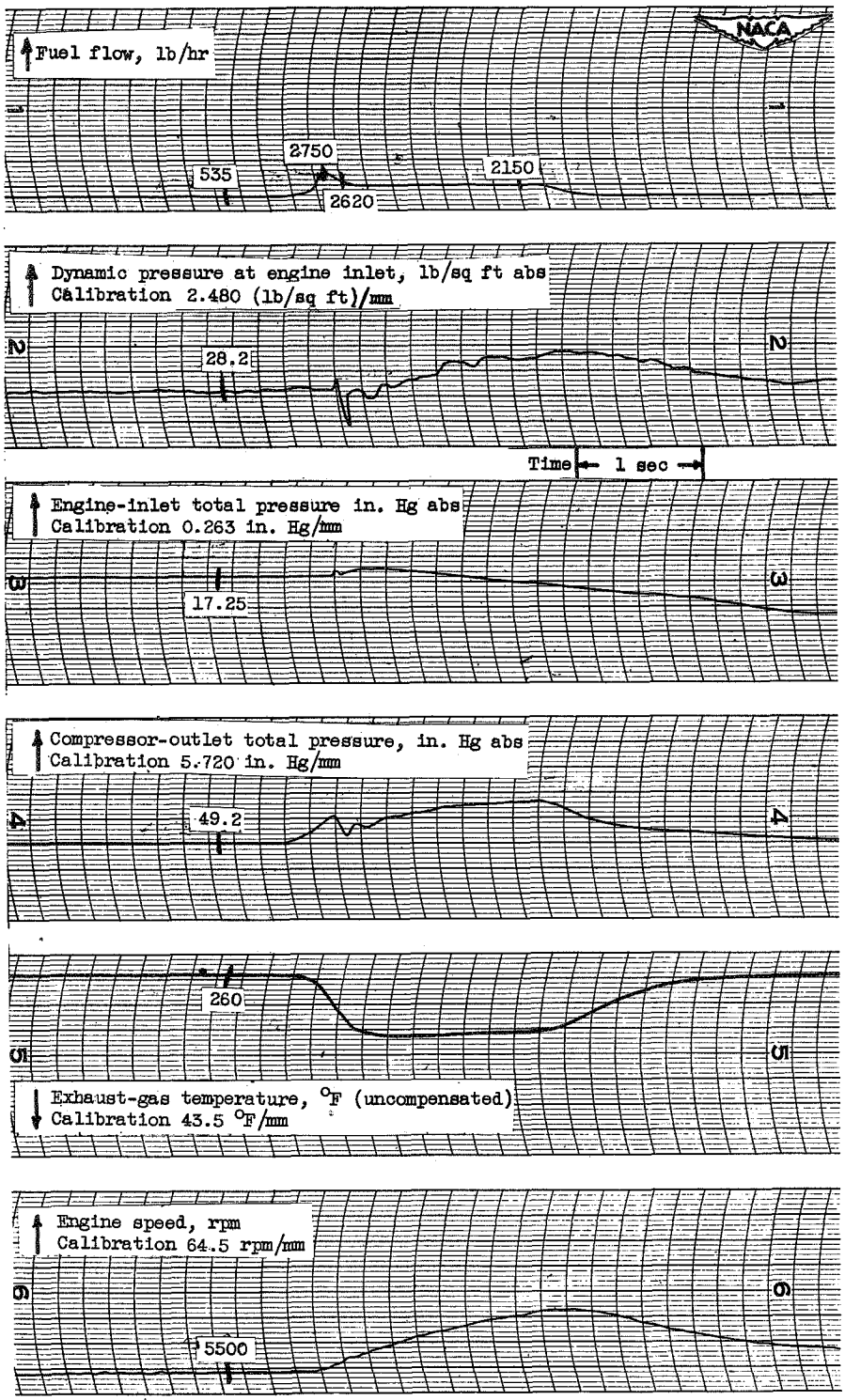

Figure 131

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 32° F; inlet guide vanes position, open.

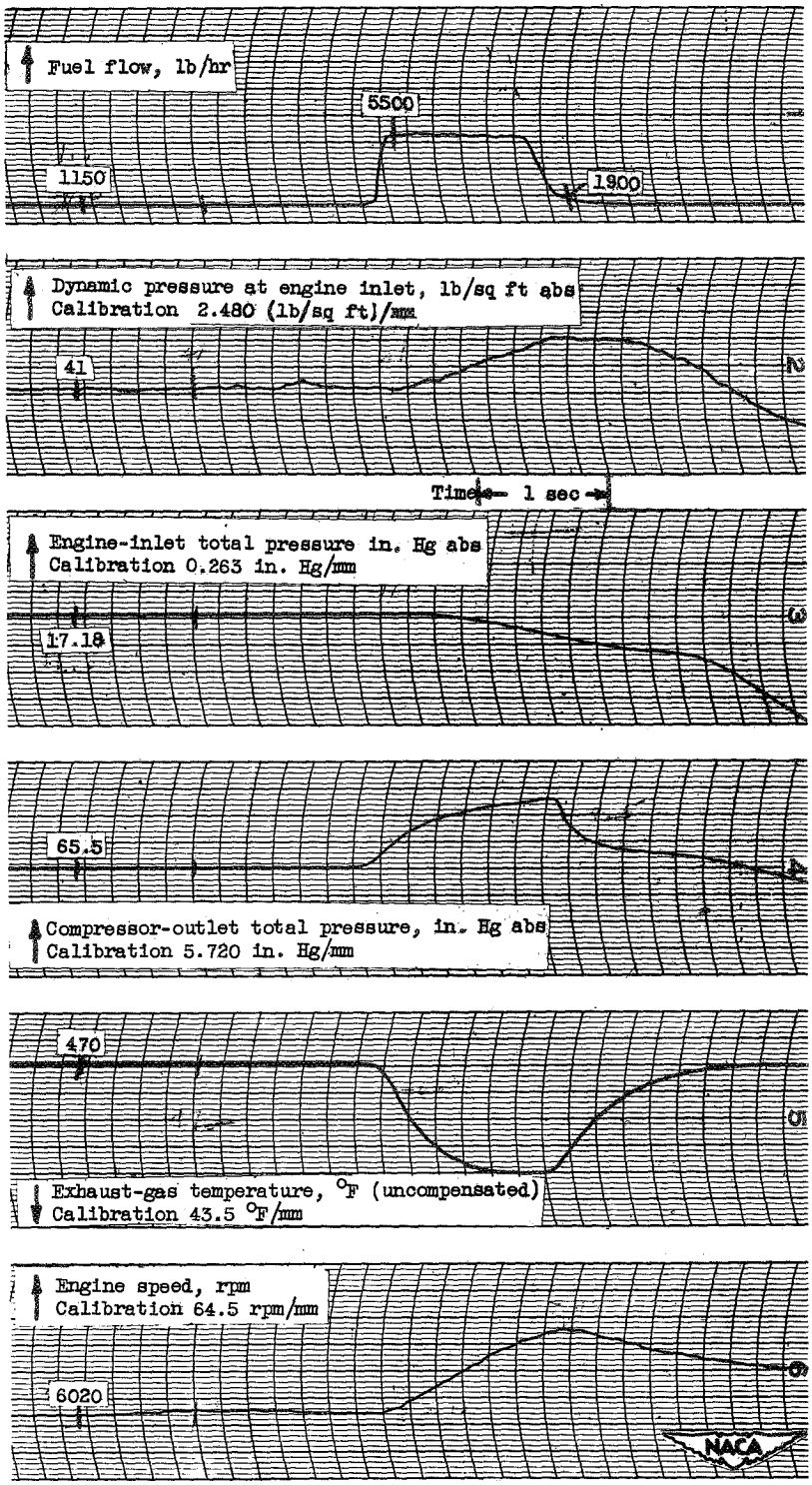

Figure 132

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 34° F; inlet guide vanes position, open.

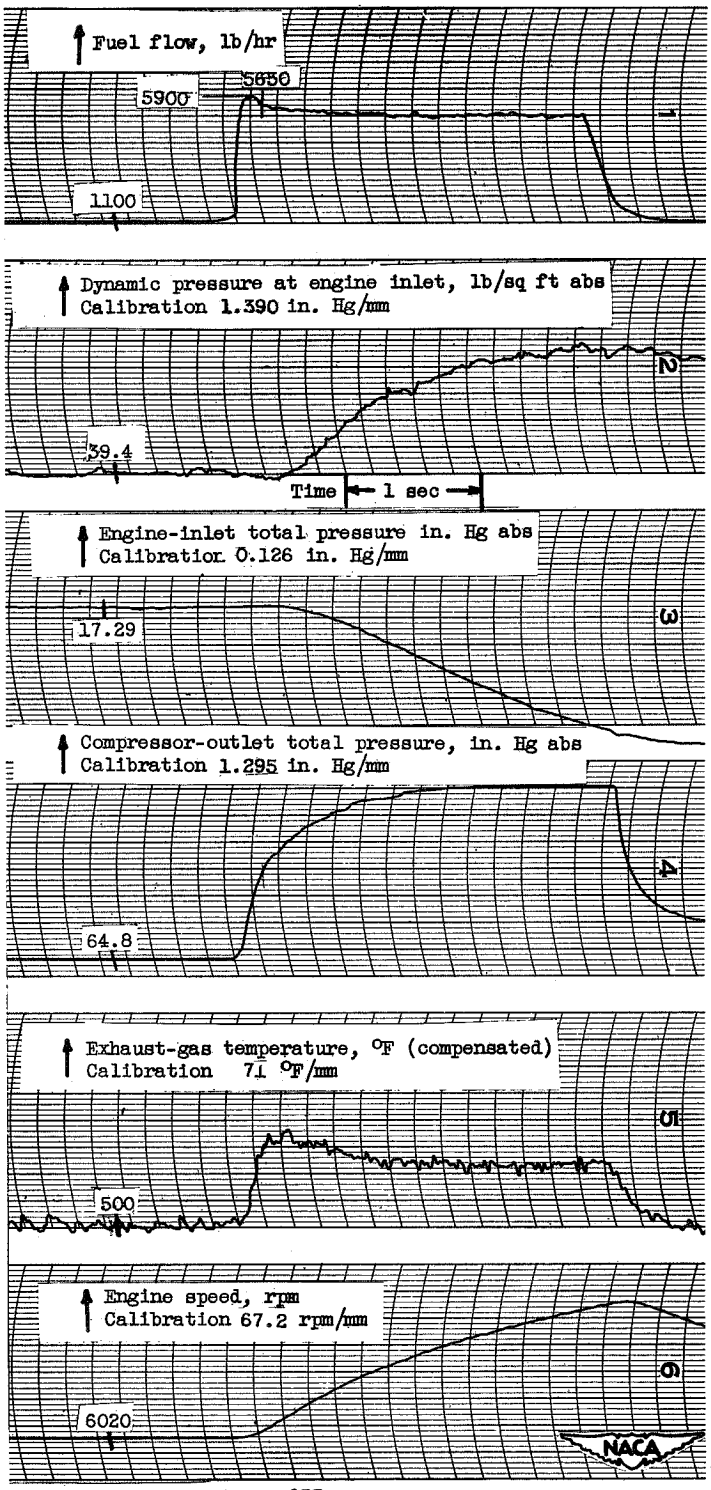

Figure 133

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 42° F; inlet guide vanes position, open.

