JM:bt
BBG-7
Flight Tests
STV-2

APL-JHU/CM-409
September 10, 1947
Copy No. [redacted]

TO: G. C. Munro

FROM: J. Metzler

SUBJECT: Flight Tests of First Ten STV-2's With Program Roll Systems

REFERENCES: (a) NOTS Letters to APL-JHU Reporting STV-2 Tests:- NP45/A9/F41-18/156/RO/AEF/meh, Serially Numbered:

#6, Fired 5 Sept 1946 - Serial (048) Jan 23, 1947
#7, Fired 25 Sept 1946 - Serial (0100) Feb 25, 1947
#24, Fired 29 Oct 1946 - Serial (0108) Feb 28, 1947
#17, Fired 16 Jan 1947 - Serial (0208) Apr 17, 1947
#14, Fired 23 Jan 1947 - Serial (0248) May 12, 1947
#1 #3, Fired 13-19 Jan 1947 - Serial (0229) Apr 30, 1947
#11 #10, Fired 20 Feb 1947 - Serial (0230) Apr 30, 1947
#25, Fired 26 Feb 1947 - Serial (0207) Apr 17, 1947

(b) STV-2 Data - APL-JHU Drawing No. 2400.

ENCLOSURE: (A) Figures 1-11. Figures 1-10 are telemetering curves, chiefly rate of roll versus deflection, some with missile speed or roll attitude included. Figure 11 is a typical set of telemetering curves of pressures and speeds from two receiving stations and camera data for comparison.

SUMMARY:

(1) Direction of Roll Response

Supersonic	Subsonic	Differentially Deflecting Surfaces
Reverse Roll	Reverse Roll	Rollerons
Reverse Roll	As Predicted	Wing Deflection
As Predicted	As Predicted	Tail Deflection

(2) Amount of Roll Response

At a speed of 1400 feet per second, the roll response was about 130°/sec., per degree of deflection per square foot of deflecting surface. At speed of 1400 ft/sec.:

Total effectiveness of rollerons is about 400 sec^{-2}
Total effectiveness of deflected wings is about 1400 sec^{-2}

(3) Roll Damping

a = about 12 sec^{-1}. Steady state was reached about 0.5 second after deflection of flap. Misalignments and gradual drift made measurements difficult.

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(4) Accuracy of Records

Although differences were observed on all duplicate telemetering channels, comparisons with measurements by other methods were possible in the case of measurement of speed by ram pressure, Figure 11, Enclosure (A). Discrepancies of about 15 per cent were found between stations and between methods.

Purpose of This Report

Preliminary data, Reference (a), have been issued by NOTS, Inyokern, and CVAC on ten STV-2's with roll systems. It is the purpose of this report to analyze the data from these test to determine aerodynamic parameters. This report is based on the final data from telemetering and theodolite information.

General Purpose of These Flight Tests

Apart from the purposes of checking the operational characteristics of a revised inter-rocket manifold, of studying separation, and of determining operational effects of the launcher's elevation 10° higher (to 30°) with a 10 foot extension (to 35 feet) all of which were reported satisfactory, the main purposes of these flight tests of roll systems were as follows:

> To provide a sustained velocity region of flight; and in this region to determine the rate of roll, the rate of change of rolling velocity resulting from differentially deflecting surfaces (1) at fixed angles and (2) with programmed movement, and to determine the damping in roll and the effectiveness of the roll control surface.

General Description and Configuration of STV-2

For details of the general configuration of STV-2, see the drawing of Reference (b).

The STV-2 is a projectile-shaped test vehicle 120 inches long with a diameter of 12 inches. Seventy-five (75) inches back from the point of the long tapered nose there are four movable wings having a span of 36 inches and a total area of 1.78 square feet. These wings are untapered, unswept, basically rectangular in planform, with tips having positive rake. At the rear there are four swept-back fixed fins having a span of 41 inches and a total area of 6 square feet.

Deflecting surfaces consist of two rollerons having a span of 26 inches and a total area of 0.28 square feet, or of the two horizontal wings or tail fins, which (except the tail fins) are differentially actuated by the electro-hydraulic system, changing deflection every 1-1/2 seconds. These movements are regulated by a bang-bang control system consisting of a clock mechanism which is electrically started at separation from the booster carriage.

Inside the afterbody of the vehicle, a slow burner ABL rocket having a diameter of ten inches, a rated thrust of 1000 pounds, and a rated duration of 10 seconds, is electrically fired at separation.

To record information, the vehicle operates four channels of APL FM Telemetering employing the following end instruments:

(A) Ram stagnation pressure gauge, (B) Position of the deflecting surfaces, (C) Rate of roll, and (D) Roll attitude.

General Results and Sources of Data

The chief sources of information are the telemetering records in the form of rolls of photographic traces, each roll with a custom prepared calibration card for the trace of each frequency channel. The flight and preflight records used by APL were made at the "Vagabond Lady" Station located beside the Stran-Steel hut near the launcher. (CVAC uses the records of the "Weary Willie" Station located in a telemetering truck at Tower 4, G-1 range, about 8000 feet down range, about 20° left of the firing line). Both stations were fully equipped with recording facilities. The data of these rolls were transferred to the graph sheets, Enclosure (A), by plotting points at every one-tenth second of flight during normal performance and at every one-twentieth second for the first 3 seconds and during rapid changes.

"Newsreel" Kodachrome 16 millimeter motion pictures are available. These show the STV-2 vehicle and booster carriage assembly, the launching, the flight, and the recovery of the expended unit. Checks on the roll characteristics of the vehicle while attached to and separating from the booster carriage were obtained by examination of these newsreels.

Memoranda and data by CVAC and NOTS, included in Reference (a), have been freely used and copied. These include descriptions of test vehicles and test conditions, theodolite camera curves, and the Test Firing Reports which apparently are copies of original field data sheets.

Aerodynamic Coefficients. The simplified equation for the response in roll of a missile is:

$$I \ddot{\phi} + A \dot{\phi} = L$$

where ϕ = Angle of Roll

I = Moment of Inertia of Missile About Roll Axis

A = Aerodynamic Torque Due to Roll Angular Velocity

L = Torque (Producing Roll)

where A and L are constant for constant speed and altitude.

Dividing by I gives:

$$\ddot{\phi} + a\dot{\phi} = K$$

where

$$a = \frac{A}{I}$$

$$K = \frac{L}{I}$$

For constant missile velocity and altitude and a fixed control surface setting, L is a constant, hence, under these conditions

$$\dot{\phi} = \frac{K}{a} + ce^{-at}$$

c being a constant depending on the initial conditions, and

$$\ddot{\phi} = -ace^{-at}$$

It is unlikely that all of the ideal conditions ever would be obtained. This approximate equation may, however, be used to obtain values of <u>a</u> and <u>K</u>. The following graphic method has been used. Starting at a time when a bang-bang deflection of the roll control surfaces has just been completed and ending when the new steady state of roll is reached, the telemetering record of rate gyro, $\dot{\phi}$, is plotted versus time as a large scale curve. The function $\ddot{\phi}$ is graphically measured along this curve, and the corresponding $\ln|\ddot{\phi}|$ is plotted producing a roughly straight line, the slope of which is -a. The possible effect of deceleration and change in pressure was examined and found negligible because of the short space of time in which calculations were made.

The STV-2's did not contain angular accelerometers, but a fair estimate of the angular acceleration can be obtained from the rate of roll. Examination of a number of the telemetering records has shown that, for the STV-2,

$$a \doteq 12 \text{ sec}^{-1}$$

when the speed is 1400-1500 feet per second. Individual measurements ranged from about 6 to 15 seconds^{-1}.

The value of K depends on the magnitude of the roll control surface deflection, as well as on the surface being used for roll control and can be found from the relation

$$K = a\dot{\phi}_s$$

where

$\dot{\phi}_s$ = Steady state roll angular velocity, provided information on <u>a</u> and $\dot{\phi}_s$ is available.

In the case of the STV-2, the steady state is reached within about 0.5 second after the roll control surface assumed a new deflection.

