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MODEL: 309A-309C-319A

REPORT NO. 7

APPLICATION OF CIRCULATION CONTROL TO
AN AIRPLANE OF MILITARY LIAISON TYPE
NONR CONTRACTS 234(00) and 856(00)

Cessna Aircraft Company
Wichita, Kansas

Cessna
Aircraft Company
Wichita, Kansas

Engineering Report

MODEL ~~309A-309C~~ : REPORT NO. 7

319A

APPLICATION OF CIRCULATION CONTROL TO

AN AIRPLANE OF MILITARY LIAISON TYPE

UNDER CONTRACTS 234(00) and 856(00)

REPORT DATE: June 11, 1953

PREPARED BY: Earl O. Blosser

WITNESSED BY: Jack W. Fisher

APPROVED BY: Alex Petroff

TITLE PERIODIC PROGRESS REPORT
PREPARED BY EGB DATE 6-11-53
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CESSNA AIRCRAFT CO.
WICHITA, KANSAS

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CESSNA MODEL 309A-309C - MOMR CONTRACT 234(00)

Analysis

During this period the film record of flight tests performed on April 23, 1953 on Model 309A was read and analyzed. All possible data was gathered and tabulated from the film record, including take-off velocities, rate of climb, distance to climb over a 50 foot obstacle, time to climb, landing approach velocities, descent velocities, contact velocities, time to descend over a 50 foot obstacle, and distances to land over a 50 foot obstacle. Take-off and landing distances were then corrected to sea level, zero wind, and 2200 lbs. gross weight.

The distances obtained were averaged and are being compared to calculated take-off and landing distances for purpose of establishing correction factors which can then be used in refining earlier calculations of take-off and landing distances for Model 319A.

The corrected data shows that take-off performance over a 50 foot obstacle was improved by 34% with the use of ELC, while only 7% improvement in landing performance occurred. This was due to the fact that with system on and propeller idling the elevator power was insufficient to obtain a three point attitude.

The data and results of take-off and landing performance are now in the process of assembling into a formal report form. Two reports will be issued: the observed data and analysis of performance.

Design and Drafting

A layout has been started showing the installation of the ethylene oxide jet pump in the Model 309B.

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Shop

The 309A has now been disassembled. The wings, battery box and other components of the aircraft will be placed in storage until they are needed.

The aft fan in the right wing has been removed. This will be used as a pump for a mock-up of the Model 319A suction duct.

Construction of the firewall for the Model 309C and brackets and fittings required for the installation of the hydrogen peroxide jet pump are in progress.

With the exception of the installation of five thermocouples the left wing of the Model 309C is complete.

On the right wing 12 pitot static tubes remain to be installed.

Following the receipt of the H_2O_2 pumping system from Reaction Motors Inc. the airplane will be reassembled. Engineers and technicians from Reaction Motors Inc. are scheduled to arrive on or about June 15.

Trip

On May 6, 1953 Earl G. Blosser visited Wyandotte Chemical Company to discuss jet pump installation problems.

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CESSNA MODEL 319A - NOMR CONTRACT 856(00)Status of Purchased Parts

Some difficulty has been experienced in the procurement of purchased parts. It is felt that apparent reluctance and delay exhibited by outside organizations is largely explained by the following factors:

1. The project requires the design and construction of special equipment, such as axial fan, for instance, which is not in production.
2. The universal shortage of engineering personnel to do the design work.
3. Reluctance of sub-contractors to divert the available personnel to work on components that have no immediate production possibilities.
4. Relatively small amount of money involved in each case.

The following lists individual purchases and the current status of each:

Axial Fans

Design and delivery is being undertaken by Joy Manufacturing Company of New Philadelphia, Ohio. Detailed engineering drawings are expected to arrive by mid-June for approval. Date of delivery has been estimated by Joy Manufacturing Company to be 18 to 20 weeks following final approval. Steps are currently being taken by Cessna to reduce this time period.

Hydraulic Pump and Motors

First flights of the Model 319A will be conducted with boundary layer control power provided by a hydraulic system. Vicker's Inc., of Detroit, Michigan, has proposed to design this system and supply all parts except hydraulic lines. The only engineering details as yet received include pump and motor part numbers which were required by both the fan and engine manufacturers. Delivery from Vicker's is expected by early July.

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Engine

Modification to the engine required for installation of the hydraulic pump is being performed by Continental Motors, Corp., Muskegon, Michigan. In addition to these changes they are supplying the basic engine, and delivery date has been set as on or before July 15, 1953.

