6th Part of Report No. A.&A.E.E./814.

AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT
BOSCOMBE DOWN

This report deals with the aircraft or equipment as tested. Action to remedy defects or decisions to accept items not in strict compliance with the specification are matters for decision & action by the Ministry of Aircraft Prodn.

Corsair I J.T.118
(Double Wasp R.2800-8)

Handling trials.

A.& A.E.E. ref: 4477/12 - AS.83.
M.A.P. ref: RA.5461/11/RDN3(a).
Period of tests: November, 1943.

Progress of issue of report

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1st Part of A.& A.E.E./814	J.T. 118 - Weights and loading data.
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1. Introduction.

The Corsair I is a Naval single-seater fighter powered with a Double Wasp R.2800-8 engine. It is understood that this aircraft is to be used for operational training from airfields only, owing to the poor forward view for deck landing.

Handling tests have been made covering the normal range of centre of gravity positions obtainable on the aircraft. Although carrier operation is not envisaged, comments on deck landing etc. are included, since the layout of the cockpit and aircraft is in many respects similar to that of the Corsair II, which will be used for carrier operation. The principal difference between the Corsair I and II is that the latter has a higher seating position and a modified hood and windscreen to give a better view. Handling tests of a Corsair II are at present also in progress and will be reported on separately.

2. Condition of aircraft relevant to tests.

2.1. General. The principal features of the aircraft were:-

The wing span had not been reduced on this aircraft by clipping the wing tips.
Ailerons incorporating a balance tab in each, in addition to a trimmer tab on the port aileron only.
Trimmer and balance tab on each side of the elevator.
Trimmer tab on rudder.
3 x 0.5" guns in each wing, muzzles sealed, ejection chutes open.
Aerial mast forward of cockpit. Aerial from mast to rudder and thence to side of fuselage behind the cockpit hood.
I.F.F. aerials. V.H.F. aerial under fuselage.
Three open-ended exhausts on each side of fuselage aft of cowling gills and near bottom of cowling.
Air intake for engine, intercooler, and oil cooler in leading edge of wing root on each side of the engine. Intercooler outlet below fuselage. Oil cooler outlet in wing undersurface.
Hamilton 3-blade hydromatic propeller, type 23E50-495.
Internal rear view mirror.
CO modifications fitted consisting externally of small air scoop on each side of the fuselage, and an extractor underneath.

2.2. Loading. The aircraft was flown at the following loadings:-

	Weight (lb)	Position of C.G. inches aft of horizontal reference line
(a) Short range fighter load (aft limit)	11,880	100.2
(b) Forward limit	10,340	96.3

/Loading (a)

Corrigendum to 6th Part of Report No. AAEE/814
dated 30th December 1943.

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Please amend your copy of the 6th Part of Report No. A.& A.E.E./814 as follows:-

Para. 4.21, line 13.

Delete "...... a length of elastic rubber cord attached to the front of the control column and exerting a forward force."

and insert "...... a tension spring attached to a crank in the elevator control circuit and exerting a force tending to move the control column forward".

Para. 4.23, line 15.

Delete "very".

Loading (a) was obtained when carrying full Service equipment, main fuel tank (192 gallons) full, and full oil (16.7 gallons). The short range fighter should carry only 10 gallons of oil, so that this loading was higher by about 60 lb. than the Typical Service load.

Loading (b) was the forward centre of gravity limit. This loading is normally obtained when carrying an auxiliary fuel tank with fuel used. On these tests, this loading was obtained by internal ballasting, and the overload fuel tank was not carried. The most forward centre of gravity position obtainable from loading (a) by dissipation of load is 97.8 ins. aft.

The limits of the practical centre of gravity range are from 96.3 to 100.2 inches aft of the horizontal reference line or to 101.2 inches aft including the 1% S.M.C. aft extension.

These centre of gravity positions are measured with undercarriage down. At a weight of 11,880 lbs. raising the undercarriage moves the centre of gravity aft by 1.1 inches.