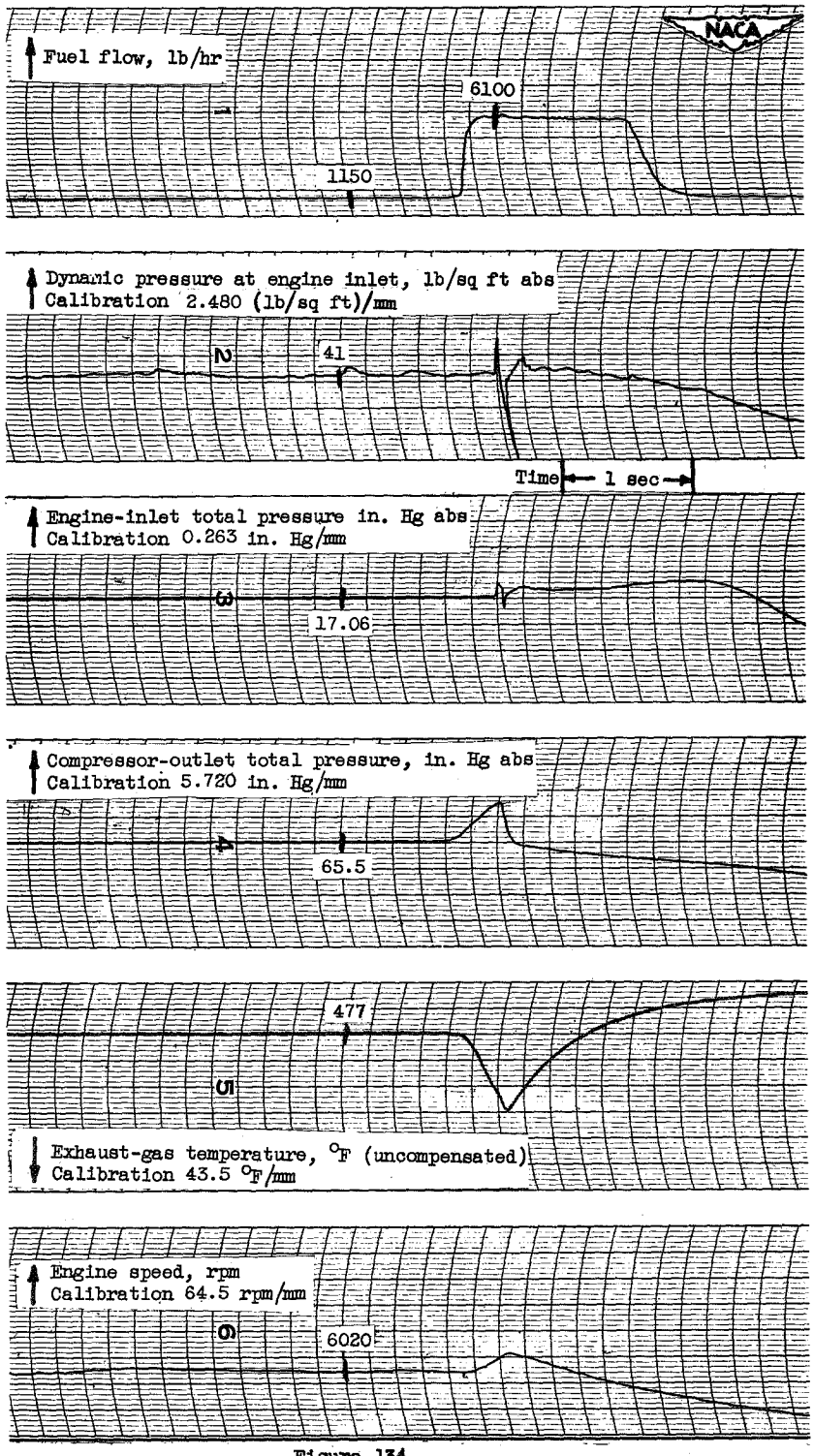

Figure 134

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 34° F; inlet guide vanes position, open.

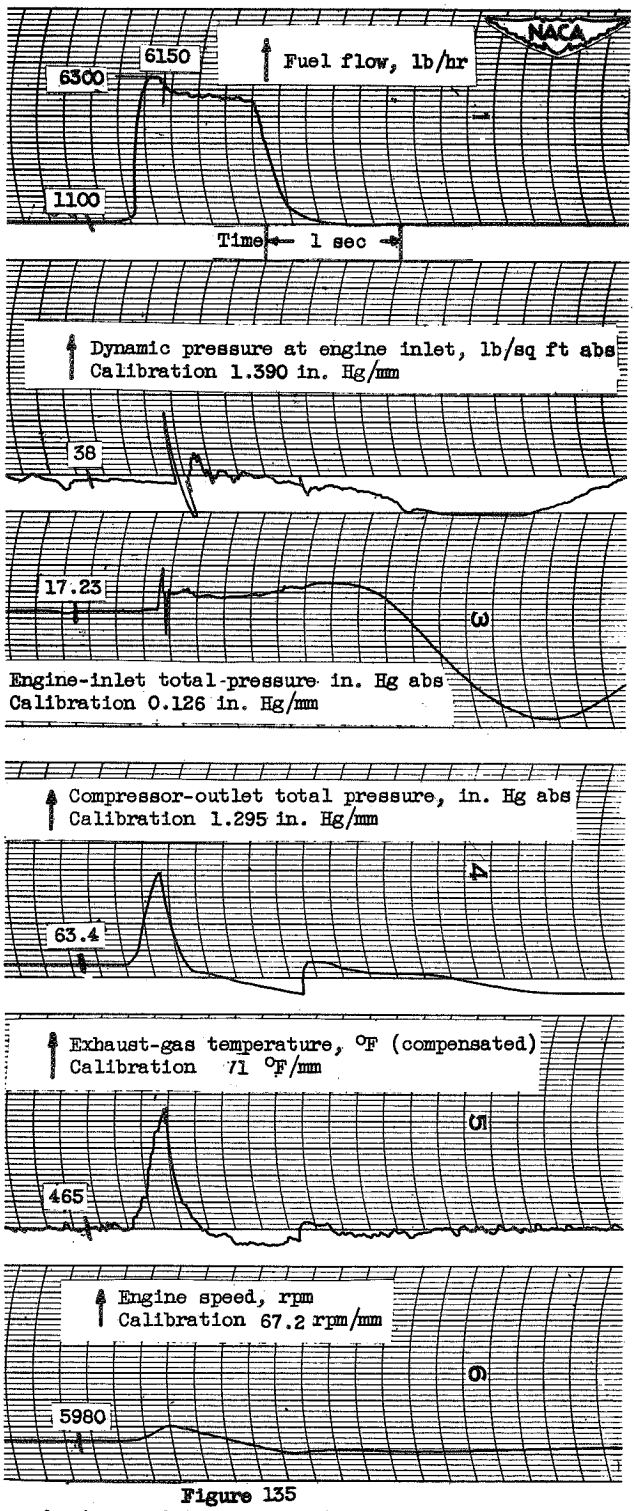

Figure 135

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 42 °F; inlet guide vanes position, open.