Values of K are tabulated in the following page

<u>Roll Response</u>. Response to differentially deflected rollerons and wings was measured by the difference in the steady rate of roll before and after their deflection. This was done at 1400 feet per second (for deflections at the wing location) because this was the only speed at which data on five vehicles were available without extrapolation. Measurement of the sixth vehicle was prevented by failure to obtain good data. Measurements are tabulated below:

Speed at Which Response Was Measured Ft/Sec	STV-2 Serial Number	Degs. Defl.	Total Response Deg/Sec	Response According To CVAC Report CF-650: Flight Deg/Sec	Response According To CVAC Report CF-650: Theory Deg/Sec	Response (Col 4) Per Deg.Defl. Deg/Sec	Effectiveness of Roll Control Surfaces $a \times \ddot{\varphi} = K$	Response (Col 7) /sq ft Surface Deflected Deg/Sec
Inter-Wing Rollerons - Standard STV-2's -- Area: 0.28 Square Feet								
1400	No. 24	10.0°	-242	-335	300	-24	-290	-86
1400	No. 17	3.6°	-126	-135	175	-35	-420	-124
1400	No. 14	2.2°	- 80	- 60	100	-36	-430	-130
Deflected Wings - Area: 0.89 Square Feet								
1400	No. 10	5.0°	-580	-460	930	-116	-1300	-131
1400	No. 11	3.3°	-410	-335	620	-124	-1500	-139
1400	No. 13	1.3°	No Data	No Data	240	---		---

NOTE: With regard to the values in the last column, it may be accidental that the standard rollerons and the deflected wings do not show more difference in response per unit area. If they may be considered together, (except at 10° rolleron deflection where the response falls off by one-third) they produce an average roll response of approximately 130° per second, per degree of deflection per square foot of deflecting surface.

Speed at Which Response Was Measured Ft/Sec	STV-2 Serial Number	Degs. Defl.	Total Response Deg/Sec	Response According To CVAC Report CF-650	Response (Col 4) Per Deg.Defl. Deg/Sec	Effectiveness of Roll Control Surfaces $a \times \ddot{\varphi} = K$	Response (Col 7) /sq ft Surface Deflected Deg/Sec
Forward Rollerons - Area: 0.28 Square Foot							
1100	No. 1	10.0°	-11	These were CAL	- 1	- 12	- 4
1200	No. 25	12.5°	-160	Constructed Units	-13	-160	-47

NOTE: It may be noted that the response from forward rollerons is small and may be variable.

Angles of Attack and Yaw. If yaw and pitch were present, they were not of sufficient magnitude to be detected by the methods of observation used. No further discussion of pitch and yaw angles is included

Booster Inter-Rocket Manifold. It has been reported that the introduction of solid steel inter-rocket manifold into the booster was satisfactory.

Launching at Inyokern. It has been reported that launching at an elevation of 30° with a 35 foot guide rail was satisfactory.

Forward Rolleron System, Mk. 50, Mod. 1, (CAL Construction)

Description and Programs of Deflections. Vehicles STV-2 No. 1 and No. 25 were assembled by the Cornell Aeronautical Laboratory. Located 21.15 inches back from the nose were two rollerons, Reference (a), with tips having positive rake. These were actuated cyclically by the electro-hydraulic control system about one second after separation and at successive intervals of one second. The amplitudes of successive deflections were altered by a cam which allowed the bell crank to go a distance depending on the position of the cam. The movement of the hydraulic piston was stopped against this bell crank. The cam was moved into successive positions by a rachet device and a motor driven clock mechanism. These movements turned out to be somewhat mixed but were programmed roughly along the following lines:

Vehicle	Program of Deflections
Serial No. 1	3 1/3° cw, 3 1/3° ccw, 6 2/3° ccw, 6 2/3° cw, 10° ccw, 10° cw;
Serial No. 25	5° cw, 15° ccw, 15° cw, 5° ccw, 15° cw, 10° ccw

Results: Forward Rollerons Ineffective. Compared to other configurations for producing rolling torques, the forward rollerons were ineffective in degree of response produced.

Both vehicles showed "reverse roll"* at all speeds.

The aerodynamic roll damping coefficient, a, was computed for No. 1 only, at one of the program changes which produced counterclockwise roll response, when the speed was 1500 feet per second. The value obtained was a ≐ 7 (rough approximation)

* By "reverse roll" is meant a response tending to roll the vehicle in the reverse direction to that preidcted in consideration of the deflected surfaces alone.

Inter-Wing Rolleron System (CVAC Construction of Standard STV-2)

Description and Program of Deflections. Vehicles STV-2 No. 24, No. 17, and No. 14 were assembled by the Consolidated-Vultee Aircraft Corporation as indicated precisely in the drawing of Reference (b). Their rollerons were located at the forward wing position mounted 45° counterclockwise from the vertical wings when viewed from the rear. The rollerons were differentially rotated by a bang-bang roll control system which reversed their deflection at separation (in the case of No. 14, this was delayed for 1 1/2 seconds) and at successive 1 1/2 seconds intervals thereafter (in the case of No. 24, this was at 2 1/2 seconds intervals). The amplitude of movement of the hydraulic piston was controlled by a restraining stop in the cylinder. The movements followed the following programs.

Vehicle	Program of Deflections
Serial No. 24	10° cw, 10° ccw, and so on.
Serial No. 17	3° 38' cw, 3° 38' ccw, and so on.
Serial No. 14	2° 12' cw, 2° 12' ccw, and so on.

Results: Inter-Wing Rollerons Somewhat Effective. Inter-wing rollerons effected reverse roll at all speeds. See table in the General Results, Paragraph 4-b.

The aerodynamic coefficient, a, was computed by selecting a vehicle, STV-2 No. 24, which had what was considered to be fairly uniform rate gyro curves (of response to rolleron deflection). After 8.3 seconds of flight, when the rolleron deflection rotated the vehicle in a counterclockwise direction, at a missile speed of about 1400 feet per second, a damping coefficient of $a \doteq 12$ was computed.

Further calculations were made on STV-2 No. 17. After 10.4 seconds of flight, when the rolleron deflection rotated the vehicle in a counter-clockwise direction, and when the speed was about 1350 feet per second, a damping coefficient of $a \doteq 11$ was obtained.

After 7.9 seconds of flight, when the rolleron deflection rotated the vehicle in a clockwise direction, and when the speed was about 1400 feet per seond, the value of a was $a \doteq 6$.

Horizontal Wing Roll System (CVAC Construction)

Description and Program of Deflection. Vehicles STV-2 No. 13, No. 11, and No. 10 were assembled by the Consolidated-Vultee Aircraft Corporation with no rollerons or ailerons. The horizontal wings were differentially rotated by a bang-bang roll control system which reversed their deflection about 1 1/2 seconds after separation, and at 1 1/2 second intervals thereafter. The amplitude of the movement of the hydraulic piston was made constant by a stop in the cylinder. The movements followed the following programs.

Vehicle	Program of Deflections
Serial No. 13	1° 20' ccw, 1° 20' cw, and so on
Serial No. 11	3° 20' ccw, 3° 20', cw, and so on
Serial No. 10	5° ccw, 5° cw, and so on

Results of Horizontal Wing Roll System. All three vehicles showed reverse roll at supersonic speeds. At subsonic speeds, No. 11 and No. 10 had direction or roll as predicted for the wing deflections alone. (A record on No. 13 at subsonic speed was not obtained).

See table in General Results, Paragraph 4-6. The aerodynamic coefficient was not computed.

Horizontal Tail With Differential Deflection (CVAC Construction)

Description. In No. 7 there were no rollerons or ailerons. The horizontal tail fins were set with a differential deflection of 1° in a clockwise direction (this being the direction of their rotation as seen from outside the test vehicle looking along the axis of rotation of the particular surface).

Results of Horizontal Tail Roll System. At both supersonic and subsonic speeds, No. 7 rolled fairly steadily at about 2 1/2 r.p.s. in a clockwise direction as viewed from the rear of the vehicle. This is the direction of roll as predicted for the tail deflecting surfaces alone. In this connection it may be noted that this is the only vehicle which did not have reverse roll. The tail deflection was calculated to approximate the maximum misalignment to be expected from manufacturing tolerances. The resultant roll was greater than the greatest roll response to 5° differential deflection of the horizontal wings. It is not known how much of this was due to the deflecting surfaces and how much was caused by further accidental misalignment.

Speed Measurement by Stagnation Pressures

It appears that telemetered stagnation pressure can be a good method of measuring vehicular speed, provided the free stream pressure is known.

Stagnation pressure gauge readings were telemetered from seven of the ten STV-2's. Curves of supersonic speed versus time of flight were prepared from these data, after calculating the speed by the use of Rayleigh's pilot-tube formula. Ambient pressures taken directly from meteorological data obtained at the field at the time of flight, when available in Reference (a), were found to follow the normal curve of pressure versus altitude within 2 or 3 millibars. Under such conditions, in the measurement of speed by stagnation pressure, the free stream pressure may be taken from the normal curve, using the altitude obtained from the theodolite data and correcting for the atmospheric pressure at the surface. In comparing speeds with those obtained from camera data, head and tail winds were taken into consideration, although the weather was fairly calm, these made corrections up to 20 feet per second.