3. Scope of tests.

The aircraft has been flown at each of the loadings of para. 2.2. Comments are given on the cockpit layout, and the control and flying characteristics at each loading.

4. Results of tests.

4.1. Cockpit layout.

4.11 Ease of entry and comfort:- Entry to the cockpit was from the starboard wing, a non-skid walkway being provided on the lowest part of the cranked wing. There was a handhold in the wing surface to facilitate climbing on to the walkway, and from this entry was effected via a foothold in the sloping portion of the centre section of the wing, and a further foothold and handhold in the fuselage side. The foothold in the fuselage side was badly positioned. Entry was difficult even under favourable conditions; under operational conditions, such as at sea in a high wind and with the walkway wet, entry would be extremely difficult.

The cockpit was large and spacious, allowing the pilot considerable freedom of movement; this in itself is a good feature in view of the long range of the aircraft. There was no flooring in the cockpit and because of this and the depth of the fuselage it would be impossible to retrieve in the air, anything which might be dropped inside the cockpit.

The height of the seat could be adjusted by a lever on the left of the seat. With the seat in the fully up position, a tall pilot's head was well clear of the hood. If the seat were inadvertently lowered fully, then a short pilot could not see over the side of the fuselage.

A safety harness consisting of shoulder and seat straps was fitted and was satisfactory.

A cold air control was provided above the rudder bar for ventilation and was satisfactory in operation. By opening the cockpit hood one division there was a flow of fresh air, reasonably free from draughts, throughout the cockpit. A Stewart-Warner combustion heater was fitted in the cockpit but was not tested. Without this, the cockpit was reasonably warm at heights up to 20,000 ft., the greatest height reached to date.

The sliding cockpit hood was operated by pulling a spring loaded wire at the top of the hood which released catches on each side of the hood. It could be locked in a number of positions between full open and full closed. The force required to move the hood was heavy, but it was possible to open the hood in flight at speeds up to 230 mph ASI.

4.12 View. When taxying the view was very bad because of the steep attitude assumed by the aircraft on the ground.

/The view

The view in level flight was reasonably good, though somewhat obstructed by the thick framework of the hood and windscreen. Since the cockpit was placed aft of the wing the view forward and downward was poor, but the view behind the trailing edge of the wing was good.

For landing the forward view was very poor, due to the high position of the nose during the approach. The view through the windscreen side panel, obtained by moving the head, was somewhat better though still obstructed by the width of the fuselage and engine. The width of the cockpit made it almost impossible to look round the side of the windscreen.

4.13 <u>Control layout.</u>

(a) <u>Flying controls.</u> The control column was of the vertical grip non-split type and was exceptionally long. Movement of the control column was clumsy because of its length, and as the control column was rather far forward in level flight it was difficult to exert lateral forces. With the seat in its uppermost position the hand-grip was too low for comfort. This is an undesirable feature from the point of view of landing, as the seat is then fully up to obtain the best possible view, and firm control movements are necessary.

The rudder bar was adjustable for leg length, though this was not easy to do in flight.

The controls could be locked on the ground by struts from the rudder pedals to the control column. These struts did not prevent the pilot from sitting in the seat with the controls locked.

(b) <u>Trimmer controls.</u> Trim tabs were provided on the elevators, ailerons, and rudder. The three trimmer controls were conveniently grouped together on the port side of the cockpit slightly below the level of the pilot's waist, and operated in the correct sense. The elevator trimmer wheel was mounted with its axis horizontal, the aileron trimmer wheel with its axis 45° aft of the vertical, and the rudder trimmer wheel with its axis vertical. It was easy to confuse the rudder and aileron trimmers, though this is no doubt a matter of practice. Luminous indicators were provided on each trimmer control.

(c) <u>Flaps and undercarriage.</u> The flap control lever projected laterally from the port side of the cockpit and moved vertically over a graduated toothed quadrant, it being possible to select any intermediate flap position.