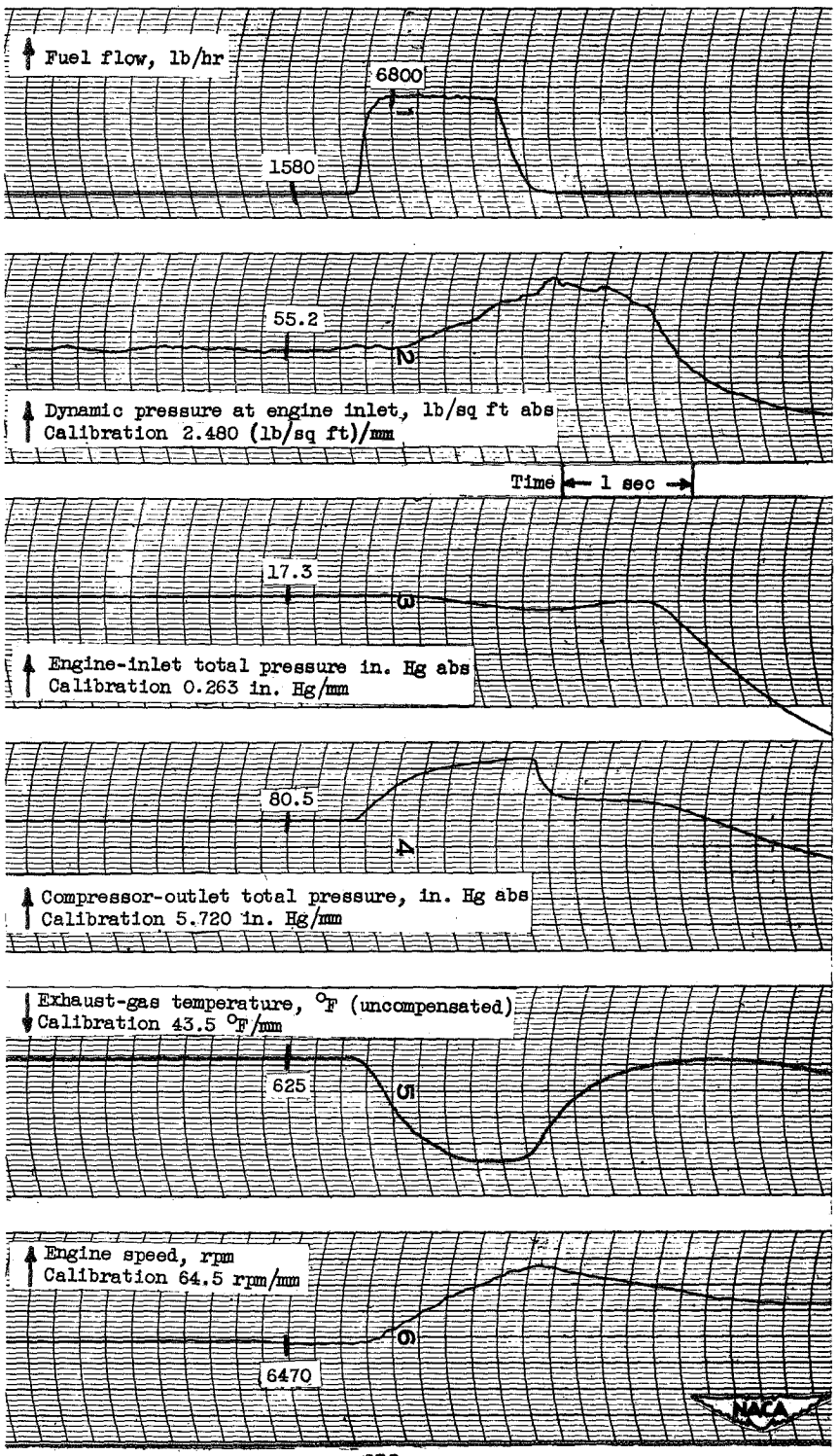

Figure 136

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 35° F; inlet guide vanes position, open.

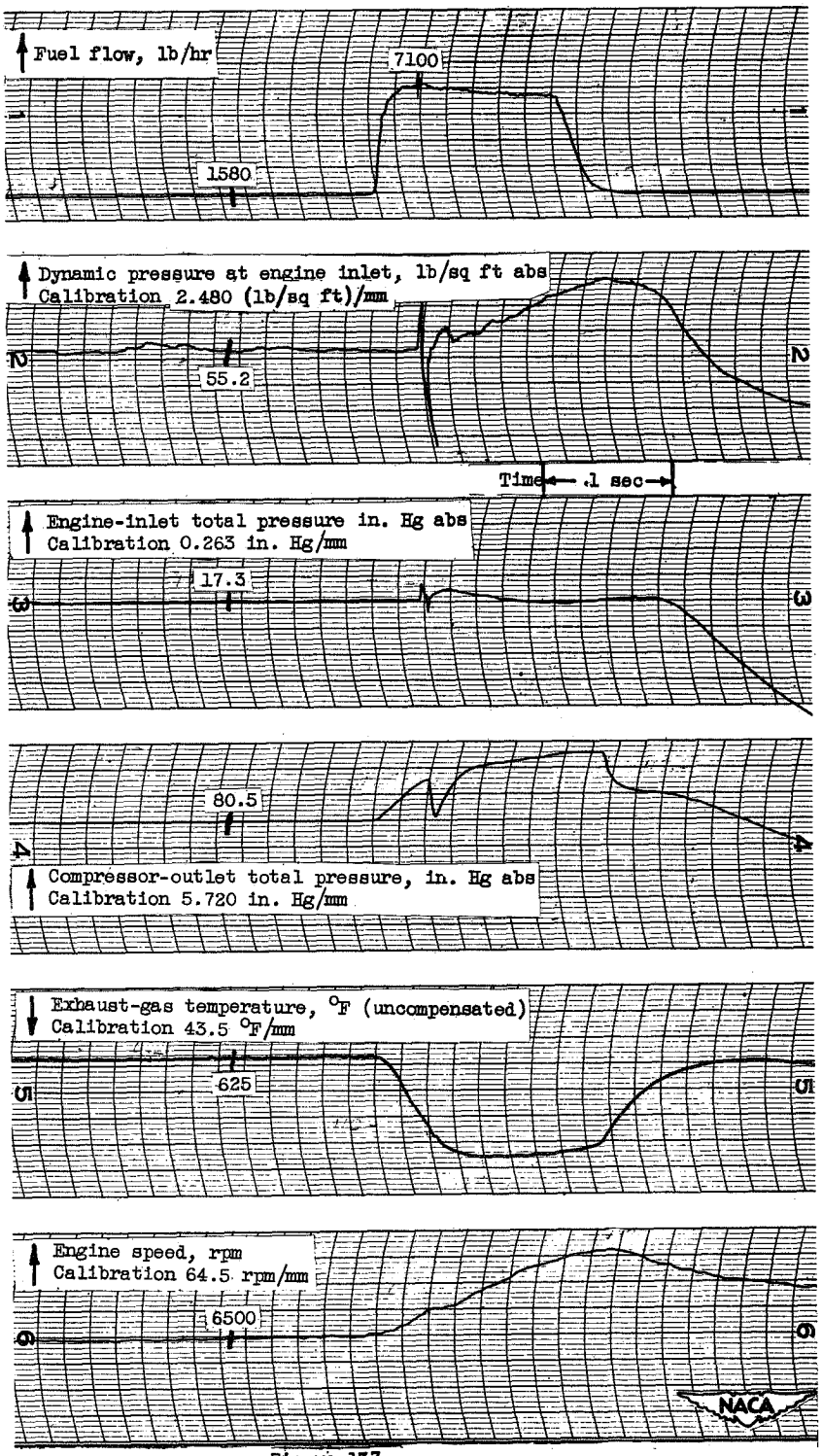

Figure 137

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 35° F; inlet guide vanes position, open.

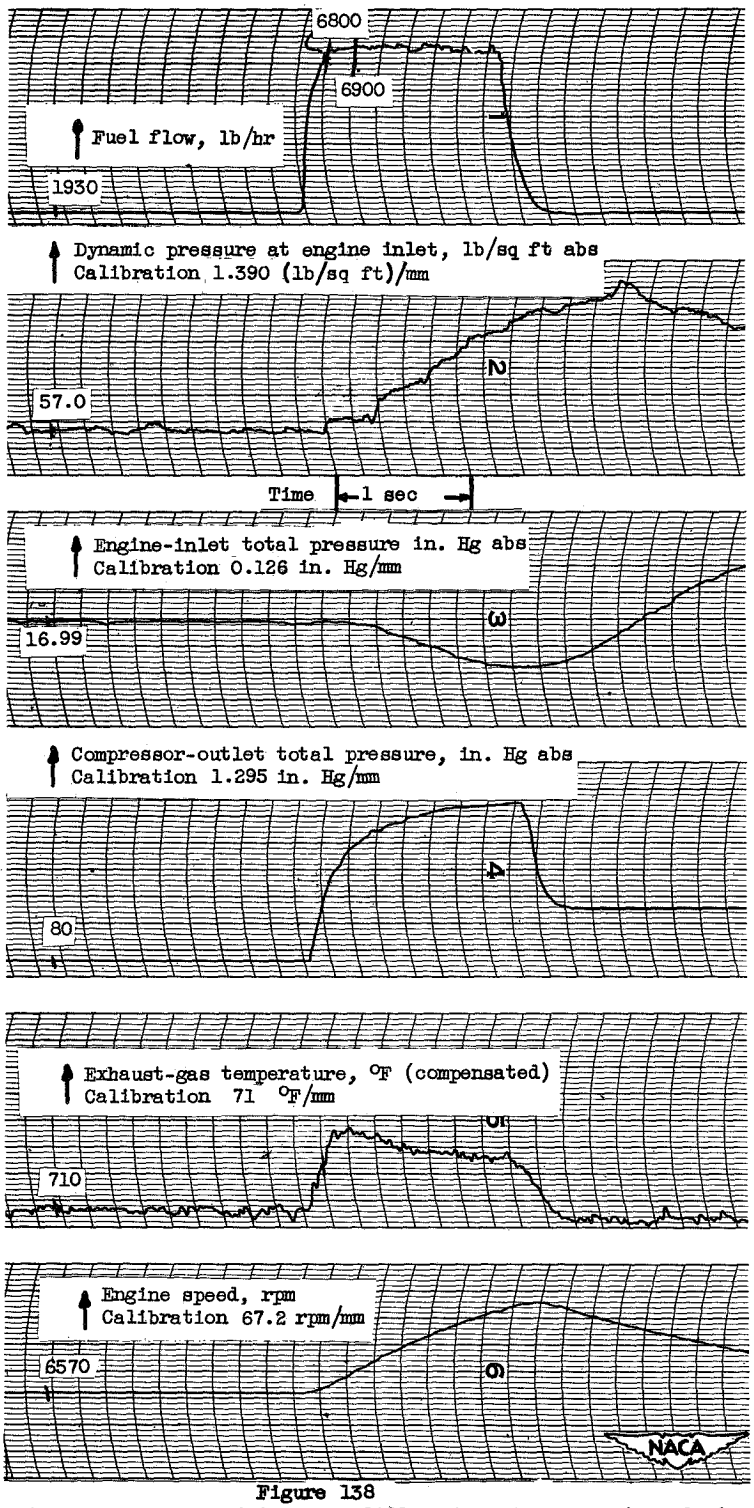

Figure 138

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 42° F; inlet guide vanes position, open.