Propeller

Arrangements are currently being discussed with the Hartzell Propeller Company of Piqua, Ohio, for the supply of a constant speed propeller and spinner with special provisions for the low and high pitch stops. Delivery can be made within one week after issuance of a formal purchase order.

Miscellaneous

Other negotiations are presently being made for supply of equipment required for bench tests of electrical, pneumatic, and solid propellant boundary layer control systems. Organizations contacted are as follows:

General Electric Co.
Aircraft Gas Turbine Dept.
West Lynn, Mass.
(Solid Propellant)

Walter Kidde and Co., Inc.
Belleville, N.J.
(Pneumatic)

Electric Specialty Co.
Stamford, Ohio
(Electrical)

Jack and Heintz, Inc.
Cleveland, Ohio
(Electrical)

Analysis

Computed take-off and landing performance has been completed and the data compared to performance of Cessna Model 305A (L-19A). The results of this comparison are shown by Figures 3 and 4.

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Further attempts to obtain correction factors from a comparison of Model 309A flight test and calculated take-off distances have been undertaken. However, these factors, when applied to calculated distances for Models 319A and L-19, fail to yield satisfactory results. It is felt that large differences which exist between thrust and drag relationships of the different airplanes largely accounts for this result. It can be stated reasonably that absolute distances will all be smaller than calculated.

A thorough analytical investigation of the 319A stability and control characteristics with and without boundary layer control has been started. It is expected that these computations will yield limitations to center of gravity position, optimum horizontal stabilizer incidence, and elevator deflection and area required for a three point landing.

Design

The following drawings have been completed:

12319-6	Wing Structure Assembly
12319-15	Fuel Tank Installation
12319-17	Mock-Up of the Suction Duct

The mock-up of the suction duct which will be bench tested utilizing the fan and the generator dismantled from the Model 309A is being made.

Further prints of 12319-6, wing structure assembly, have been released to shop. Templates from 12319-13, wing loft, have been made. Further development of internal ducting on this loft will continue with completion of aerodynamic design.

Drawing 12319-13 engine installation, has been completed. Prints have been released to the shop.

Drawing 12319-15, fuel tank installation, has been started. The drawing will include the tank, installation and a schematic arrangement of the engine fuel system.

Drawing 12319-7, cabin modification, which will incorporate the new rear spar carry-through, window modifications, and a new wing fairing has been started.

Shop

Plaster mold for the construction of the right wing tip has been made. All parts required for the construction of the wing spars have been formed and one spar is completed. Form blocks for the wing ribs are being made.

Flight Tests

In order to work out any cooling problems that may arise when the O-470-A engine is installed in an L-19, it is planned to install a standard O-470-A engine in an L-19 (per 12319-13) to solve these problems as soon as possible. The action of governor on constant speed Hartzell propeller, especially at low pitch stops, also, will be observed.

Trips

Visits were made to Continental Motors Corp. and Vicker's Inc., to arrange for delivery of the 319A engine modified to operate the hydraulic HLC system and to discuss selection of specific hydraulic motors.

The discussions with personnel of each company are summarized as follows:

Continental Motors Corp. The Continental engine Model O-470-A was selected for the following reasons:

- a. Overall engine length is shorter than the L-19 engine allowing space within the cowling for installation of the hydraulic pump. Use of any other engine (of comparable horsepower) with the hydraulic pump installed would require expensive cowling redesign.
- b. The engine and accessories are 25 lbs. lighter than the engine presently installed in the production L-19. (neglecting hydraulic pump and its provisions).
- c. The standard L-19 engine (Continental Model O-470-11) would require additional modification to provide for a constant speed propeller.

Modifications to the O-470-A engine include:

- a. Mounting and adapter for Vicker's hydraulic pump (PV3915-30).
- b. Needle bearing in place of bronze bushing on camshaft drive.
- c. Wider faced gears on both crankshaft and cam drive.
- d. Torsional damping device on pump adapter to insure constant hydraulic power output.
- e. 24v - 15a generator and either a 12 or 24 volt starter.
- f. Pressure carburetor and fuel pump (standard L-19 provisions).

Delivery of the engine ready for installation can be expected by the middle of July.

Vicker's Incorporated - Previous discussions concerning the motors had indicated the possible use of Vicker's Model No. 3906-30 operating at 12,000 RPM. It now appears that provision of satisfactory units of this type cannot be made within the required time limits. The Vicker's people now recommend a 3909-15 motor which will deliver 8.5 HP at 6,000 RPM. The size of this motor exceeds the space limitations imposed by the 5 inch diameter fan hub, which required that the motor be mounted outside of the housing, driving the fan shaft by means of a set of beveled gears.