The undercarriage control lever was mounted on the port side of the cockpit below the instrument panel and moved vertically in a quadrant. To operate, the spring loaded knob on the end was pulled out and the lever was then free to move. The lever was placed too far forward and too low to be easily operated, the pilot could not reach it without first releasing the safety harness; in addition a short pilot had also to lower the seat. This feature is very undesirable.

With the rudder bar in the aftmost position there was a grave danger of the pilot's left foot fouling the lever whilst taxying, releasing the lock, and inadvertently retracting the undercarriage. The main wheels could be lowered separately to form a dive brake. The control for this was within easy reach of the pilot, on the left of the instrument panel.

(d) <u>Brakes.</u> Toe operated brake pedals were mounted on the rudder bar, following customary American practice, and it was not easy to apply the brakes evenly, though this is probably a matter of practice. No method of locking the brakes when parking the aircraft was provided.

(e) <u>Engine and associated controls.</u> The engine and propeller controls were grouped on the port side of the cockpit forward of the trimmer controls. The throttle, mixture, and supercharger controls were smooth in operation; no friction adjustment was provided, but on this particular aircraft the controls showed no tendency to slip. The constant speed propeller control moved vertically in the rear of the throttle box, and was fitted with a rotating wheel for fine adjustment. This fine adjustment was very helpful, as only small control movements were required for large variations of rpm.

/A fuel

A fuel tank selector cock was mounted on the port side forward of the elevator trimmer wheel, the various positions being clearly marked on a horizontal plate below the handle.

The control levers for the engine cowling gills, intercooler, and oil cooler shutters were located on the starboard side of the cockpit within easy reach of the pilot. The switch panel on the starboard side containing the fuel primer and engine starter switches was partly obscured by radio equipment and operation of these switches was very awkward.

4.14 Instrument layout. The instrument layout was generally satisfactory, all instruments and indicators being plainly marked and easily read.

4.15 Emergency exit. For emergency jettisoning of the hood two handles were provided, one on each side of the hood, the handles being held in position by safety pins to prevent inadvertent release of the hood. To jettison the hood it was first necessary to extract the safety pins, and then pull both handles inwards and forwards. The hood could then be pushed free of the aircraft. This method of releasing the hood is most unsatisfactory, as it requires the use of both hands, is complicated, and the removal of the safety-pins in an emergency is most impracticable. With the hood jettisoned, escape should be satisfactory.

An escape panel was provided on the starboard side of the cockpit for exit in the event of the aircraft overturning on landing and the hood becoming jammed. It could be released by operating the release lever mounted in the centre of the panel and pushing it out. The space should then be adequate for the pilot, less parachute, to escape.

4.2. Ground handling and flying qualities at loading (a).

4.2 1. Taxying. Taxying was not easy as the aircraft displayed a strong tendency to swing from its path. The design of the tail wheel was such that any side load on the wheel caused it to turn at right angles to the longitudinal axis of the aircraft. In view of this and the lack of view forward, it was found most convenient to lock the tailwheel and to taxy along a zig-zag path. This procedure was rather tiring, but advisable, especially when taxying across wind. Taxying into position on a flight deck would be rendered very dangerous and difficult by this type of tail wheel. As mentioned in para. 4.13(d) it was not easy to apply the brakes evenly.

The view was extremely bad owing to the steep attitude of the aircraft and the excessive width of the nose. When taxying the control column was awkward and heavy to hold back because of the high position of the seat relative to the hand grip and a length of elastic rubber cord attached to the front of the control column and exerting a forward force.

4.2 2. Take-off. The best trimmer settings for take-off were 1 division nose up on elevator, 6 divisions right on rudder, and 6 divisions right on ailerons. Using no flap the aircraft accelerated rapidly and took-off after a run of moderate length. The aircraft showed a slight tendency to swing to the left, but this could be easily checked by use of rudder. The tail rose after about half the run had been completed, a moderate force being required on the control column. When taking-off from a rough airfield the aircraft pitched rather violently, being thrown into the air before flying speed had been attained. This was rather uncomfortable, but not dangerous.