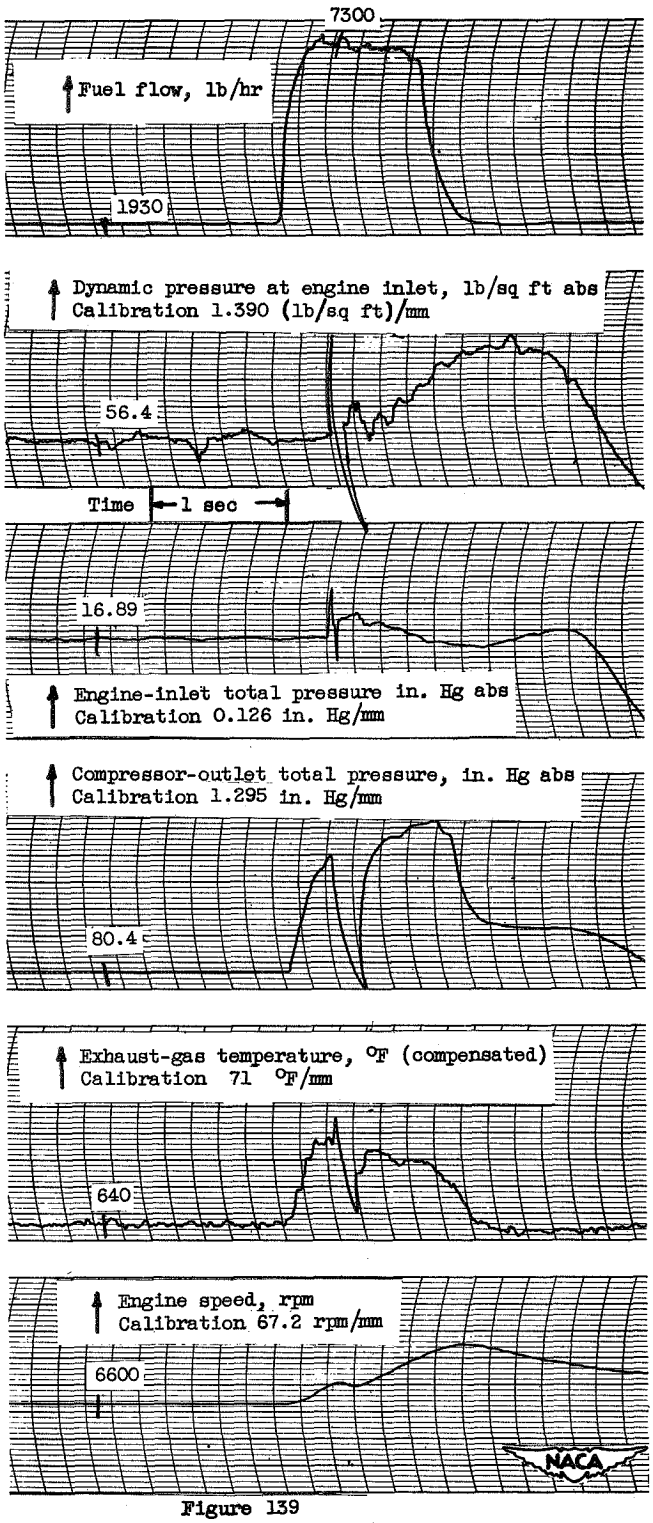

Figure 139

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 42° F; inlet guide vanes position, open.

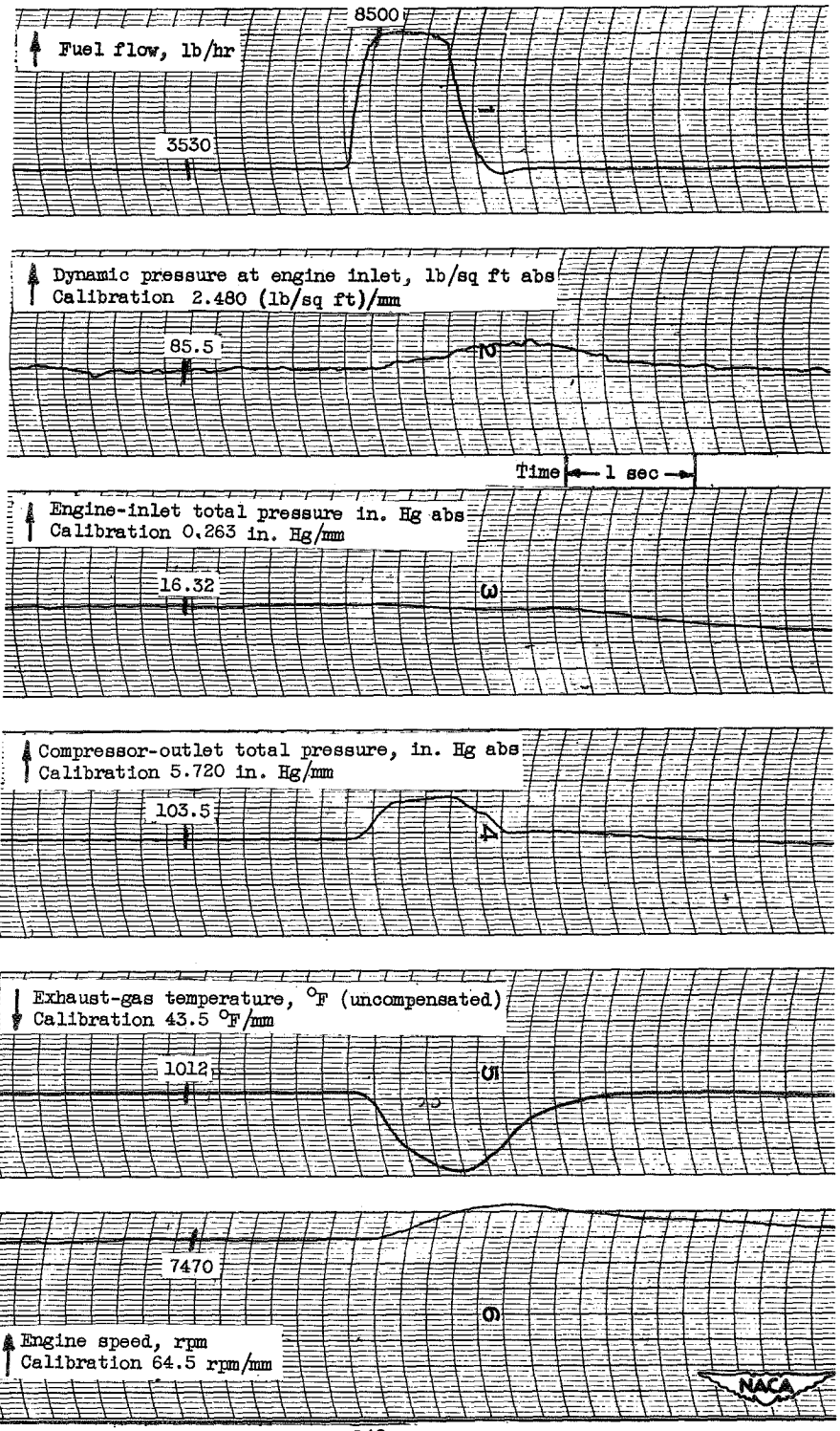

Figure 140

Oscillograph traces showing variations of different engine parameters during a step change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 35° F; inlet guide vanes position, open.

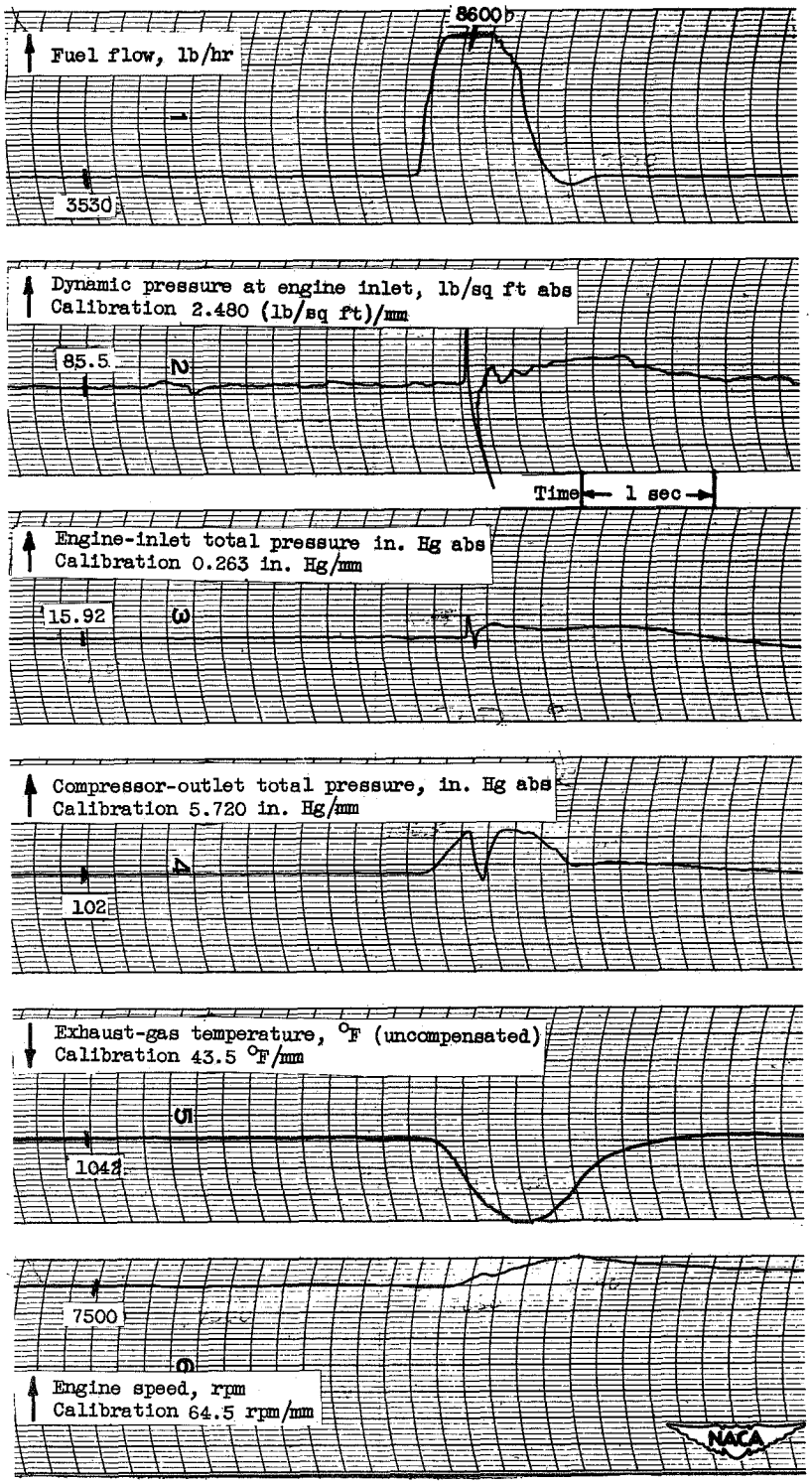

Figure 141

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 35° F; inlet guide vanes position, open.

