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INTELLIGENCE SERVICE

U. S. ARMY AIR FORCES

WASHINGTON, D. C.

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NOT TO BE TAKEN INTO THE AIR ON COMBAT MISSIONS

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FLIGHT CHARACTERISTICS OF THE

JAPANESE ZERO FIGHTER

This document records the results of performance trials of the Zero fighter in comparison with U. S. service aircraft and is supplementary to Informational Intelligence Summary No. 59.

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Trial flights have been carried out by U. S. pilots to investigate the performance and maneuverability of the Japanese Zero fighter (ZEKE) in comparison with the P-38F, P-39D-1, P-40F, P-51, F4F-4 and F4U-1.

All tests were conducted at San Diego. Comparisons with AAF fighters were carried out by representatives of Army Air Forces Proving Ground Group from Eglin Field. Navy pilots handled the trials against the F4F-4 and the F4U-1.

The Japanese aircraft used in these tests is a Type Zero Mark I, Carrier Fighter, Model 2. Descriptive details of

[redacted]

this airplane were contained in Informational Intelligence Summary No. 59, Director of Intelligence Service, Headquarters, U. S. Army Air Forces. A brief recapitulation of some of the principal features is included here to serve as background for comments of the Proving Ground test officers, and to supplement the earlier Summary.

Conclusions and recommendations are the considered opinions of the test officers and pilots who conducted the trials. These opinions are disseminated for the information of all concerned, but in no sense are they to be considered directives or operational instructions.

Appended at the end of the summary are fifteen pages of photographs showing instruments and controls in the cockpit of the Zero fighter, together with a series of views of the aircraft in flight and on the ground.

Pertinent extracts from the Proving Ground reports and Navy reports are set forth in the following pages.

EXTRACTS FROM THE REPORT OF
ARMY AIR FORCES PROVING GROUND GROUP
Eglin Field, Florida

1. CONCLUSIONS:

The Zero fighter, because of its low wing loading, has superior maneuverability to all our present service type aircraft.

It is necessary to maintain a speed of over three-hundred (300) miles per hour indicated to successfully combat this airplane.

In developing tactics against the Zero, cognizance should be taken of two facts:

1. Slow rate of roll of the Zero at high speeds.

2. Inability of the Zero engine to continue operating under negative acceleration.

The engine performance of the Zero is superior to the present service type engine without turbo superchargers. This superiority is recognizable in the fact that maximum manifold pressure can be maintained from sea level to sixteen-thousand (16,000) feet.

2. RECOMMENDATIONS:

That all pilots entering the theater of action where the Zero can be expected, be instructed in the following:

1. Never attempt to dog fight the Zero.

2. Never maneuver with the Zero at speeds below three-hundred (300) miles per hour indicated unless directly behind it.

3. Never follow a Zero in a climb at slow speeds. (Service type ships will stall out at the steep angle where the Zero has just reached its most maneuverable speed. At this point it is possible for the Zero to complete a loop putting it in a position for a rear quarter attack.

That airplanes to be used against the Zero be as light as possible and that all equipment not absolutely necessary for combat be removed.

3. OFFENSIVE AND DEFENSIVE TACTICS:

The most important features to consider in developing successful tactics against the Zero would appear to be its slow rate of roll at high speeds and the failure of its engine to run under negative acceleration.

4. AIRPLANE GENERAL:

The Zero fighter is a low wing, single engine, single seater monoplane, of all metal construction, flush riveted, with fabric covered control surfaces. The airplane is constructed entirely as one unit. Replacement of any part of the airplane structure would necessitate a depot repair job with facilities for re-riveting.

The fuselage is of semi-monocoque construction. The material used is much lighter than that used in U. S. Service type aircraft. Fuselage skin thickness is .021.

The main landing gear is hydraulic operated and retracts 90° inward to the line of flight. The tail wheel is fully retractable, but is non-lockable and non-steerable. It is held straight in the extended position by two shock chords.

Wing flaps are small but adequate. They are also hydraulically operated.