There was no noticeable change of trim on retracting the undercarriage. Control on the climb away was good, though the rate of climb was rather poor.

4.2 3 Controls and general flying. At low speeds the elevator was light, becoming progressively heavier with increase of speed; this heaviness was particularly noticeable both during an out of trim dive and on recovery from a trimmed dive. The elevator was effective at all speeds.

The rudder was heavier to the left than to the right at low speeds with engine on and a reasonable amount of control remained down to the stall. At high speeds (up to 350 mph ASI) the rudder was heavy but effective. At moderate and high speeds the rudder forces were almost equal to right and left.

/At speeds

At speeds up to 250 mph ASI the ailerons were light and effective, a full roll at this speed taking six seconds to complete at 10,000 ft. It was found possible to apply full aileron at 350 mph ASI, but when applying right bank at this speed the stick force suddenly lightened after about three-quarters travel, indicating that a tendency to overbalance was present. During the approach to land at low speed the ailerons were light and lacked feel, though they were still very effective.

There was no tendency for tight turns to tighten automatically. A fairly heavy pull force was required to maintain a turn.

4.24. Stability.

(a) Longitudinal. From the general handling characteristics the longitudinal stability appeared satisfactory. Steady flight could be maintained without excessive concentration on the controls.

When trimmed longitudinally on the climb at 160 mph ASI a longitudinal disturbance followed by release of the control column caused the aircraft to take up an undamped phugoid motion between 140 mph ASI and 172 mph ASI.

In level flight at 165 mph ASI (1700 rpm. 27 ins. Hg) a similar test resulted in an undamped oscillation between 140 and 198 mph ASI.

After a similar disturbance when trimmed for all-out level flight, the aircraft returned to level flight after four oscillations.

On a trimmed glide with flaps and undercarriage up, at 120 mph ASI, the aircraft diverged upwards to the stall after a longitudinal disturbance followed by release of the control column.

(b) Lateral and directional. The aircraft displayed very good directional stability characteristics throughout the entire speed range. If the rudder was displaced and then released the aircraft returned to its original flight path after two or three oscillations. It was possible to hold a reasonable sideslip in either direction.

When displaced laterally from its trimmed condition and the control column released, the aircraft returned to laterally level flight.

4.25. Stalling characteristics.

Stalling speed. Flaps and u/c up		100 mph ASI
" " " " " down.	Engine off	86 mph ASI
	Engine on	75 mph ASI

Flaps and undercarriage up.

The stick force required to stall the aircraft with cooling gills closed when trimmed on the glide at 1.2 times stalling speed was very light.

The stall occurred with the control column about a quarter of its travel back from the central position.

As the aircraft approached the stall there was some slight elevator buffet. At the stall the nose and right wing dropped sharply, and there was some noise due to the flow round the cockpit hood breaking down. It was impossible to hold up the wing by applying aileron.

Recovery was immediate on easing the control column forward.

Flaps and undercarriage down.

Engine off. The stalling characteristics with cooling gills closed were in general similar to those with flaps and undercarriage up, with the exception that the right wing dropped slightly before the nose.

Very little warning of the stall was given, the nose and right wing dropping suddenly and sharply.

As before recovery was immediate on easing the control column forward.

/Engine on.

Flaps and undercarriage down.

Engine on. At 2300 rpm, 19" HG, and with the engine cowling gills 1/3rd open the aircraft stalled at 75 mph ASI.

At the stall the left wing dropped and the ailerons became completely ineffective, while there was a tendency for the control column to come fully back automatically.

In this condition, the aircraft contrôls were very light and ineffective and it appeared that the aircraft would spin if the control was held back.

Recovery from the stall was straightforward on easing the control column forward.

4.26. Dives.

(a) Unbraked. The aircraft was dived to 430 mph ASI, being trimmed into the dive. As speed increased in the dive progressively less trimming was required after a large initial change of trim upon entering the dive. In the dive the aircraft displayed stable characteristics about all axes, and was very steady, though it was very sensitive to rudder trim. In was observed during the dive that the fabric on the outer wing panels bulged outwards somewhat alarmingly, whilst that on the flaps was pressed in. A considerable pull force was required to recover from the dive.