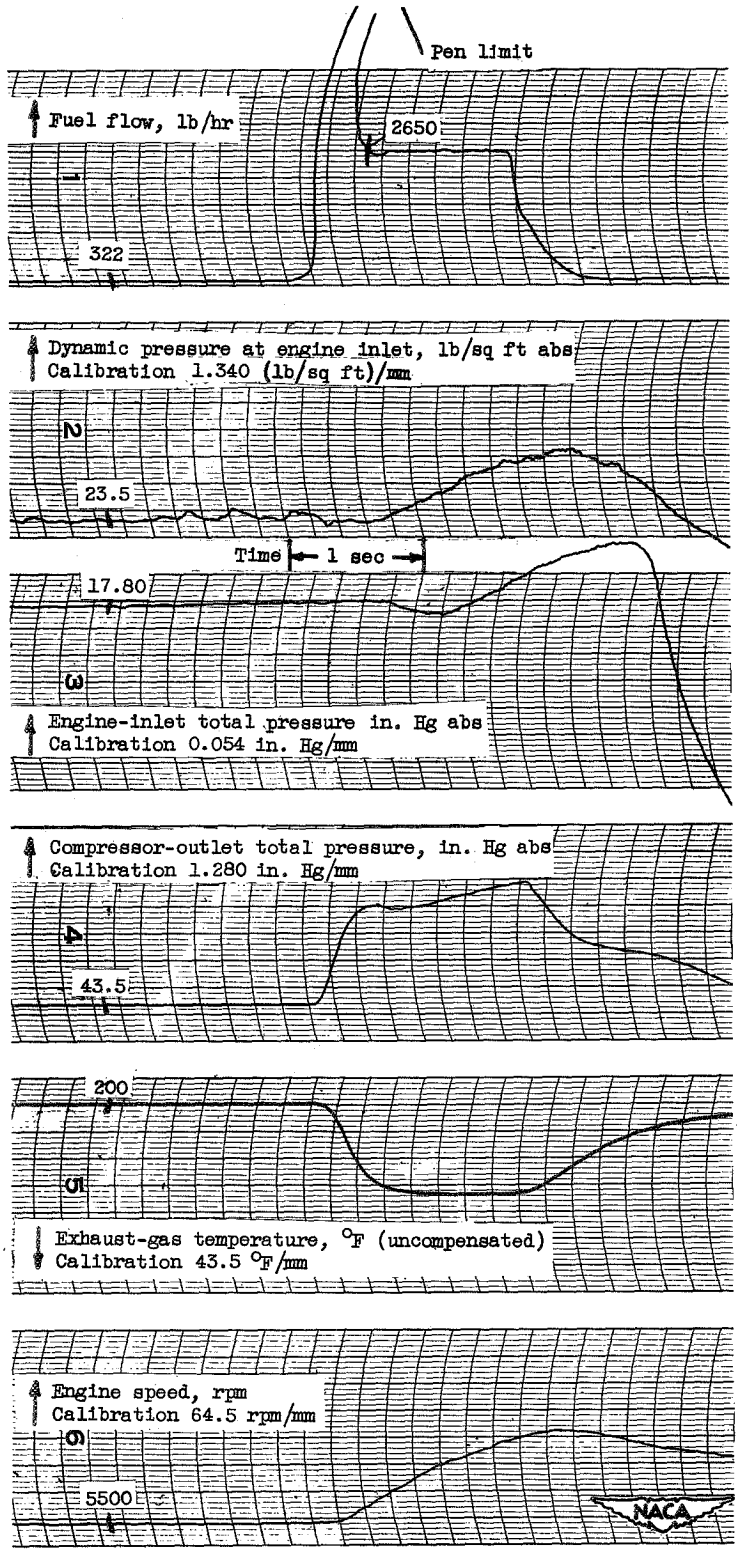

Figure 142

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

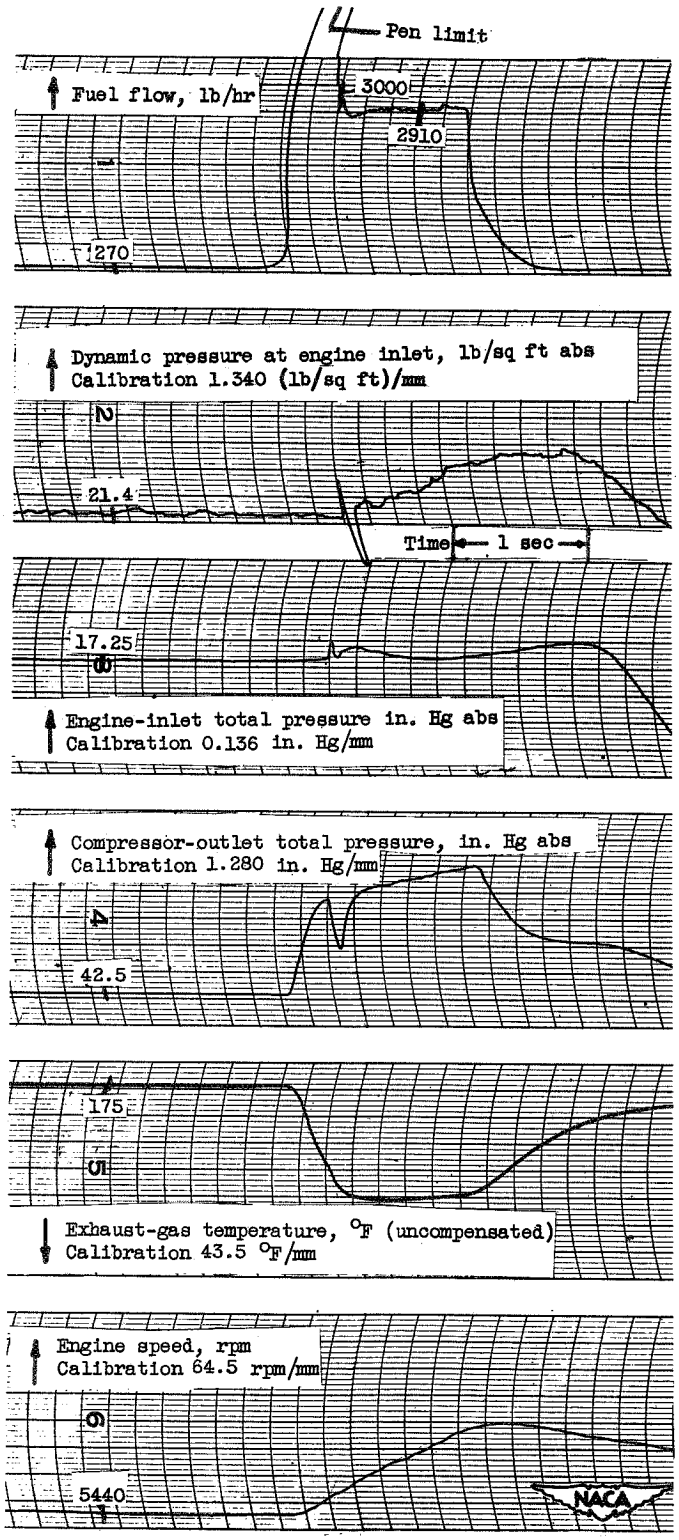

Figure 143

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

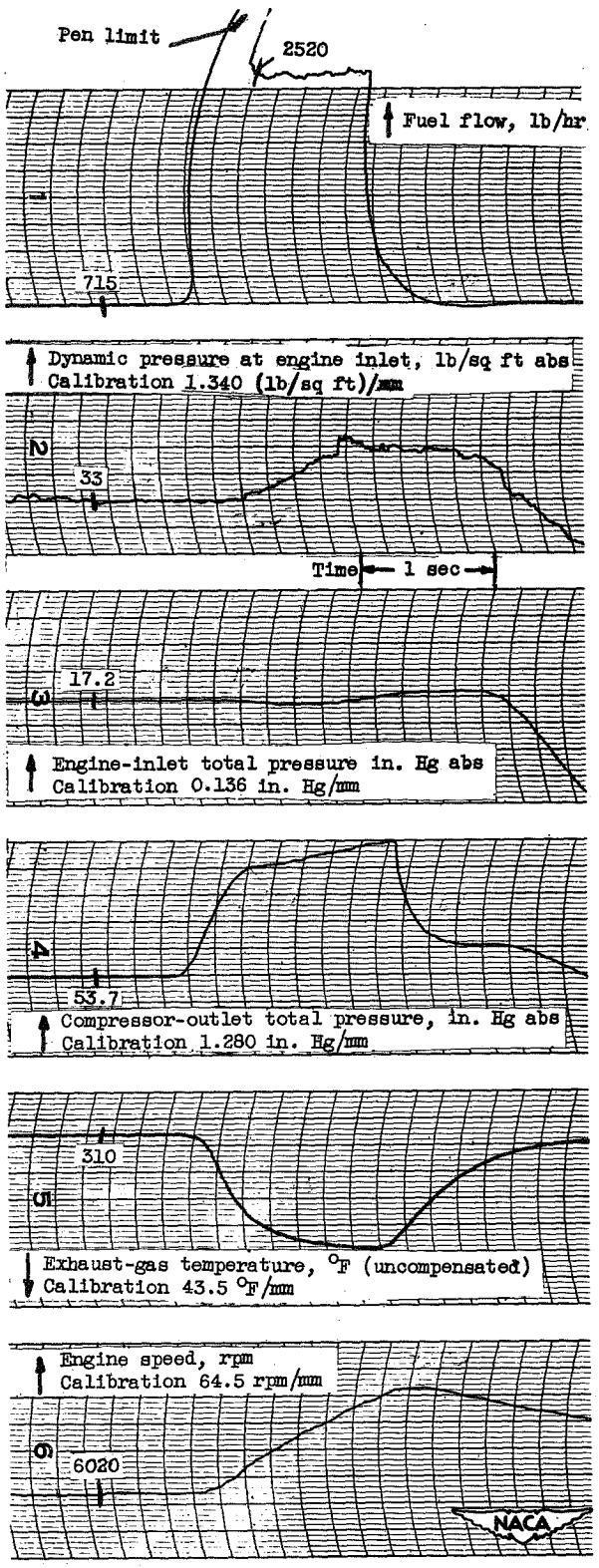

Figure 144

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

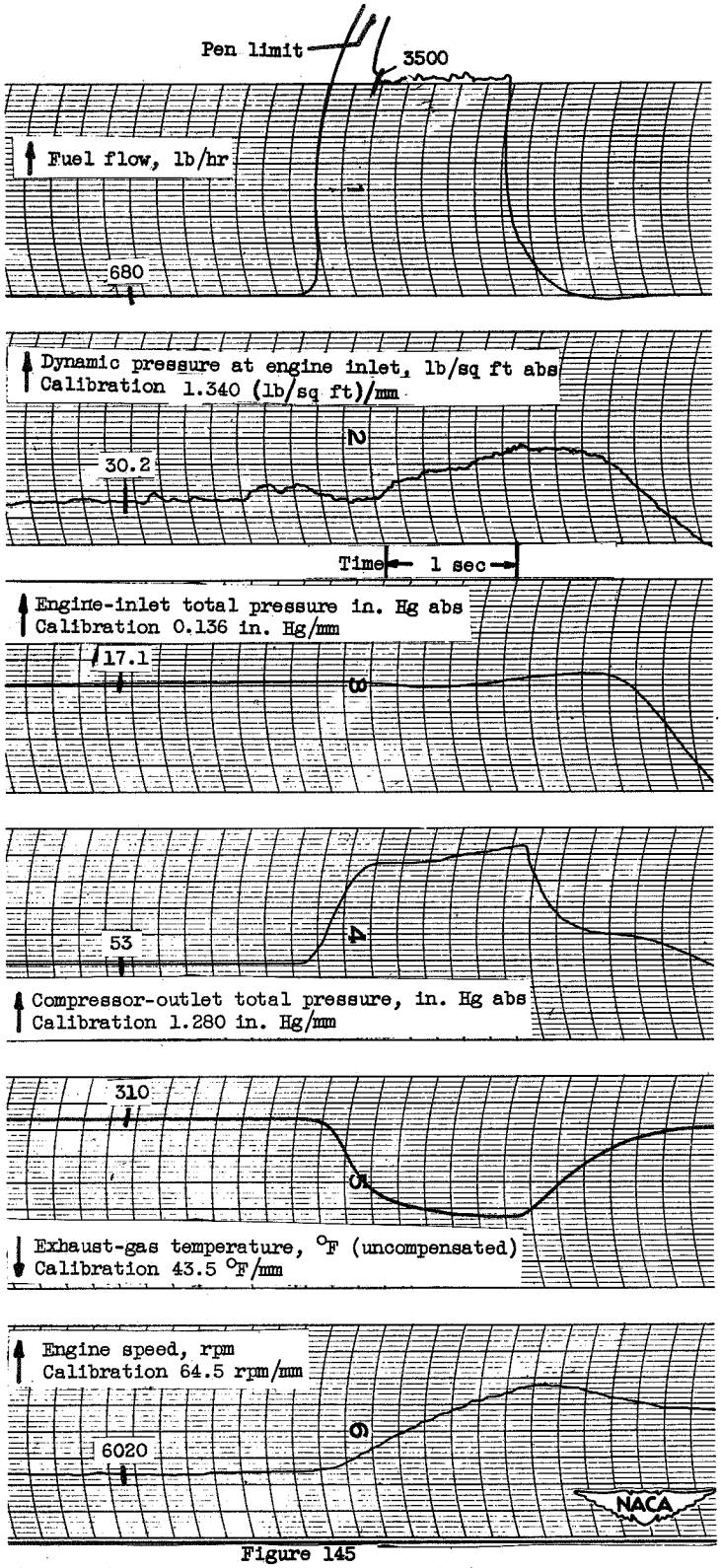

Figure 145

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 29° F; inlet guide vanes position, closed.