Engine cowl flaps and oil cooler flaps are manually operated.

The ailerons are very large and somewhat resemble the Fries Type.

The plane is powered with a fourteen (14) cylinder twin row radial air cooled engine estimated at 900 H.P. at sixteen-thousand (16,000) feet. Three (3) non-self-sealing gasoline tanks are provided. Two (2) wing tanks of fifty-four (54) gallons each and one (1) fuselage tank of thirty-seven (37) gallons capacity. The engine is equipped with a single stage blower and some method is employed for manifold pressure regulation, but the exact details of the system are unknown at the present time. It is equipped with a three (3) blade hydraulic constant speed propeller. Engine is equipped with a float type low pressure carburetor.

Weight of the airplane with a full military load — 5555 pounds.

5. COCKPIT:

All around visibility from the cockpit is excellent. The only restriction is in a narrow turn-over brace directly behind the pilot's head.

All flight controls are conventional. A rudder bar is used instead of individual pedals. Toe brakes are used and are hydraulically operated.

All flight and engine controls are conveniently placed around the cockpit within easy reach of the pilot. The pilot sitting normally in the cockpit can reach every control necessary to operate the airplane and fire the guns.

6. FLYING CHARACTERISTICS:

The large ailerons make the ship highly maneuverable at speeds up to three-hundred (300) miles per hour indicated. Above three-hundred (300) miles per hour indicated, it is virtually impossible to reverse a turn.

The rate of roll of the Zero is faster from right to left than from left to right.

An outstanding characteristic of the Zero is its high rate of "zoom." This "zoom" is at nearly a vertical angle and can be continued from fifteen-hundred (1500) to two-thousand (2,000) feet depending upon the starting speed. This should not be considered as indicative of the rate of climb of this airplane.

The Zero does not possess a particularly high rate of climb as indicated by the following performance figures.

PERFORMANCE FIGURES

These figures are the calibrated results obtained by the Navy after a series of trials.

Maximum speed	Sea level	270 mph.
" "	5,000 feet	287 "
" "	10,000 "	305 "
" "	*10,000 "	326 "
" "	20,000 "	321.5 "
" "	25,000 "	315 "
" "	30,000 "	306 "
Rate of Climb	Sea level	2750 ft/min.
" " "	15,000 feet	2380 "
" " "	20,000 "	1810 "
" " "	30,000 "	850 "

Service ceiling . . . . . (approx.) 38,500 feet.

* Critical altitude.

The Zero is very stable and has excellent stall characteristics.

There is no tendency for the wing to whip when a stall is reached.

A slight tail flutter was experienced at three-hundred-thirteen (313) miles per hour indicated. It has not been definitely determined if this is a weakness of the Zero type or of this one airplane.

Take-off is very rapid. The ship became airborne with little effort by the pilot.

The Zero lands from a gliding speed of eighty-five (85) miles per hour indicated; estimated landing speed fifty-five (55) miles per hour indicated. The ship is very easy to land with no tendency to ground loop.

The Navy reports the following indicated stalling speeds.

	POWER ON	POWER OFF
Landing gear retracted	74 mph.	78 mph.
Gear and flaps down	61 mph.	69 mph.

7. METHOD OF TEST:

The Zero fighter was flown against the P-51, P-38F, P-39D-1, and a P-40F.

Each of the above service type aircraft was flown with the "Zero" and comparable climbs, maneuverability, defensive and offensive tactics were determined from sea level to twenty-five-thousand (25,000) feet. The test was conducted in five-thousand (5,000) feet steps.

Take-offs were started together and each climb was started from each ship's best climbing speed. Every effort was made to eliminate the possibility of zooming when the climb was started.

Notes of the actual trials are set forth below.

8. ZERO vs P-38F:

Ships took-off in formation on a pre-arranged signal. The Zero left the ground first and was about three-hundred (300) feet in the air before the P-38 left the ground. The Zero reached five-thousand (5,000) feet about five (5) seconds ahead of the P-38F. From an indicated speed of two-hundred (200) miles per hour the P-38F accelerated away from the Zero in straight and level flight quite rapidly. The Zero was superior to the P-38F in maneuverability at speeds below three-hundred (300) miles per hour. The P-38F could out dive and out turn the Zero at this altitude at speeds above three-hundred (300) miles per hour.