Accuracy of Telemetric Data

The accuracy of telemetric data can not be checked completely by comparison with other methods of observation, although it has been noted that there are variations between duplicate channels on apparently fixed values such as flap settings, also variations between the records of the two receiving stations.

Ram pressure gauge readings provide a means by which speeds computed from their telemetric data can readily be compared with the speeds measured by triangulation of theodolite camera data and by acceleration camera data.

Each curve of speed calculated from ram pressure (Paragraph 9) was plotted along with the corresponding theodolite camera and acceleration camera velocity curves for comparison. In making the comparison, acceleration camera data when available was used in preference to theodolite data. In most of these curves, the curve of speed calculated from pressure runs roughly parallel to that from camera data but is different from the latter by 90 feet per second (on the average). This difference corresponds to a pressure difference of about 3 1/2 pounds per square inch. The two telemetering records of this same function for each flight, moreover, differ on the average about this same amount from each other. On comparison of the records of 4 vehicles, No. 7, No. 17, No. 13, and No. 10, the average difference between stations was about 3 pounds per square inch in 20, or about 15 per cent.

Figure 11 of Enclosure (A) is a typical set of curves of the two records of ram pressure gauge readings, (1) from the "Vagabond Lady" telemetering records and (2) from CVAC data read from the "Wearie Willie" records. The corresponding speeds are also plotted, with two speed curves from camera data for comparison. Differences between all four curves in Figure 11 may be noted.

Recommendations