Vicker's will proceed to provide a circuit diagram specifying the component parts and include a cost estimate. They will provide all parts of the system from pump to motors with the exception of quadrant controls and the hydraulic

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WICHITA, KANSAS

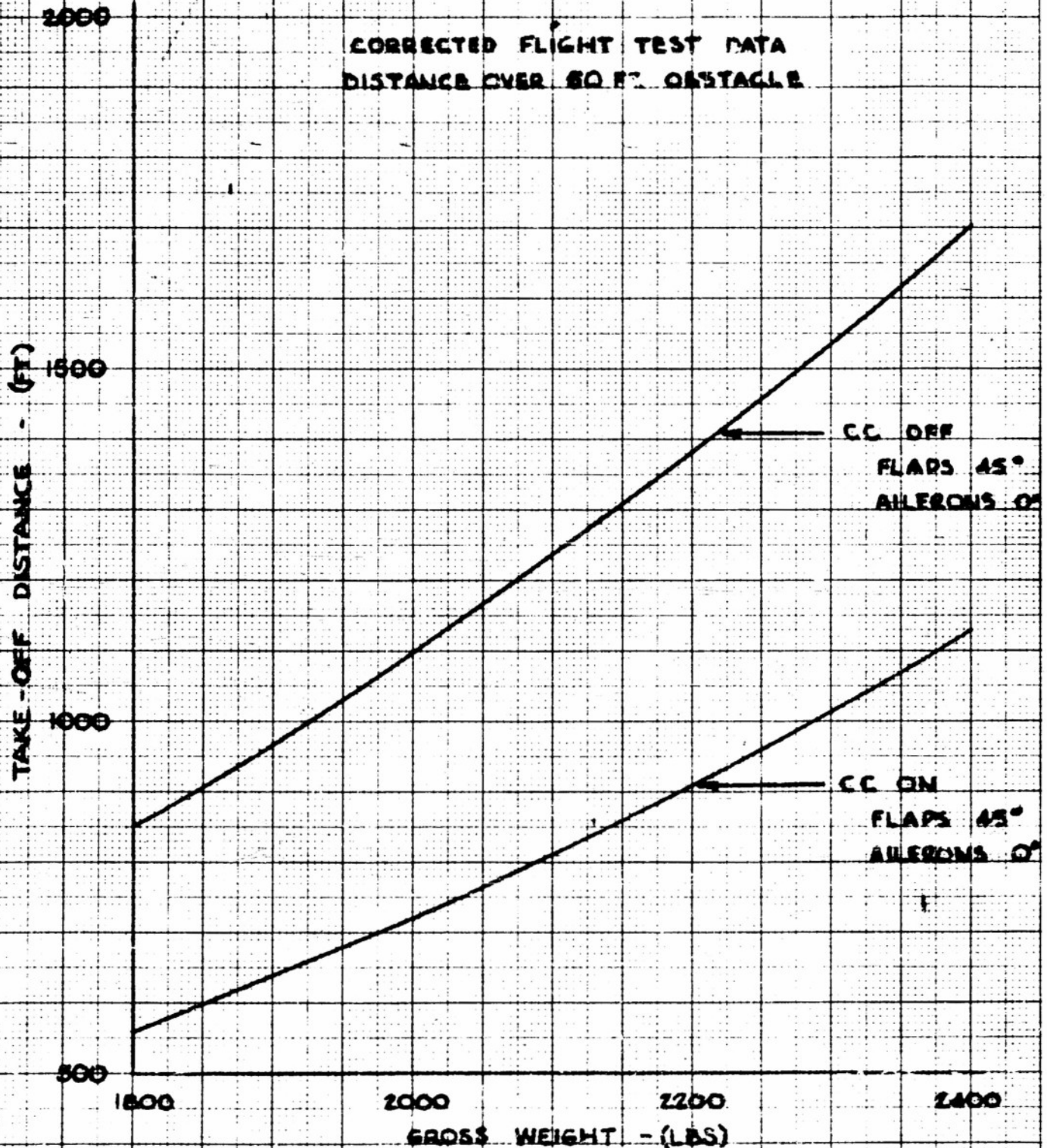
MODEL 309A-309C-319A

lines. Delivery date will be approximately July 15, 1953. In addition they recommend that a Vicker's representative be sent to Wichita to install the system and conduct initial operating tests.