A fairly heavy push force was required to hold the aircraft in a dive up to 400 mph ASI when trimmed for level flight. The aircraft recovered normally on releasing the control column, and showed no tendency to build up excessive accelerations during recovery.

(b) Braked. The aircraft was dived to 325 mph ASI with the dive brakes extended. Extension of the dive brakes took about ten seconds and caused a considerable nose down change of trim. The aircraft was dived at about 60° and was very steady in the dive. Practice would be required to achieve accuracy in bombing with this type of aircraft because of the extremely heavy stick forces required to adjust the flight path.

4.27. Approach and landing. Lowering the undercarriage produced a nose down change of trim, but there was no further change of trim when the flaps were fully lowered. With engine on, the approach to land at 100 mph ASI was straightforward and easy, though the forward view was very poor.

For a deck-landing approach at 90 mph ASI the nose of the aircraft was high; there was an adequate amount of control available provided no large adjustments to the flight path were required. Response to throttle movements on the approach was sluggish and as a result there was a tendency for the pilot to make larger throttle movements than were actually required.

When the aircraft touched down on an airfield, there was a series of loud bangs from the rear end of the fuselage. The cause of this was not established, but it may have been due to the arrestor hook hitting the fuselage as the tail oleo moved. Even with the tail wheel locked, the aircraft showed a tendency to swing on landing and this had to be corrected by coarse use of the brakes and rudder. Because of this swinging tendency a cross wind landing on a runway might be difficult.

4.28. Baulked landings. Baulked landings were comparatively easy, as there was plenty of power available, the aircraft climbing away quite well. The flap hydraulic system on this type of aircraft incorporated a relief valve which was so arranged that with engine power increased to 2500 rpm and 25" Hg, pressure was

/released when

released when speed exceeded 115 mph ASI and the flaps were blown up to the retracted position. This flap retraction caused no noticeable change of trim. Retraction of the undercarriage during the climb away was awkward (see para.4.13 (c)) owing to the high position of the seat relative to the undercarriage lever.

4.3. Flying qualities at loading (b). The flying qualities at this loading were generally similar to those at loading (a), with the following exceptions:-

The longitudinal stability characteristics showed a general improvement over those displayed at loading (a), the aircraft performing a slow damped oscillation of small amplitude after a longitudinal disturbance followed by release of the control column under all conditions of flight.

The control forces to cause a change of speed were heavier. In particular the force required to hold the aircraft in the dive when trimmed for level flight was heavy, and it was not possible to hold this force at the maximum speed reached of 450 mph ASI.

5. Conclusions.

The layout of the cockpit is unsatisfactory in the following respects:-

(a) The control column is long and clumsy.

(b) The undercarriage operating lever is placed too far forward, and too low.

(c) The installation of a radio panel over the starboard switchbox renders access to the starter switch very difficult.

(d) The hood operation is not easy.

(e) The cockpit hood jettison device is much too complicated for operation in an emergency.

(f) Entry to the cockpit is most awkward, and would be improved by the provision of a retractable ladder below the fuselage and further handholds in the fuselage side.

The ground handling qualities of the aircraft are bad, due chiefly to the design of tail wheel employed. This directional instability when taxying would be dangerous on the flight deck of an aircraft carrier, especially since the ground view is very poor.

The view for landing is very bad due to the wide nose, the steep attitude when landing and to the thick framework of the windscreen and cockpit hood; it is not acceptable for a deck landing aircraft.

On the whole the flying qualities of the aircraft are good, though the stall with cooling gills closed is rather sudden and violent with very little or no warning given of its approach.

The elevator control is heavy, particularly when the centre of gravity is in a forward position and some lightening of the control is desirable.

6. Further developments.

Tests are being made on a Corsair II aircraft to assess the improvements in view made by the redesign of the cockpit hood and windscreen and any other changes, and will be reported at a future date.

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