In order to get the most information and the most reliable information from a necessarily budgeted minimum of flight tests, (1) it has been recommended that critical preflight data so far as practicable be precisely recorded by two or more independent proved-in source employing two or more basic methods of observation, e.g. that records of flap deflections be made by both visual inspection and by photography simultaneously with the calibration of both telemetering receivers; and (2) it has been recommended to telemeter, at periodic short intervals during flight, steps of calibration of each end instrument.

J. Metzler

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17 A Bonney
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19 D T Sigley
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25 A Kossiakoff
26 H S Morton
27 W H Goss
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29 R K Dahlstrom
30 T Davis
31 E S Franklin
32 W G Berl
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34 A O Wise
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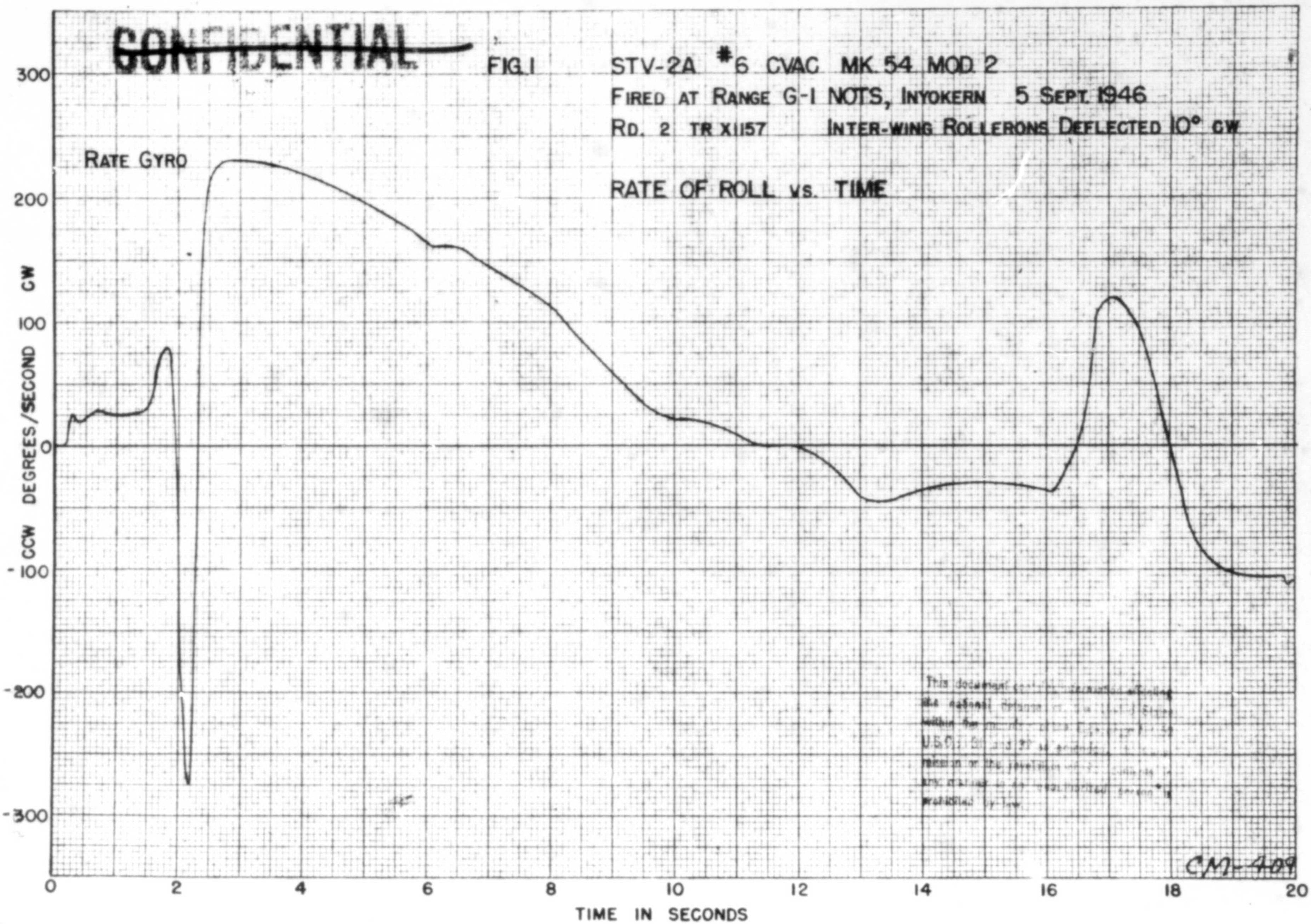
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FIG.1
STV-2A #6 CVAC MK. 54 MOD 2
FIRED AT RANGE G-1 NOTS, INYOKERN 5 SEPT. 1946
RD. 2 TR X1157 INTER-WING ROLLERONS DEFLECTED 10° CW
RATE OF ROLL vs. TIME
RATE GYRO
CCW DEGREES/SECOND CW
300
200
100
0
-100
-200
-300
0
2
4
6
8
10
12
14
16
18
20
TIME IN SECONDS
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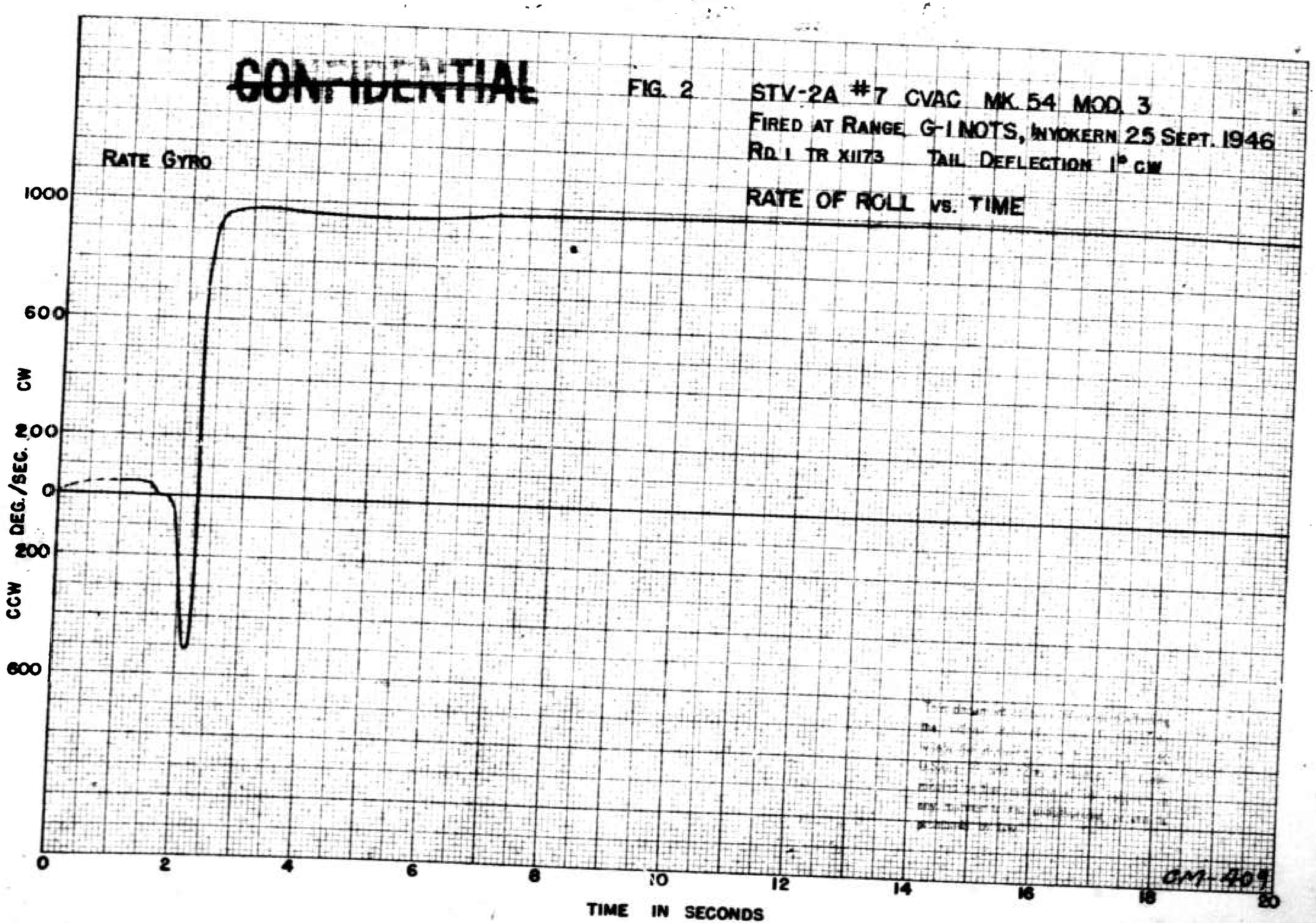
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FIG. 2
STV-2A #7 CVAC MK. 54 MOD. 3
FIRED AT RANGE G-1 NOTS, INYOKERN 25 SEPT. 1946
RD. 1 TR X1173 TAIL DEFLECTION 1° CW
RATE OF ROLL VS. TIME
RATE GYRO
1000
600
200
0
200
600
CCW DEG./SEC. CW
0
2
4
6
8
10
12
14
16
18
20
TIME IN SECONDS
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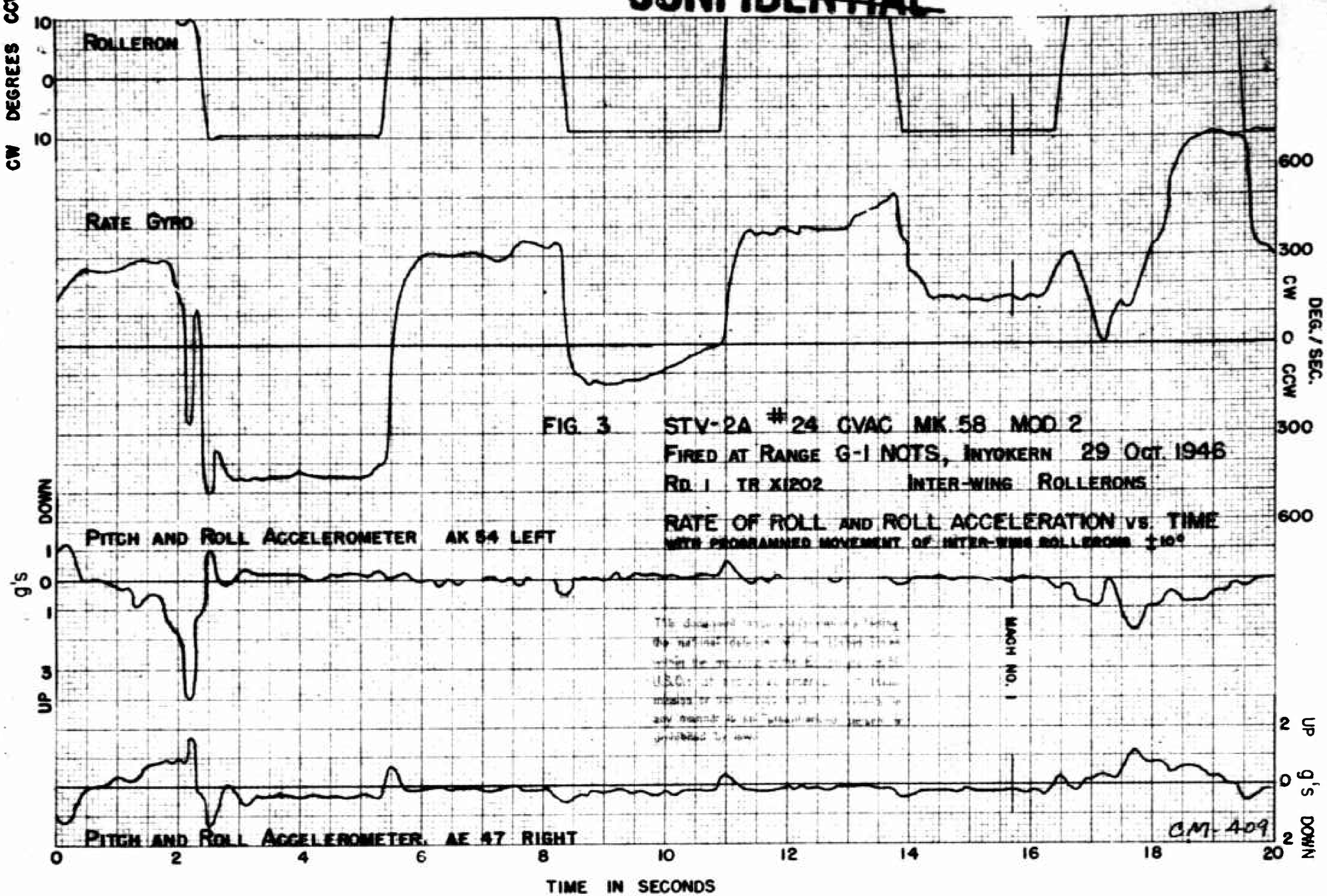