The planes returned to formation and both ships reduced to their best respective climbing speeds. Upon signal the climb was started to ten-thousand (10,000) feet. Again the Zero was slightly superior in straight climbs reaching ten thousand (10,000) feet about four (4) seconds ahead of the P-38F. Comparable accelerations and turns were tried with the same results.

From ten thousand (10,000) to fifteen-thousand (15,000) feet the two airplanes were about equal. The Zero was slightly ahead, but not enough to be considered advantageous. Again comparable accelerations, speeds and maneuverability were tried with the same results.

In the climb from fifteen-thousand (15,000) feet to twenty-thousand (20,000) feet, the P-38 started gaining at about eighteen-thousand two-hundred (18,200) feet. At twenty-thousand (20,000) feet the P-38F is superior to the Zero in all maneuvers except slow speed turns.

This advantage is maintained by the P-38F at all altitudes above twenty-thousand (20,000) feet.

One maneuver in which the P-38F is superior to the Zero is a high speed reversal. It is impossible for the Zero to follow the P-38F in this maneuver at speeds above three-hundred (300) miles per hour.

The test was continued to twenty-five-thousand (25,000) and thirty-thousand (30,000) feet. Due to the superour speed and climb of the P-38 at these altitudes, it could out maneuver the Zero by using these two advantages. The Zero was still superior in slow speed turns.

9. ZERO vs P-39D-1:

Climb from sea level to five-thousand (5000) feet indicated. Take-off was accomplished in formation on signal. P-39D-1 was drawing 3000 RPM and seventy (70) inches manifold pressure. Engine started to detonate so manifold pressure was reduced to fifty-two (52) inches. P-39D-1 left the ground first and arrived at five-thousand (5,000) feet indicated just as Zero was passing four-thousand (4,000) feet indicated. Fifty-two (52) inches manifold pressure could be maintained to four-thousand five-hundred (4,500) feet indicated. At five-thousand (5,000) feet indicated from a cruising speed of two-hundred-thirty (230) miles per hour indicated the P-39D-1 had a marked acceleration away from Zero. Climb from five-thousand (5,000) feet to ten-thousand (10,000) feet at the respective best climbing speeds, (thus eliminating zoom) P-39D-1 reached ten-thousand (10,000) feet indicated approximately six (6) seconds before Zero. At ten-thousand (10,000) feet indicated, from a cruising speed of two-hundred-twenty (220) miles per hour indicated, P-39D-1 still accelerated away from Zero rapidly. Climbing from ten-thousand (10,000) feet to fifteen-thousand (15,000) feet, both airplanes maintained equal rates of climb to twelve-thousand five-hundred (12,500) feet. Above this altitude the Zero walked away from the P-39D-1. At fifteen-thousand (15,000) feet indicated, from a cruising speed of two-hundred-ten (210) miles per hour indicated, P-39D-1 accelerated away from Zero slowly.

Climb from fifteen-thousand (15,000) feet indicated to twenty-thousand (20,000) feet indicated the Zero took immediate advantage and walked away from P-39D-1. At twenty-thousand (20,000) feet indicated at a cruising speed of two-hundred (200) miles per hour indicated, and from a starting signal for acceleration, the Zero momentarily accelerated away from P-39D-1. It took P-39D-1 thirty (30) seconds to catch up and go by Zero.

Climb from twenty-thousand (20,000) feet to twenty-five thousand (25,000) feet was not completed as P-39D-1 was running low on gasoline.