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MODEL 309A
TAKE-OFF DISTANCE
VS.
GROSS WEIGHT

CORRECTED FLIGHT TEST DATA
DISTANCE OVER 50 FT. OBSTACLE

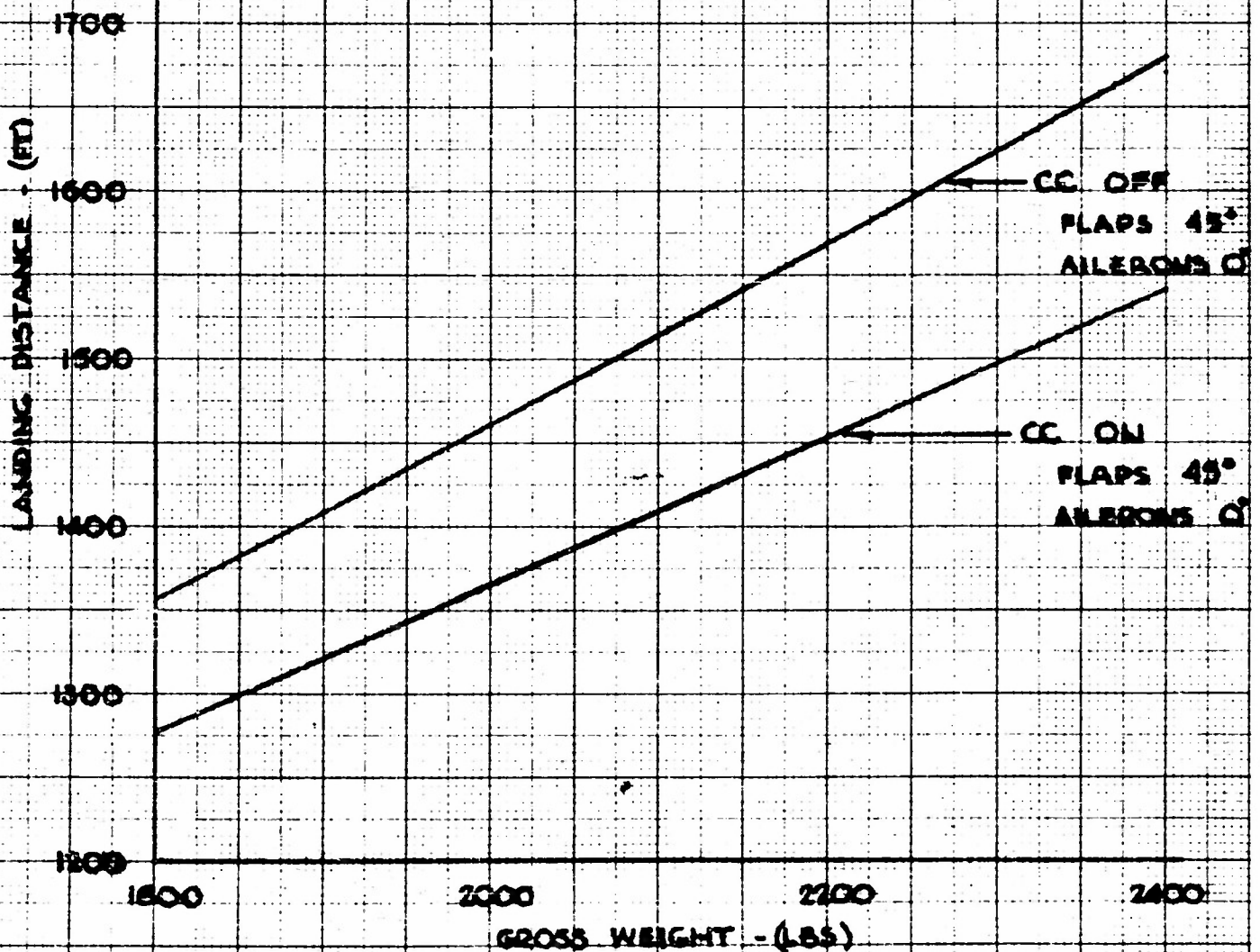


MG 6-10-53 FIGURE 1



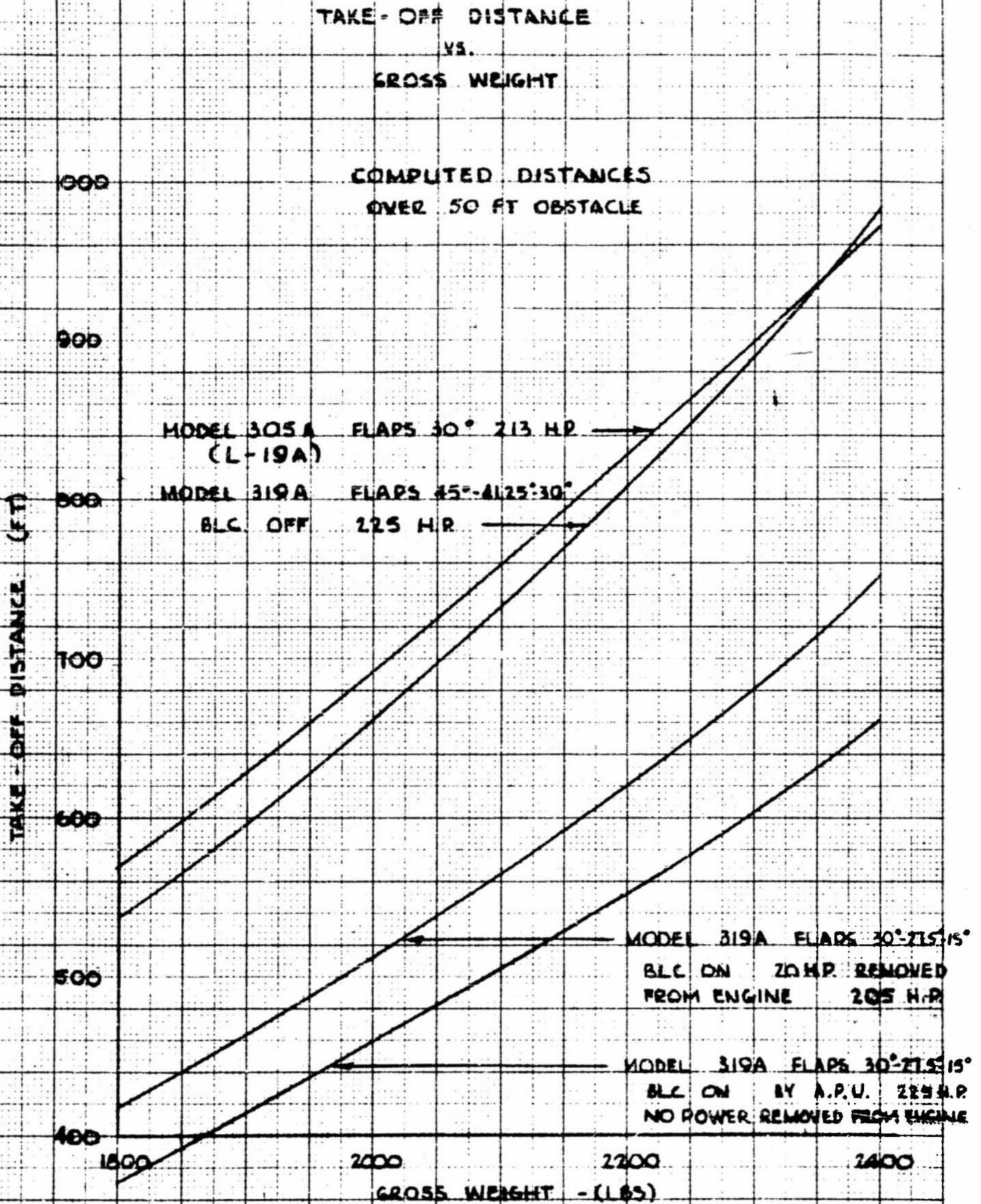
MODEL 309 A
LANDING DISTANCE
VS.
GROSS WEIGHT