FIG. 3 STV-2A #24 CVAC MK. 58 MOD 2

FIRED AT RANGE G-1 NOTS, INYOKERN 29 OCT. 1946

RD. 1 TR X1202 INTER-WING ROLLERONS

RATE OF ROLL AND ROLL ACCELERATION VS. TIME
WITH PROGRAMMED MOVEMENT OF INTER-WING ROLLERONS ±10°

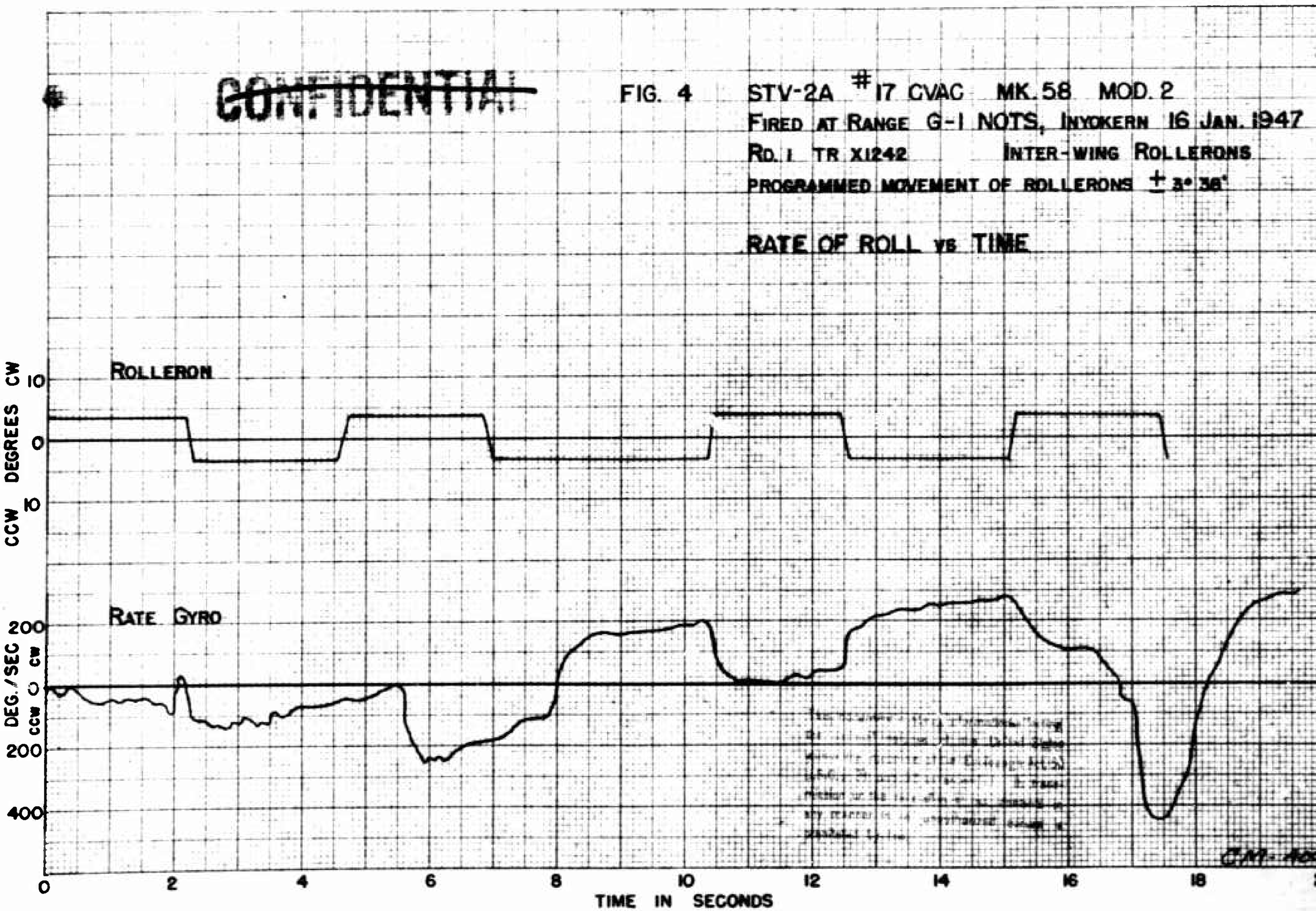

FIG. 4 STV-2A #17 CVAC MK. 58 MOD. 2
FIRED AT RANGE G-1 NOTS, INYOKERN 16 JAN. 1947
RD. 1 TR X1242 INTER-WING ROLLERONS
PROGRAMMED MOVEMENT OF ROLLERONS ± 3° 36'

RATE OF ROLL vs TIME

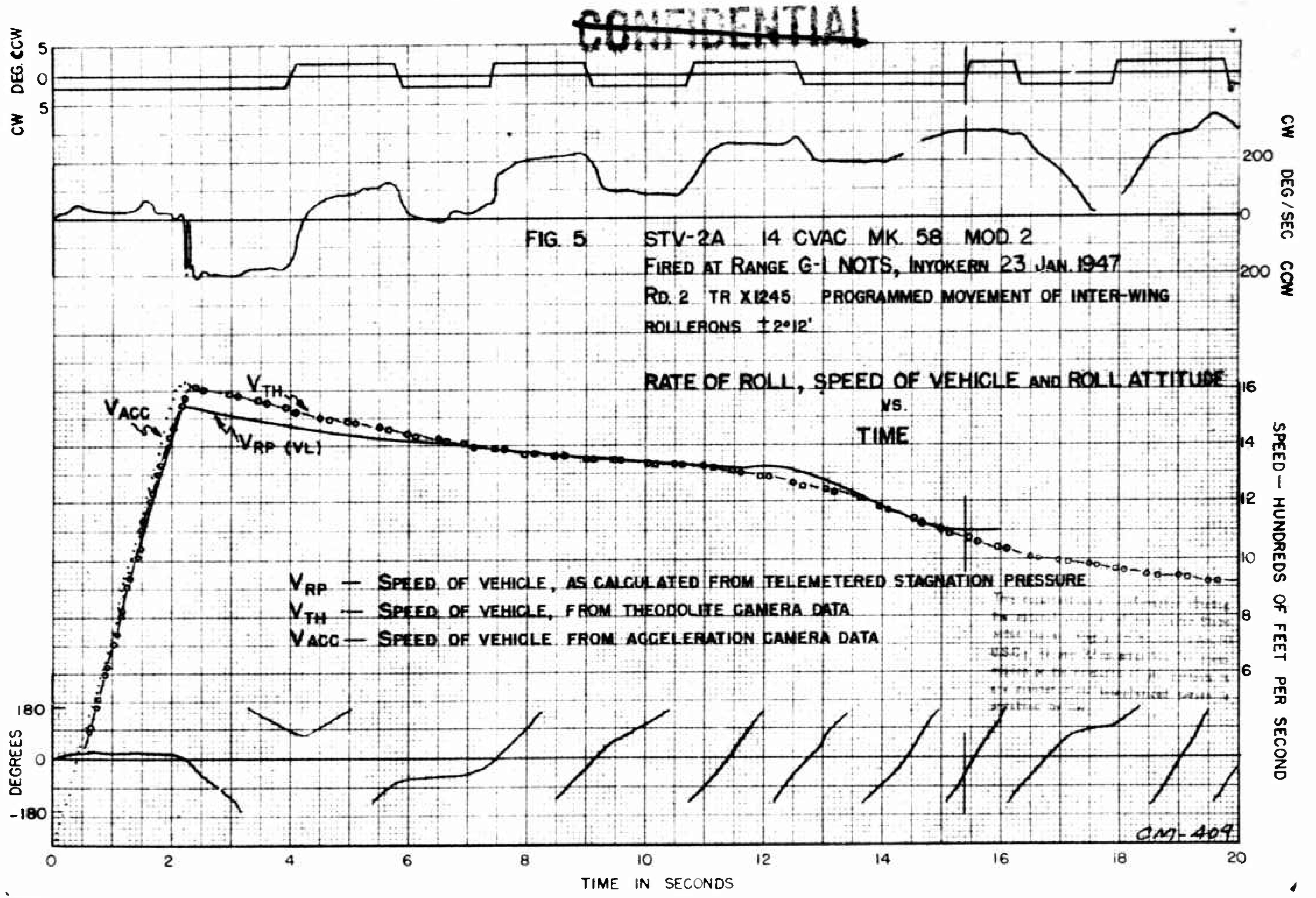
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FIG. 5 STV-2A 14 CVAC MK. 58 MOD. 2
FIRED AT RANGE G-1 NOTS, INYOKERN 23 JAN. 1947
RD. 2 TR X1245 PROGRAMMED MOVEMENT OF INTER-WING
ROLLERONS ±2°12'
RATE OF ROLL, SPEED OF VEHICLE AND ROLL ATTITUDE
VS.
TIME
V_RP — SPEED OF VEHICLE, AS CALCULATED FROM TELEMETERED STAGNATION PRESSURE
V_TH — SPEED OF VEHICLE, FROM THEODOLITE CAMERA DATA
V_ACC — SPEED OF VEHICLE FROM ACCELERATION CAMERA DATA
V_TH
V_ACC
V_RP (VL)
CW DEG. CCW
5
0
5
CW DEG/SEC CCW
200
0
200
SPEED — HUNDREDS OF FEET PER SECOND
16
14
12
10
8
6
DEGREES
180
0
-180
TIME IN SECONDS
0
2
4
6
8
10
12
14
16
18
20
CM-409

