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NACA
YP-59A
PTR-1106

CFK/mjl

TITLE: TED No. PTR-1106 - YP-59A Airplanes - Report on Jet Wake Characteristics.

DATE: May 7 1944

Test made and reported on by Flight Test Department, U. S. Naval Air Station Patuxent River, Maryland.

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TITLE — TED No. PTR-1106 - YP-59A Airplanes - Report on Jet Wake Characteristics.

REFERENCE — (a) DuAer conf ltr Aer-E-11-JCG 001295 dated 15 January 1944.

INTRODUCTION

1. Because of the unusual characteristics of the engines installed in the subject airplanes and of the fact that no airplanes of this type have been in operational service as yet, it was necessary to conduct special preliminary tests before proceeding with the usual performance evaluation. The most important of these preliminary tests, which are outlined in reference (a), were a temperature and velocity survey of the jet wake and a determination of what special problems might be involved in parking airplanes astern of and in line with the jet exhaust. Also to be investigated were engine starting, warm up, and acceleration characteristics.

PURPOSE

1. The purpose of these tests was to investigate the items requested in reference (a) as follows:

(a) A temperature and velocity survey of the jet wake at idling thrust and at full static thrust.

(b) An estimation of how close a similar airplane can be parked astern while the YP-59A engines are started and the airplane taxied from the spot.

(c) A determination of the minimum necessary warm up time measured from instant of starting the engine until the time of reaching full thrust for take-off.

(d) A determination of the time for the acceleration of the power unit from minimum idling RPM to full thrust RPM, 1) on the ground at chocks, and 2) in flight at cruising velocity.

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METHOD OF TEST

1. The temperature and velocity survey was accomplished with ten total pressure tubes and ten adjacent chromel-alumel thermocouples spaced two inches apart and set into a steel tube. The tube was placed in a horizontal position with the pressure tubes and thermocouples centered in the jet exhaust, and secured to a support which could be moved vertically. Measurements were taken at distances behind the tail pipe of from six inches to forty feet. At each station the measuring elements were moved until the maximum reading was found.

2. The maximum temperatures on the deck were determined with a series of ten iron-constantan thermocouples secured to a flat iron bar which lay on the deck. The bar was moved until a maximum reading was obtained.

3. To determine how close an airplane can be parked behind the YP-59A, an XSB2A-1 airplane was used. It was parked six inches astern the YP-59A with its left landing gear strut in line with the longitudinal axis of the YP-59A (carrier spot). A photograph of this arrangement is given in enclosure 2. The engines of the YP-59A were started, brought up to full speed, and operated there for approximately two minutes.

4. Determination of starting time and acceleration times were obtained by timing these operations with a stop watch.

RESULTS OF TESTS

1. Curves of the maximum temperatures and velocities obtained at various distances behind the tail pipe are given in enclosure 1.

2. The maximum temperatures obtained on the deck are as follows:

176 degrees F. at 5,000 RPM, 15 feet behind tail pipe.
223 degrees F. at 16,500 RPM, 20.5 feet behind tail pipe.

The wheel fairing of the XSB2A-1 vibrated considerably, and

the tire and adjacent landing gear elements became too hot to touch. However, no deterioration of paint or rubber was apparent.

3. No engine warm up time is necessary. Full thrust is available as soon as the engines are started and brought up to speed. One engine can be started and brought up to full speed in forty seconds. The time required from the instant of engaging the starter on the first engine to the point where full RPM on both engines is attained averaged two minutes.

4. The time necessary to accelerate the engines from minimum idling RPM to full RPM is approximately three seconds on the ground at chocks and, likewise, approximately three seconds in flight at cruising velocity.

CONCLUSIONS

1. Temperatures and velocities are very high close behind the tail pipe, but decrease rapidly as the distance behind the tail pipe increases.

2. The maximum temperatures on the deck are not high enough to be of any consequence.

3. Since no warm up is required, and since full RPM is not required to taxi the ship, the conditions imposed on a ship parked astern when the YP-59A engines are started and the ship taxied away would not be as severe as those imposed on the XSB2A-1 airplane during this test. It is therefore concluded that other airplanes can be parked as closely astern YP-59A airplanes as necessary and practicable, either ashore or carrier-borne.

4. The fact that engine warm up is unnecessary is a definite asset, and the starting and accelerating times appear to be satisfactory for operational use.

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5. It can be concluded that the changes in handling technique necessary for successful carrier deck operation of this or similar airplanes will be minor, and will be necessary principally to protect personnel from the jet at close range.

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Encl.
1. HW - Curves of maximum temperature and velocity vs. distance behind tail pipe.
2. HW - Photograph PTR No. 3835.

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TITLE Model YP-59A Airplanes - Report on Preliminary Evaluation.

DATE MAR 14 1944

Test made and report on by Flight Test Department, U.S. Naval Air Station, Patuxent River, Maryland.

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TITLE: Model [redacted] airplanes - Report on Preliminary Evaluation.

REFERENCE: (a) BuAer conf ltr Aer-E-11-JGG 001295 dated 15 January 1944.

INTRODUCTION

1. This report summarizes the brief and preliminary evaluation trials thus far conducted on the two Bell YP-59A airplanes assigned the Navy.

2. The airplanes are single-seat tricycle gear low wing monoplanes, powered by two General Electric I-16 (Whittle design) jet propulsion units of approximately 1600 pounds static thrust each. See photographs appended. The fuel employed is kerosene.

PURPOSE

1. A continuing program embracing all aspects of flight testing these airplanes has been established. The purpose of the preliminary tests here reported on is to determine the principal military characteristics of this and similar jet propelled airplanes, particularly in respect to their operation as Navy fighters, either carrier or shore based.