CORRECTED FLIGHT TEST DATA
DISTANCE OVER 50 FT. OBSTACLE



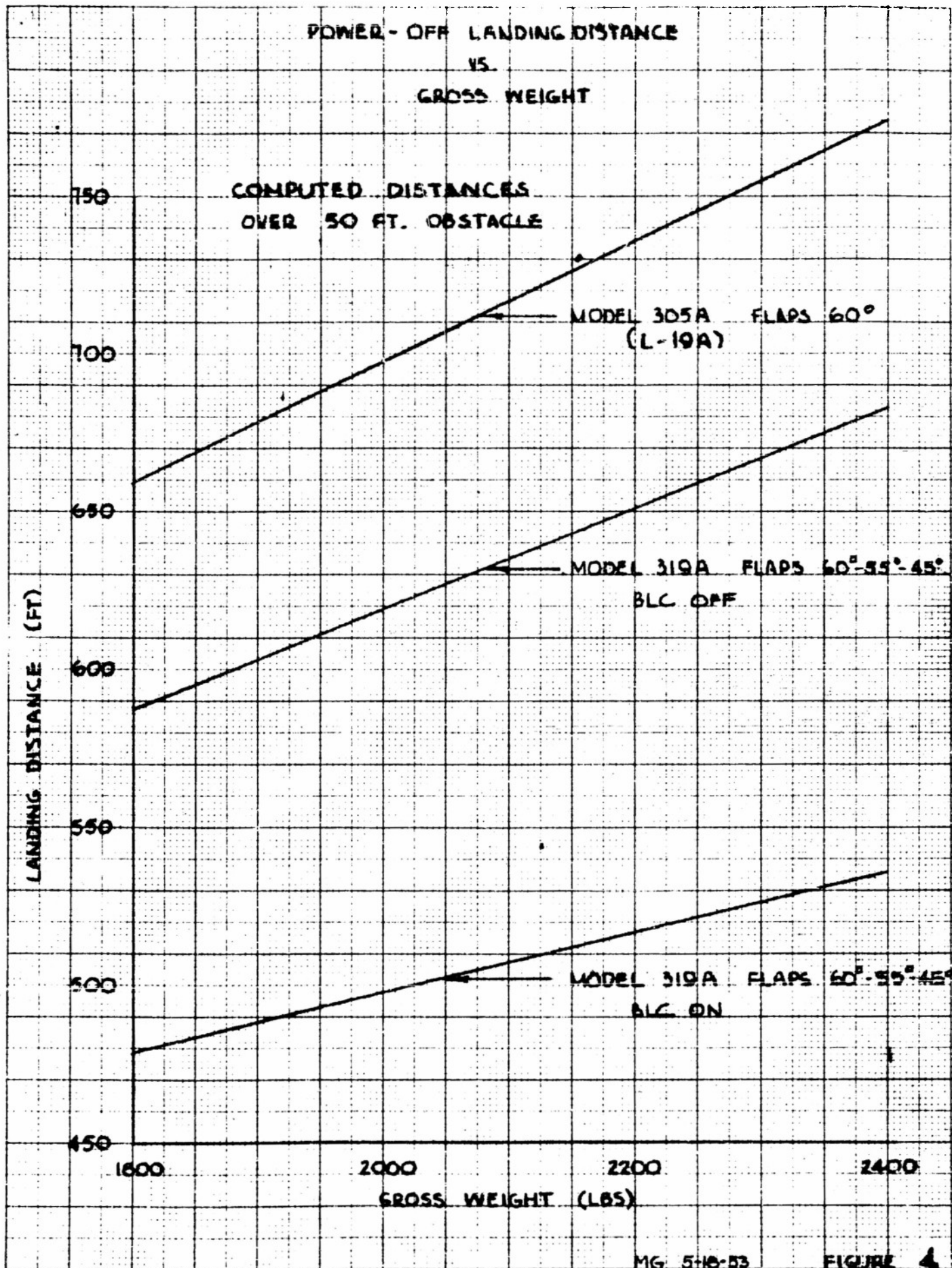
MG 640-33

FIGURE 2



MG 5-18-58

FIGURE 3



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LIST OF PERSONNEL WORKING ON HOME CONTRACTS 234(00) AND 856(00)

<u>Name</u>	<u>Title</u>	<u>Yrs. College</u>	<u>Degree</u>	<u>Engr. Yrs. Experience</u>
Alex M. Petroff	Director of Research	5	B.S. M.S. (Aero)	17
Jack W. Fisher	Section Head Engr.	7	B.S. M.S. (Aero)	4
Earl G. Blosser	Group Leader-Design	2	A.A. (Aero)	3
Robert Kenny	Engr.-Design	3	- - -	2
Isaac Garrott	Engr.-Design	2 1/2	B.S. (Aero)	4
LeRoy W. Reynolds	Engr.-Design	5	B.S. (C.E.)	3
Earl G. Cunningham	Engr.-Design	2	- - -	1/2
John Wolcott	Engr.-Design	3 1/2	- - -	2 1/2
Gerald Houk	Engr.-Design	4	B.S. (M.E.)	3 1/2
Wm. Wise	Engr.-Design	4	B.S. (C.E.)	1/2
Marvin Gertsen	Engr.-Analysis	4	A.B. (Math.)	1/2
Martin Silady	Engr.-Analysis	4	B.S. (Aero)	3

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