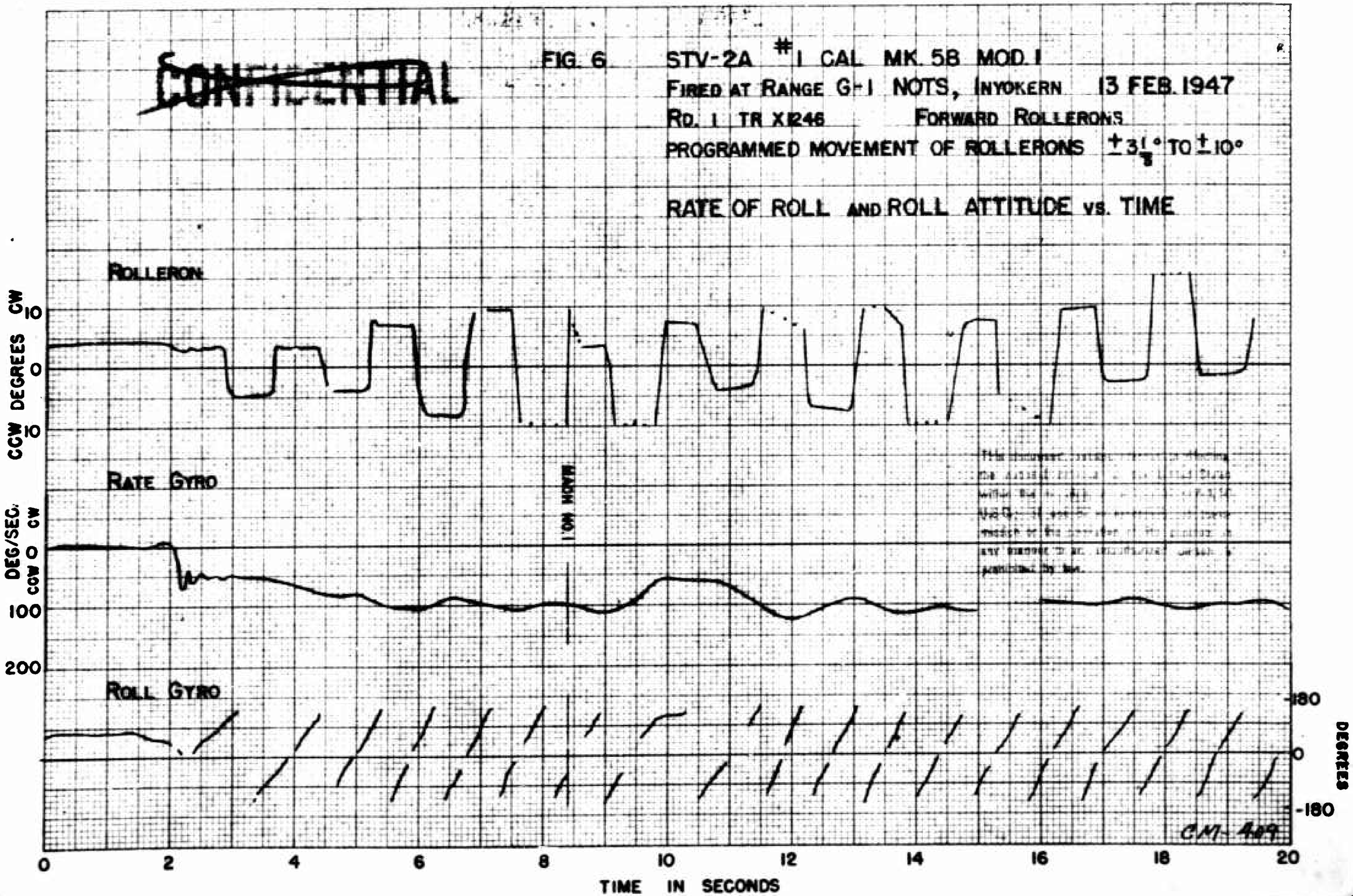


FIG. 6 STV-2A #1 CAL MK. 5B MOD. I

FIRED AT RANGE G-I NOTS, INYOKERN 13 FEB. 1947

RD. I TR X1246 FORWARD ROLLERONS

PROGRAMMED MOVEMENT OF ROLLERONS ±3⅛° TO ±10°

RATE OF ROLL AND ROLL ATTITUDE vs. TIME

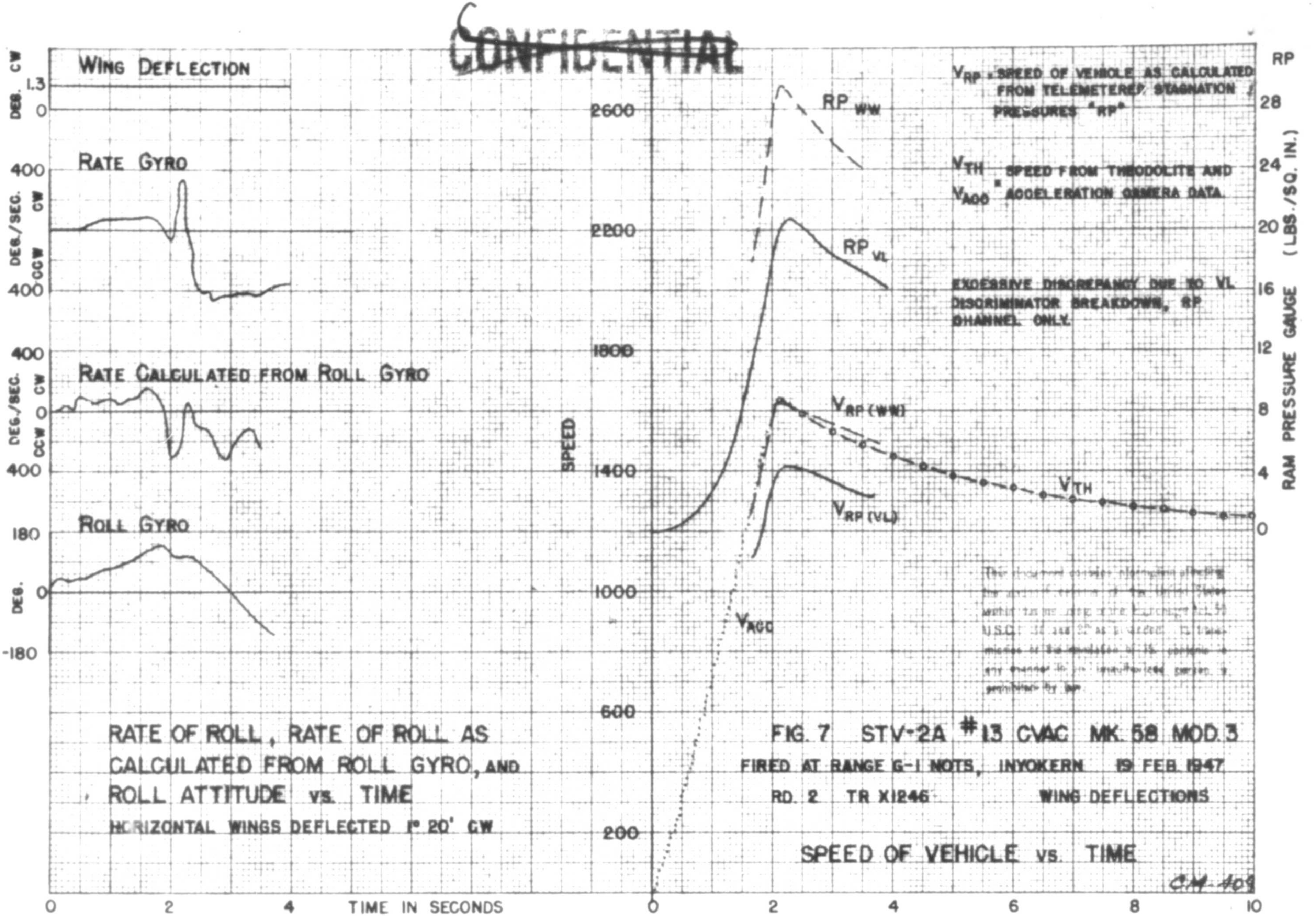


FIG. 7 STV-2A #13 CVAC MK. 58 MOD. 3

FIRED AT RANGE G-1 NOTS, INYOKERN 19 FEB. 1947

RD. 2 TR X1246 WING DEFLECTIONS

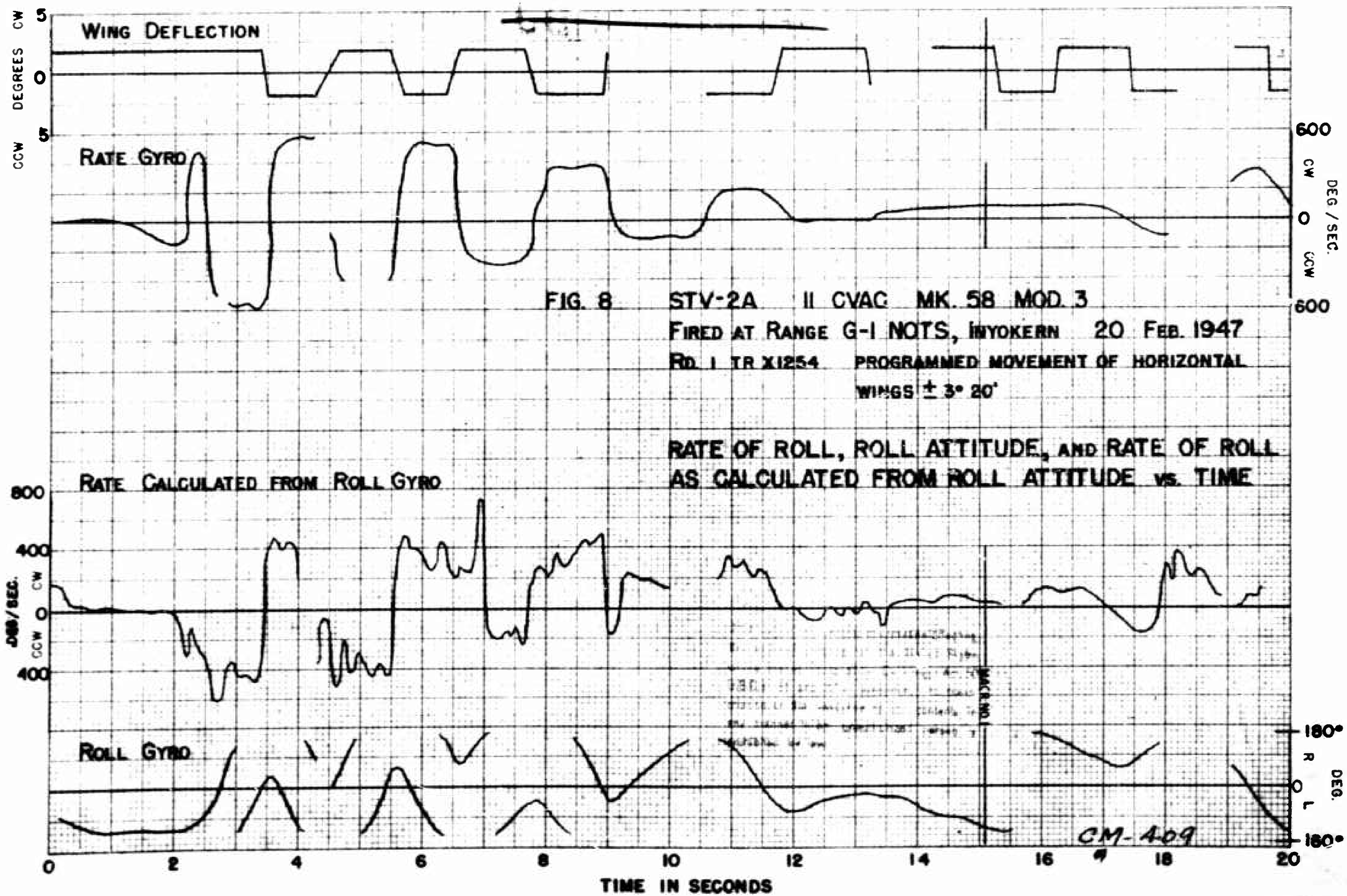
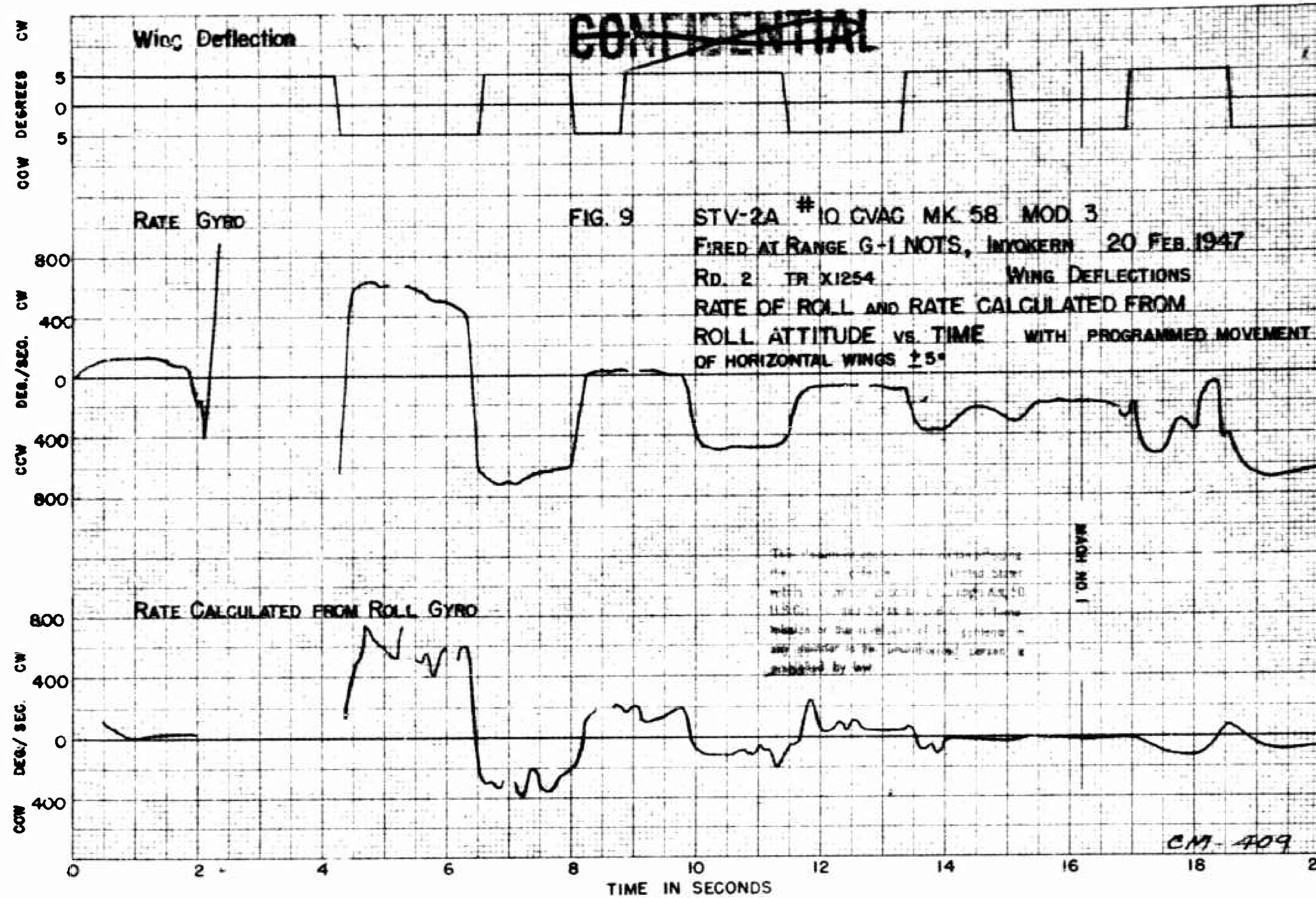


FIG. 8 STV-2A II CVAC MK. 58 MOD. 3
FIRED AT RANGE G-1 NOTS, INYOKERN 20 FEB. 1947
RD. 1 TR X1254 PROGRAMMED MOVEMENT OF HORIZONTAL WINGS ± 3° 20'

RATE OF ROLL, ROLL ATTITUDE, AND RATE OF ROLL AS CALCULATED FROM ROLL ATTITUDE vs. TIME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Wing Deflection
CW
DEGREES
CCW
5
0
5
RATE GYRO
800
400
0
400
800
CW
DEG./SEC.
CCW
FIG. 9
STV-2A #10 CVAC MK. 58 MOD. 3
FIRED AT RANGE G-1 NOTS, INYOKERN 20 FEB. 1947
RD. 2 TR X1254 WING DEFLECTIONS
RATE OF ROLL AND RATE CALCULATED FROM
ROLL ATTITUDE VS. TIME WITH PROGRAMMED MOVEMENT
OF HORIZONTAL WINGS ±5°
MACH NO. I
RATE CALCULATED FROM ROLL GYRO
800
400
0
400
CW
DEG./SEC.
CCW
0
2
4
6
8
10
12
14
16
18
20
TIME IN SECONDS
CM-409