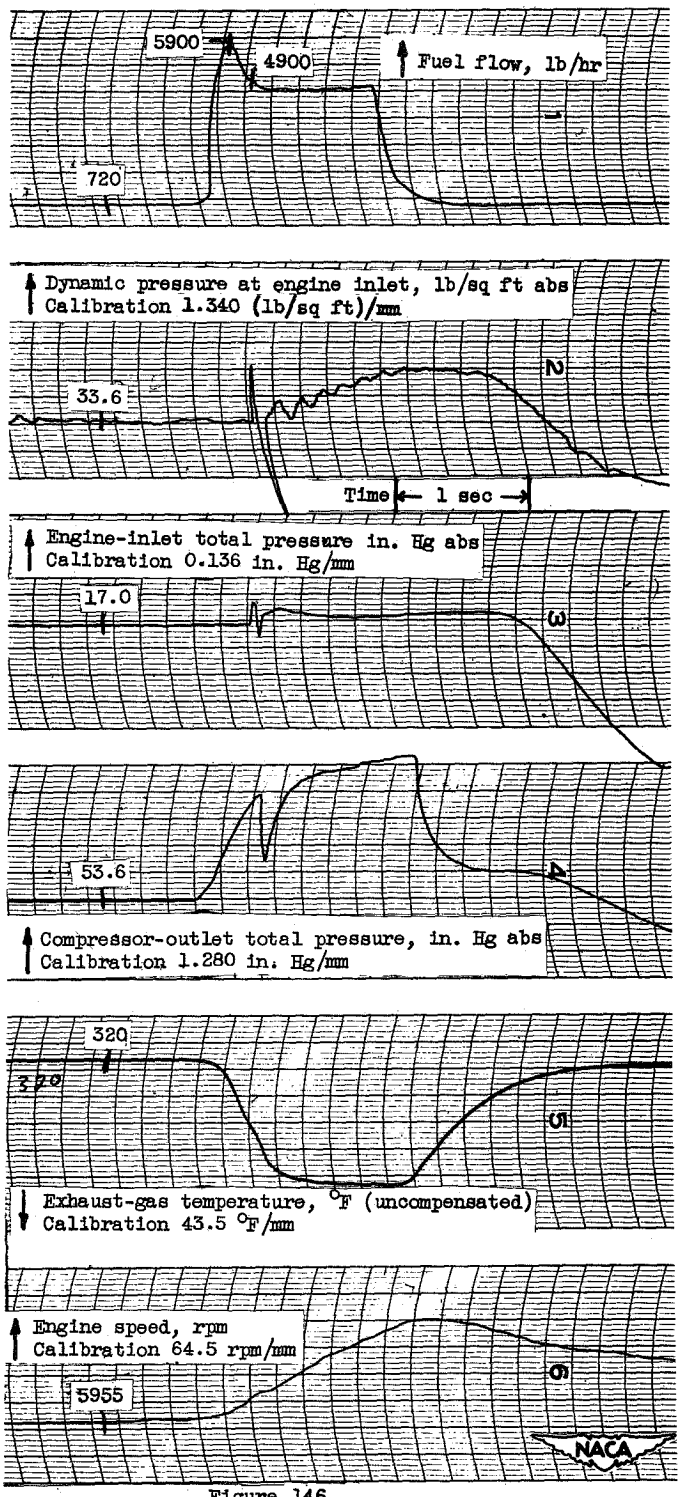

Figure 146

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

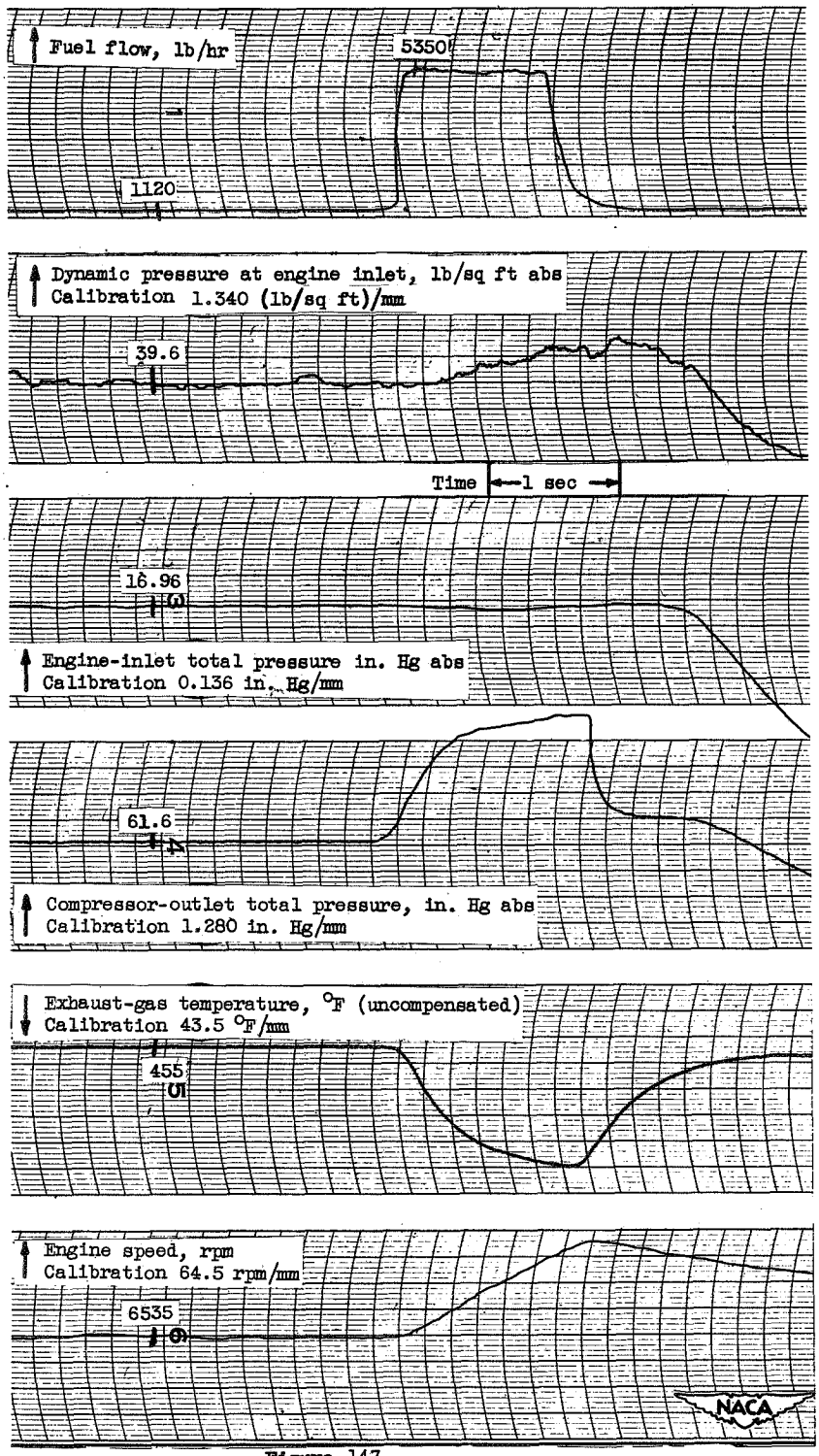

Figure 147

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

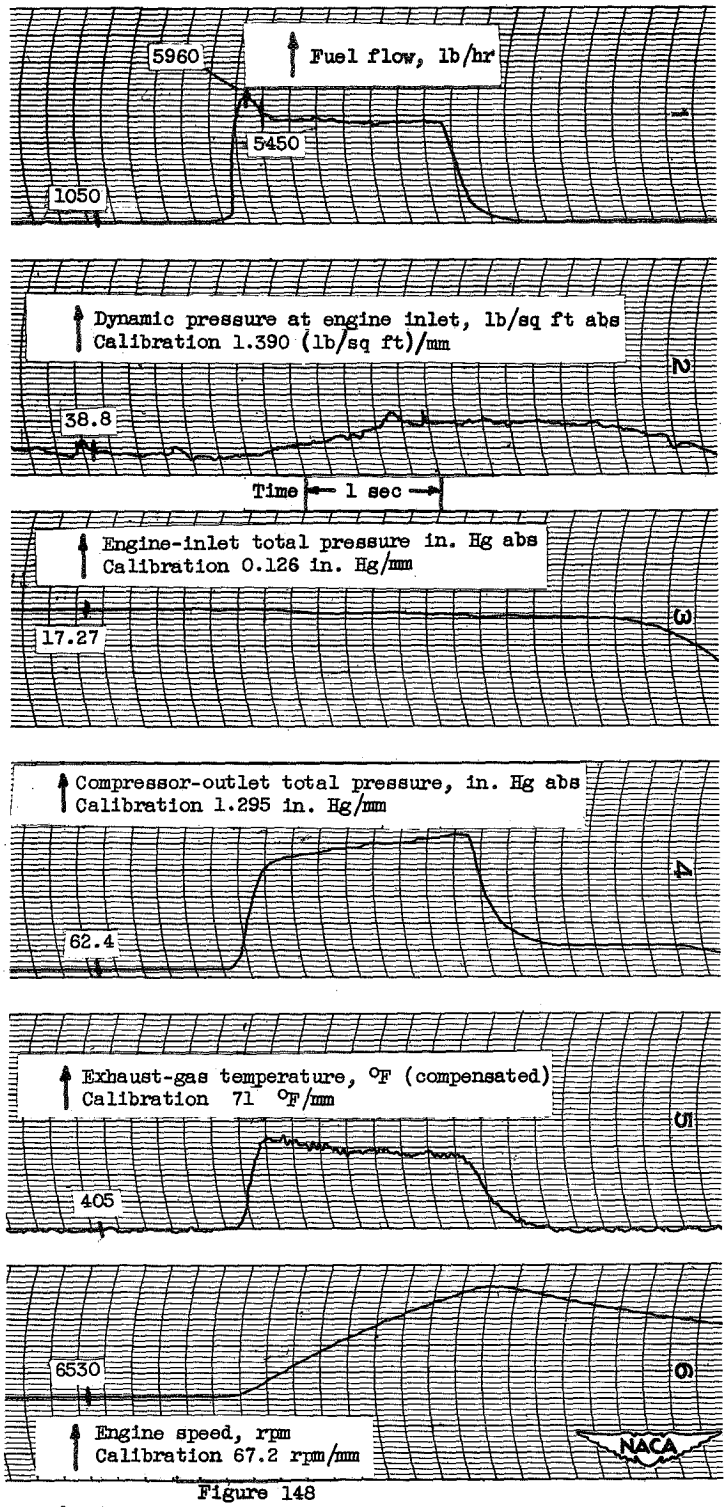

Figure 148

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 40° F; inlet guide vanes position, closed.