Climb from sea level to twenty-five thousand (25,000) feet indicated. Take-off was accomplished in formation on signal, P-39D-1 left the ground with 3000 RPM and 55 inches manifold pressure. P-39D-1 maintained advantage of climb from take-off to fourteen-thousand eight-hundred (14,800) feet indicated. Above this altitude P-39D-1 was left behind reaching twenty-five-thousand (25,000) feet indicated approximately five (5) minutes behind Zero. At twenty-five-thousand (25,000) feet indicated from a cruising speed of one-hundred-eighty (180) miles per hour indicated Zero accelerated away from P-39D-1 for three (3) ship lengths. This lead was maintained by the Zero for one (1) minute and thirty (30) seconds and it took the P-39D-1 thirty (30) more seconds to gain a lead of one (1) ship length.

10. ZERO vs P-40F:

Tests were not completed with the P-40F because it was found impossible to obtain maximum engine operation.

11. ZERO vs P-51:

Climb from sea level to five-thousand (5,000) feet indicated. Take-off was accomplished in formation on signal. P-51 was drawing 3000 RPM and forty-three (43) inches manifold pressure. This low manifold pressure was due to the setting on the automatic manifold pressure regulator. The Zero reached its best climbing speed before the P-51 left the ground. The Zero left the ground approximately six (6) seconds before the P-51. The Zero reached five-thousand (5,000) feet indicated approximately six (6) seconds before the P-51. At five-thousand (5,000) feet indicated from a cruising speed of two-hundred-fifty (250) miles per hour indicated, P-51 accelerated sharply away from Zero.

Climb from five-thousand (5,000) to ten-thousand (10,000) and from ten-thousand (10,000) to fifteen-thousand (15,000) feet produced the same results as Zero walked away from P-51 in rate of climb. At ten-thousand (10,000) feet indicated from a cruising speed of two-hundred-fifty (250) miles per hour indicated the P-51 accelerated sharply away from Zero. At fifteen-thousand (15,000)

feet indicated from a cruising speed of two-hundred-forty (240) miles per hour indicated the P-51 accelerated away from Zero, but slightly slower than at five and ten-thousand feet.

P-51 could dive away from Zero at any time. P-51's power plant failed to operate properly above fifteen-thousand (15,000) feet so test was not continued above this altitude.

12. ZERO vs F4F-4:

The Zero is superior to the F4F-4 in speed and climb at all altitudes above 1000 feet, and is superior in service ceiling and range. Close to sea level, with the F4F-4 in neutral blower, the two planes are equal in level speed. In dive the two planes are equal with the exception that the Zero's engine cuts out in pushovers. There is no comparison between the turning circles of the two airplanes due to the relative wing loadings and resultant low stalling speed of the Zero. In view of the foregoing, the F4F-4 type in combat with the Zero is basically dependent on mutual support, internal protection, and pull-outs or turns at high speeds where minimum radius is limited by structural or physiological effects of acceleration (assuming that the allowable acceleration on the F4F is greater than that for the Zero). However advantage should be taken where possible, of the superiority of the F4F in pushovers and rolls at high speed, or any combination of the two.

13. ZERO vs F4U-1:

The Zero is far inferior to the F4U-1 in level and diving speeds at all altitudes. It is inferior in climb at sea level, and inferior above 20000 feet. Between 5000 and 19000 feet the situation varies. With slightly more than normal fighter load, which may be distributed to give equal range and gun power, the Zero is slightly superior in average maximum rate of climb. This superiority becomes negligible at altitudes where carburetor air temperatures in the F4U are down to normal; close to the blower shift points it is more marked. However, the Zero cannot stay with the F4U in high speed climbs. The superiority of the F4U at 30000 feet is very marked and will persist at considerably higher loads. Attention is called to the fact that in the foregoing condition of loading all fuel in the F4U-1 is protected. In combat with the Zero, the F4U should take full advantage of its speed, and its ability to pushover and roll at high speed if surprised. Due to its much higher wing loading, the F4U should avoid any attempt to turn with the Zero unless at high speed, and may expect the latter to outclimb him at moderate

altitudes and low airspeeds. In this case the F4U should continue to climb at high airspeeds and on headings which will open the distance and prevent the Zero from reaching a favorable position for diving attack. After reaching 19000-20000 feet the F4U will have superior performance in climb and may choose its own position for attack.