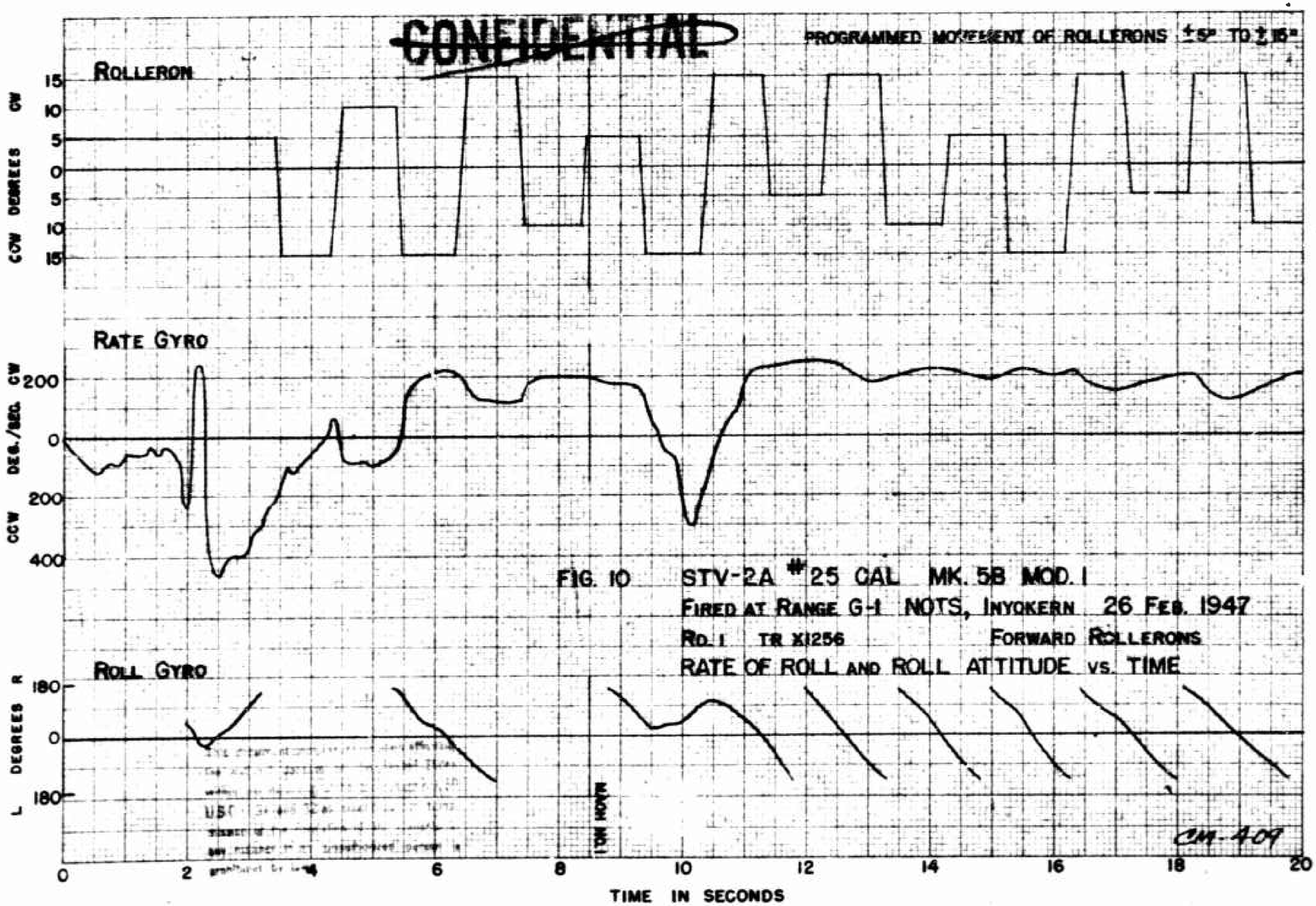
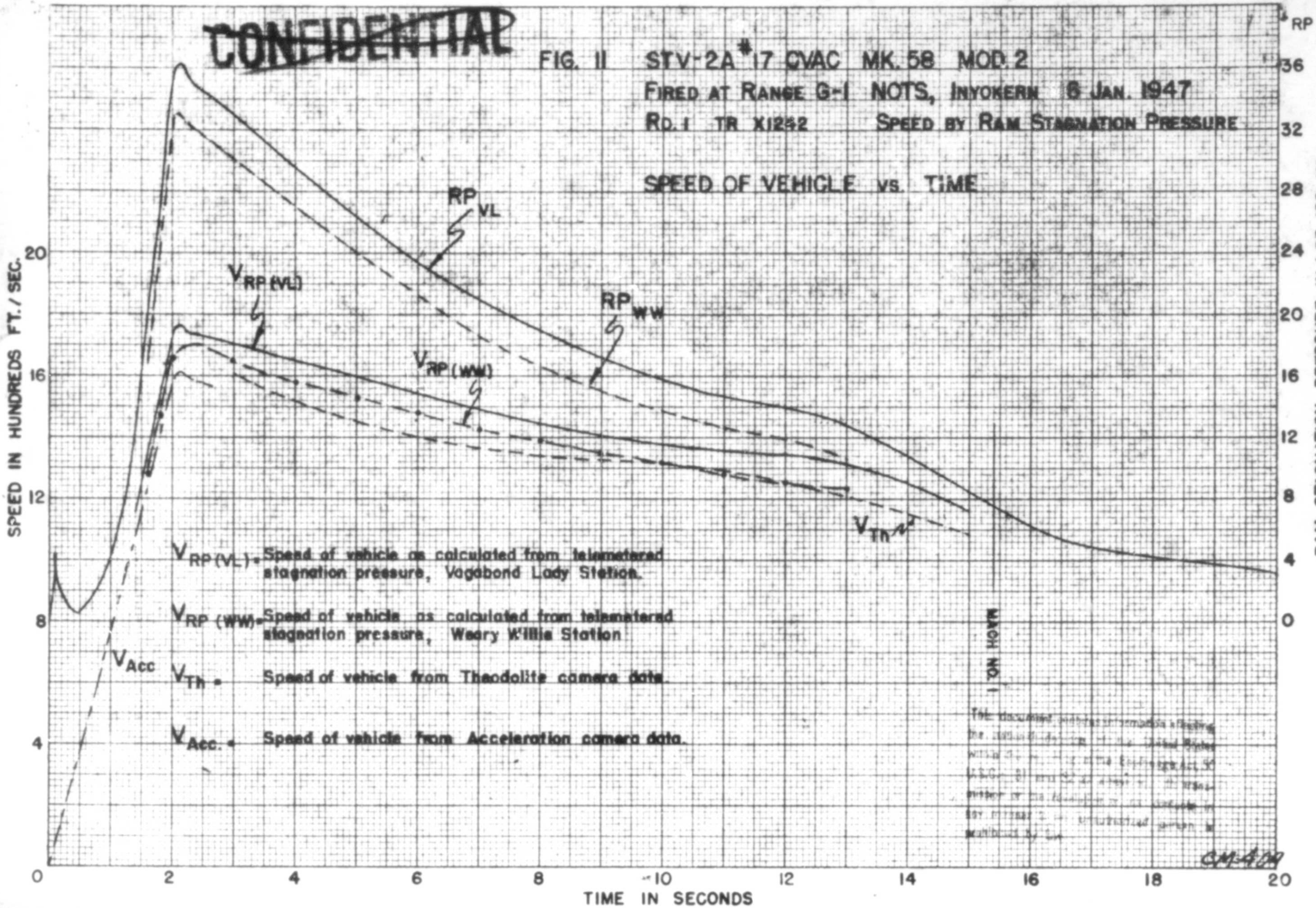


FIG. 10 STV-2A #25 CAL MK. 5B MOD. I
FIRED AT RANGE G-1 NOTS, INYOKERN 26 FEB. 1947
RD. I TR X1256 FORWARD ROLLERONS
RATE OF ROLL AND ROLL ATTITUDE vs. TIME


CONFIDENTIAL
FIG. 11 STV-2A #17 CVAC MK. 58 MOD. 2
FIRED AT RANGE G-1 NOTS, INYOKERN 6 JAN. 1947
RD. 1 TR X1242 SPEED BY RAM STAGNATION PRESSURE
SPEED OF VEHICLE vs. TIME
RP VL
RP WW
V RP (VL)
V RP (WW)
V Th
V Acc
MACH NO. 1
V RP (VL) - Speed of vehicle as calculated from telemetered stagnation pressure, Vagabond Lady Station.
V RP (WW) - Speed of vehicle as calculated from telemetered stagnation pressure, Weary Willie Station
V Th - Speed of vehicle from Theodolite camera data.
V Acc. - Speed of vehicle from Acceleration camera data.
SPEED IN HUNDREDS FT./SEC.
RAM STAGNATION PRESSURE IN LBS./SQ. IN.
TIME IN SECONDS
RP
0
2
4
6
8
10
12
14
16
18
20
4
8
12
16
20
24
28
32
36
CM-4

ATSC FORM CD D (13 FEB 47)

[redacted]

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Metzler, J	DIVISION: Guided Missiles (1) SECTION: Testing (14) CROSS REFERENCES: Missiles, Guided - Flight tests (62929); Roll (83000)	ORIG. AGENCY NUMBER CM-409 REVISION

AMER. TITLE: Flight tests of first ten STV-2's with program roll systems

FORG'N. TITLE:

ORIGINATING AGENCY: Johns Hopkins Univ., Applied Physics Lab., Silver Spring, Md.

TRANSLATION:

COUNTRY	LANGUAGE	FORG'N.CLASS	U. S.CLASS.	DATE	PAGES	ILLUS.	FEATURES
U.S.	Eng.		[redacted]	Sep'47	20	12	table, graphs

ABSTRACT

Report presents a description and configuration of the supersonic test vehicle and equipment used during the tests. The main purpose was to provide a sustained velocity region of flight, to determine the rate of roll and rate of change of rolling velocity resulting from differentially deflecting surfaces at fixed angles and to determine damping in roll and effectiveness of roll control surface. Results obtained from telemetering records in the form of rolls of photographic traces are evaluated.