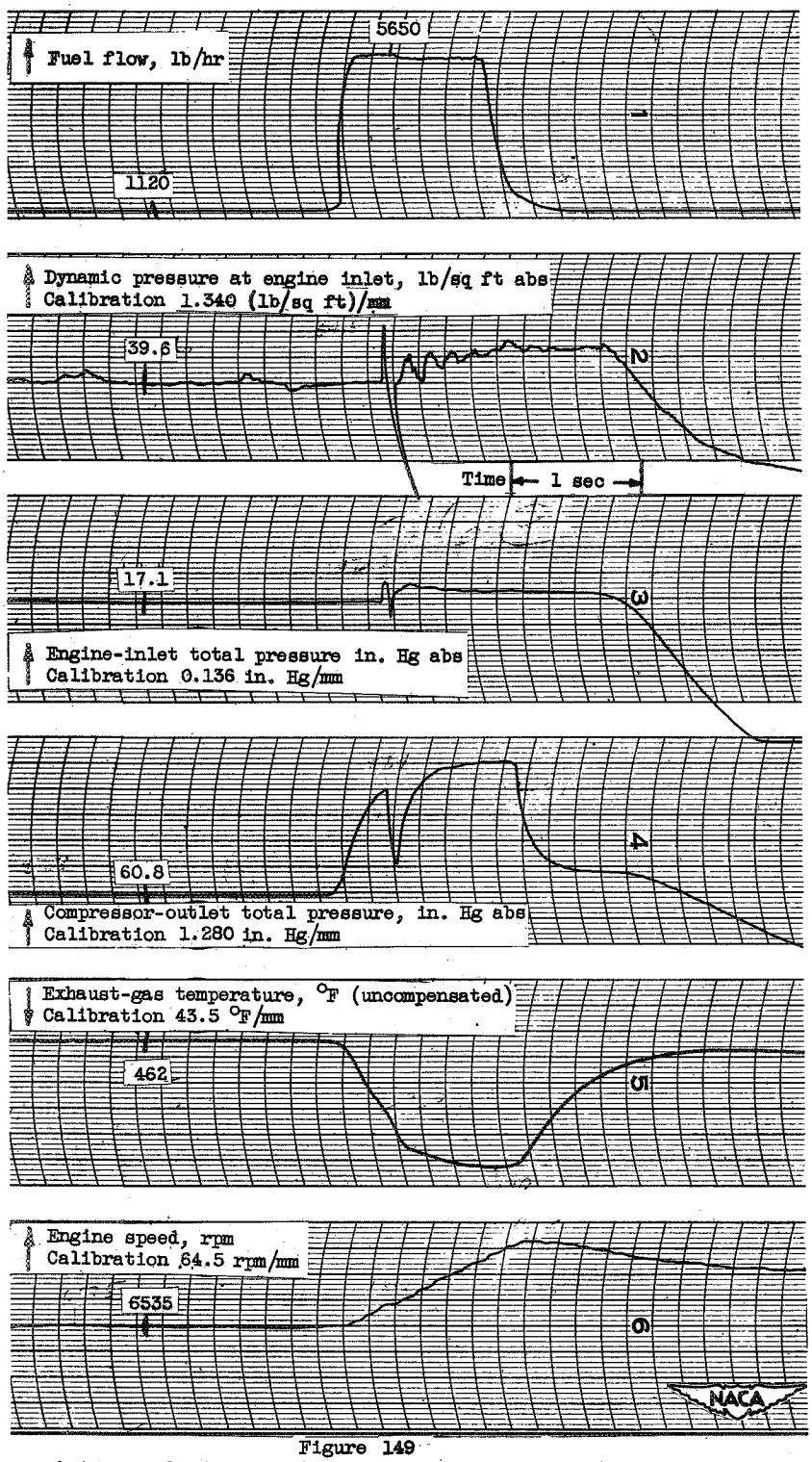

Figure 149

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

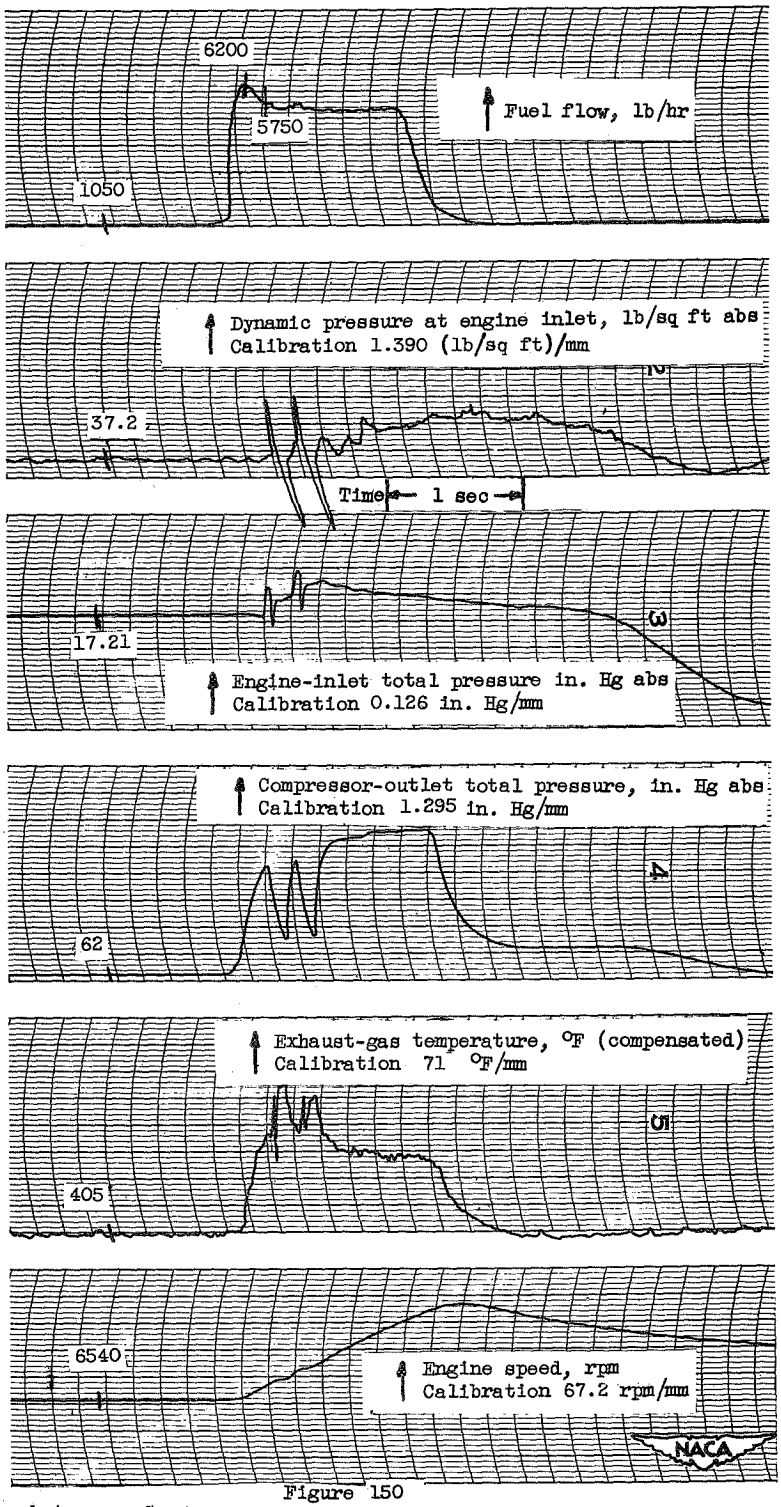

Figure 150

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 40° F; inlet guide vanes position, closed.

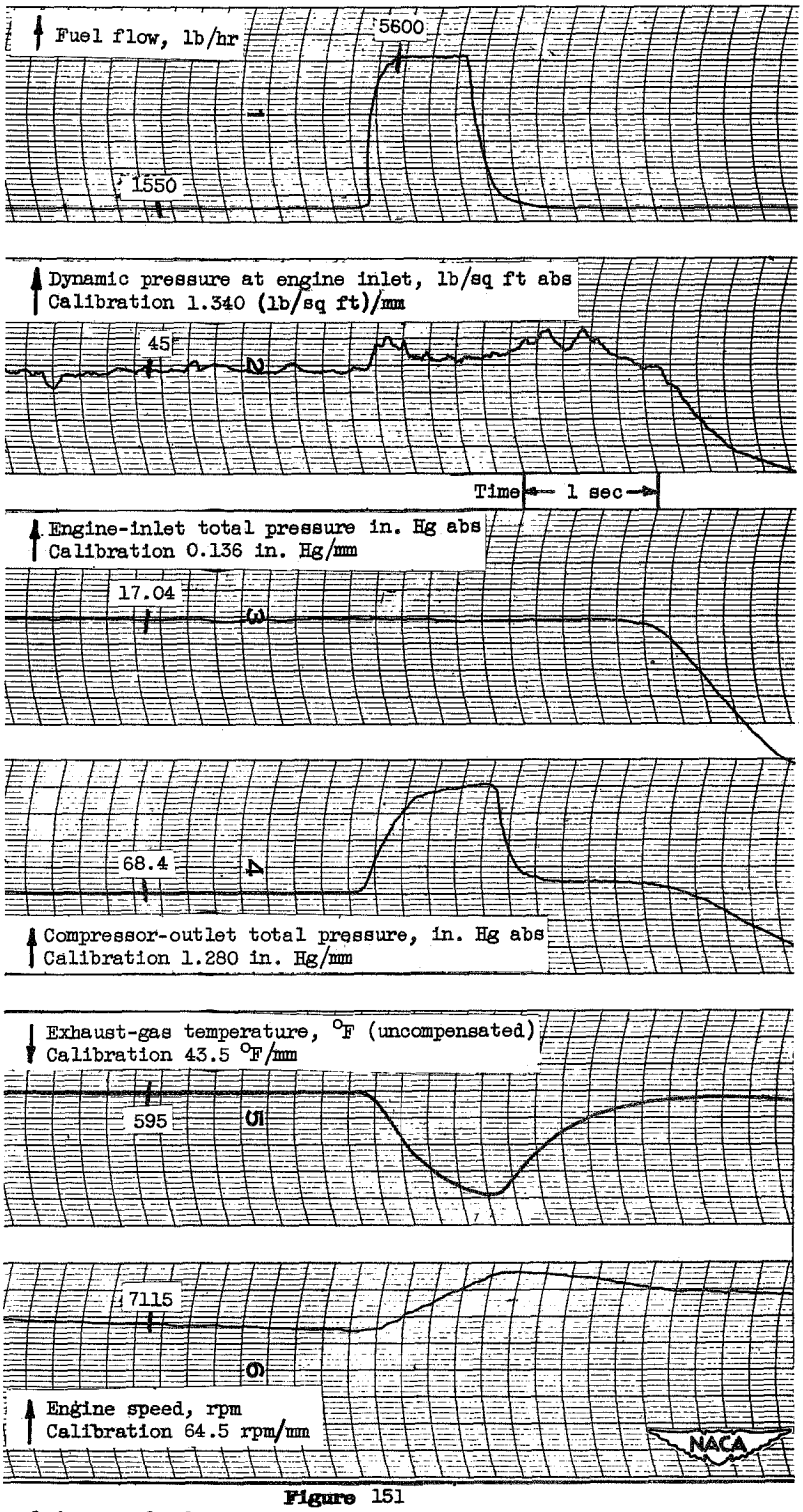

Figure 151

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

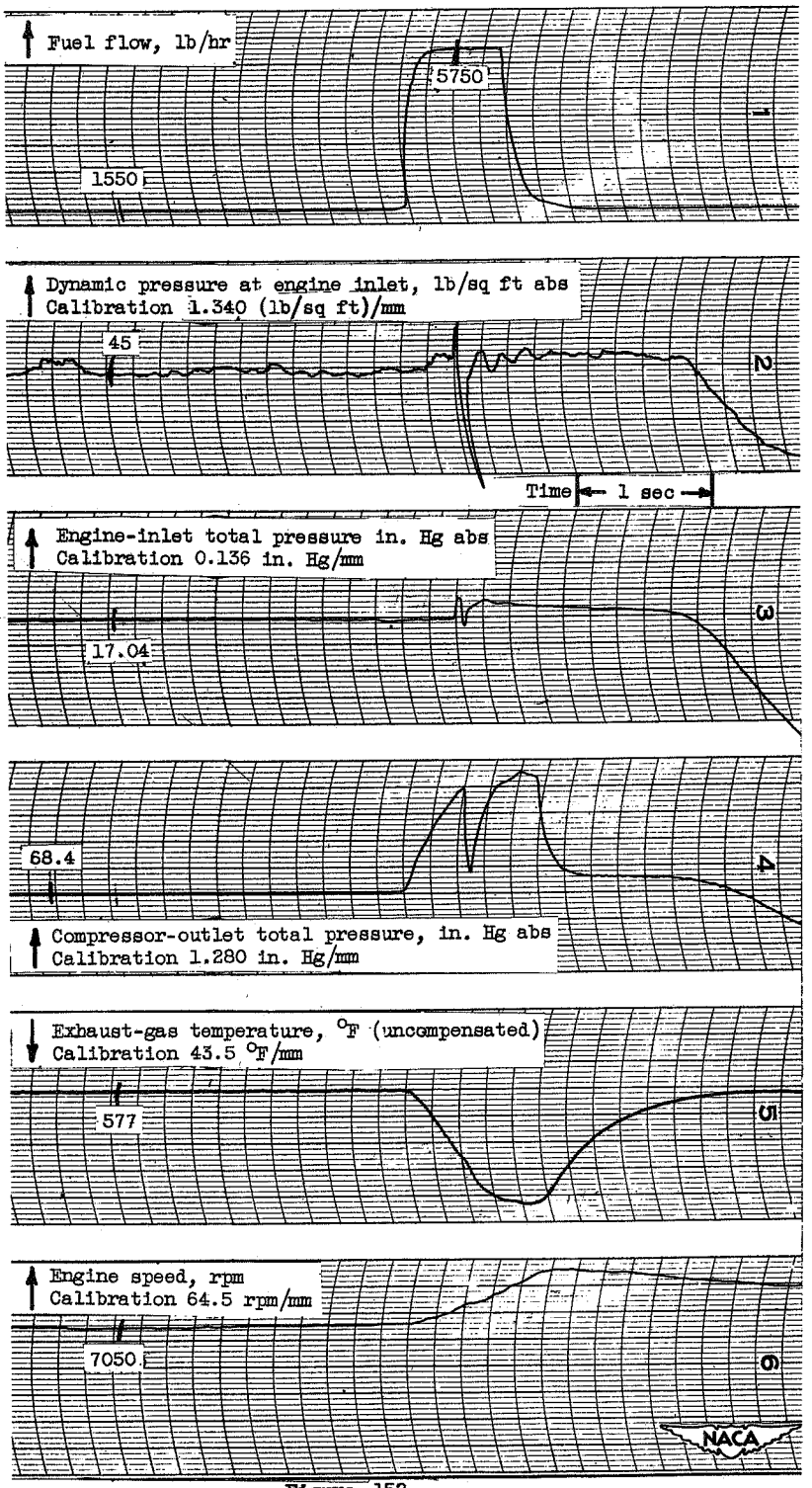

Figure 152

Oscillograph traces showing variations of different engine parameters during a step-change in fuel flow. Altitude, 35,000 feet; flight Mach number, 1.2; engine-inlet air temperature, 30° F; inlet guide vanes position, closed.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

PRELIMINARY TRANSIENT PERFORMANCE DATA ON THE J73 TURBOJET ENGINE

II - ALTITUDE, 35,000 FEET

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