METHOD OF TEST

1. The airplanes have been flown by five experienced pilots. Particular emphasis has been placed on the engine operating, take-off and climbs, high speed, diving, carrier landing and wave off characteristics. Stability and control forces were qualitatively determined. Measured take-off distances were obtained. No quantitative performance figures are as yet available because of the complexity of the necessary instrumentation, installation of which is now proceeding in airplane serial No. 11.

2. In all trials the airplanes were flown with full internal fuel and full armament, at a gross weight of 10,277 pounds and center of gravity of 29.9 per cent.

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DISCUSSION

1. Flying characteristics

(a) Stability

The airplanes exhibit excellent stability characteristics about the three axes. Longitudinal, directional and lateral stability are positive, and the directional stability is particularly marked.

(b) Control

Control is adequate for all flight conditions. Elevator control in particular is ample for minimum distance take-offs (see photograph Number -- 15.)

(c) Control forces

Control forces, except elevator forces, are high, and the contractor is currently undertaking remedial action.

(d) Response and maneuverability

Response of the airplane is rather poor, particularly at high speeds, because of the high aileron and rudder forces. Maneuverability is inherently good because of the low wing loading (25.7 lbs/sq.ft. as flown), but suffers by comparison with conventional airplanes because of the loss of power at low airspeeds, discussed below.

(e) Power characteristics

The thrust of the propelling units at constant altitude, temperature and RPM is nearly constant, so that the thrust horsepower available is roughly proportional to the true airspeed. This means to the military

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pilot that the airplane loses power as it slows down, so that take-off, climb and acceleration are relatively poor, while level and diving performance is relatively good. Speed for best climb is much higher than in conventional airplanes. This power characteristic affects also the usable turning radius of the airplane Power available in a slow tight turn is not sufficient to maintain minimum turning radius without rapidly losing altitude. Air temperature has a much greater effect on available power than in conventional engines, amounting to approximately .35 per cent per degree Fahrenheit.

(f) Special flight conditions

(1) Carrier approach and wave-off

The airplane will successfully make a carrier approach and take a wave-off from Vstall plus 5 knots in the landing condition, in cold weather (0°C). Because of the effect of temperature on thrust, opinion is reserved as to its ability to take a wave-off in hot weather.

(2) Take-off

Take-off power is low, but the low wing loading keeps the take-off distance within reasonable bounds. Take-off control is excellent, but because of the large tail clearance and effective elevator, it is possible to become air-borne at a speed that is too low for safety, once the airplane loses the benefit of ground effect. See photograph Number 15. During one take-off trial, the airplane stalled and "spun in" from three or four feet, for this reason. This phenomenon is possible in any tricycle gear airplane whose elevator effectiveness and center of gravity location enable high angles of attack to be reached in take-off, and which has sufficient tail-over-ground clearance to permit attaining them. It must be carefully considered in developing safe take-off technique for carrier operations, where the loss of ground effect as the plane goes over the bow will be sudden.

2. Engine operation

(a) Engine operation presents no difficulties except in starting, when poor technique can result in destructive overheating of the engines. Otherwise, operation is extremely simple and requires much less work from the pilot than does operation of conventional engines. There are no limitations on ground or air operation other than those automatically imposed by the barometric fuel pressure regulators and by the overspeed governors.

3. Ground operation

(a) Ample power is available for taxying and parking but the parking characteristics suffer from the limitations common to tricycle gear airplanes without vertical nose wheel suspension. The characteristics of the jet wakes are reported on in a Flight Test report of March 1944. The low ground clearance and wide tread give the airplane exceptional ground stability.

4. Military evaluation

(a) Jet aircraft of this general design have several marked advantages over aircraft with conventional engines. These advantages include:

(1) Good performance at high altitude and at high speed due to the power characteristics of the engines, and to their low specific weight and low drag.

(2) Inherently better aerodynamic stability than conventional propeller driven tractor airplanes.

(3) No directional difficulties, such as those found in propeller driven airplanes, attributable to propeller slip stream.

(4) Stable and economical landing gear, because there is no necessity for providing propeller ground clearance.

(5) A non-explosive and non-critical fuel such as kerosene or any clean petroleum product of reasonable viscosity characteristics can be used in place of aviation gasoline.

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(6) Pilots operation and control is notably simpler and less demanding than is the case with conventional engines.

(7) The advantages of twin-engine installations can be easily provided, without the unfavorable mass distribution and off center thrust moments in conventional airplanes. Good visibility for the pilot can readily be provided.

(b) The outstanding disadvantages of these airplanes appear to be:

(1) The high specific fuel consumption, particularly at low altitudes and airspeeds.

(2) The low power developed at slow speed.

(3) The development trouble attributable to lack of experience with the engines. It should be noted that the engines are inherently less complex than are conventional ones.

RESULTS OF TESTS

1. Take-off

(a) The following take-off check has been obtained:

Gross weight - lbs.....	10,277
S_o - ft.....	985
S_{25} - ft.....	440

The distances cited above have been corrected to 15°C for the effect of temperature on thrust. Attention is again invited to the loss in take-off thrust incident to higher temperatures.

CONCLUSIONS

1. Because of the preliminary nature of the tests herein reported on, few definite conclusions can be drawn as to the performance or military usefulness of the airplane. It appears, however, that 1) there is no inherent reason why aircraft of this type cannot be successfully employed by the Navy, either carrier or shore-based, 2) because of their fuel consumption characteristics,

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the airplanes are best suited for employment as high altitude interceptors, and are poorly suited for escort or low-altitude missions, and 3) that development troubles in the Bell airplane and General Electric power plants do not appear to be of sufficient importance to delay seriously the early military employment of the airplanes.

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Encl.
1. HW - Fifteen (15) Photographs
(Numbers 1 - 15 inclusive)

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