**AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT**

**DOUBLE DECK**

**Corrair F Mk.IV KD.227**

21 APR. 1945

Level speed trials with and without water injection.

A.A.E.E. ref: 5703.a/3/11/H.
M.A.F. ref: Res. 11. 546/11/A.CREN
Period of tests: 12th - 16th December, 1944.

<table>
<thead>
<tr>
<th>Report No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st part of A.A.E.E. 644.c</td>
<td>KD.227 - Carbon monoxide contamination tests</td>
</tr>
</tbody>
</table>

**Summary.**

The Corrair F Mk.IV differs from Corrair F Mk.II in the following respects:

(a) The use of water injection.
(b) U.S. Navy glossy blue finish in place of the Standard British camouflage.
(c) Different propeller including a change in diameter from 13' 3" to 13' 1".

In auxiliary high supercharger gear, the increase of boost from 52.5 ins. Hg to 60 in. Hg. allowed by the use of water injection, was found to give an increase of speed of 20 mph T.S. at all heights up to 18,400 ft., the full throttle height at 60 ins. Hg boost. The maximum true airspeed attained was 400 mph (347 knots) at 18,400 ft.

**Introduction.**

The Corrair IV differs from Corrair II, on which performance measurements have previously been made at this Establishment, by:

(a) The use of water injection, allowing increased boost pressure and hence greater power.
(b) U.S. Navy glossy blue finish, instead of standard British camouflage.
(c) A different propeller including a change in diameter from 13' 3" to 13' 1".

Level speed performance measurements were made on this aircraft primarily to determine the effect of water injection and secondly to establish the level speed performance of this variant. The results of the tests are given in this part of the report, together with those of the static position error determination used in the analysis of the results.

Preliminary results have been forwarded to M.A.F. in a letter dated January 9th, 1945.

It should be noted that no correction for pitot error has been applied, since the aircraft crashed before this could be determined. It is, however, intended to determine the pitot error on a replacement aircraft, which will shortly arrive at this station. The results of this determination and its effects on the level speeds quoted here, will be the subject of an addendum to this report.

**Condition of aircraft relevant to tests.**

2.1 General. The aircraft was a production Mk.IV Corrair fighter, built by the Goodyear Corporation and powered by a Pratt and Whitney Double Wasp engine (see para. 2.4).
The main features of the aircraft were:

Hamilton 3-bladed Hydraulic propeller of paddle-blade design (see par. 2.2)
Three exhausts on each side of cowling base.
Oil cooler and intercooler intakes at leading edge of port and starboard wing roots.
Armament - 6 x 0.5 ins. Mk. II Browning guns, 3 in each wing, gun ports and
ejection chutes sealed.
Aerial mast on nose, midway between cockpit and engine cowling. The W/T
aerial ran to a short mast on top of the rudder, with a lead-in to the
starboard side of the fuselage about 2 feet behind the cockpit hood.
Rod aerial on top of fuselage approximately 3/4 distance from hood to tail.
Two short rod aerials underneath fuselage, one at leading edge, and one 3 ft.
further back.
Deck arrestor hook under tail.
Details of the airspeed indicator system are given in par. 2.3 and fig. 1.

The following table gives the principle differences between this aircraft and
the Corsair II, the Mark previously tested at this station.

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Propellers</th>
<th>Blade Dia.</th>
<th>Blade No.</th>
<th>Surface Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corsair IV and KD 227</td>
<td>13 1/2&quot;</td>
<td>6444A - D</td>
<td>U.S. Navy Glossy blue finish</td>
<td></td>
</tr>
<tr>
<td>Corsair II and JT 259</td>
<td>13 3/4&quot;</td>
<td>6443A - 21</td>
<td>Standard British camouflage</td>
<td></td>
</tr>
</tbody>
</table>

Care was taken throughout the tests to maintain the high polish of the wings
and to remove any dirt which might accumulate, no uneveness or distortion of the
leading edge or surfaces of the wings was perceptible. As usual, however, with
Corsair aircraft, the edges of the inspection panels were bevelled and consequently
a small groove surrounded each panel.

2.2 Propeller details. Main details were:

<table>
<thead>
<tr>
<th>Hamilton Hydraulic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter: 13 1/2&quot;</td>
</tr>
<tr>
<td>No. of blades: 3</td>
</tr>
<tr>
<td>Direction of rotation: Right hand</td>
</tr>
<tr>
<td>Hub serial No.: 66685</td>
</tr>
<tr>
<td>Blade No. 1 serial No.: 24,5762</td>
</tr>
<tr>
<td>Construction: Hollow steel</td>
</tr>
</tbody>
</table>

2.3 Airspeed indicator system. The pitot and static sides of the airspeed
indicator were connected to a Kollsman pressure head, type AN-5816-2, which was
mounted on the leading edge of the port wing tip (see Fig. 1).

2.4 Engine numbers and limitations. The aircraft was powered by a Pratt and
Whitney engine R2800-39 (Makers No. HP-20616).

The relevant engine limitations applicable to auxiliary high supercharger gear
at the time of test were:

<table>
<thead>
<tr>
<th>RPM</th>
<th>Manifold pressure in. of Hg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max, for level flight at combat power: 2700</td>
<td>54.5 without water injection</td>
</tr>
<tr>
<td>2700</td>
<td>60 with do.</td>
</tr>
</tbody>
</table>

2.5 Loading. The take-off weight for these trials was 12,080 lb. (no ex-
ternal load carried), and the c.g. was 100.2 in. aft of the axis of reference.
3. Scope of tests.

3.1 Position error. The static position error was measured by the aneroid method in level flight, with flaps and undercarriage up over a speed range of 120 mph ASI to 320 mph ASI.

These tests were undertaken for use in the reduction of the level speed results.

3.2 Level speed. Level speeds were measured with engine cowling gills, intercooler shutter and oil cooler shutter closed at heights between 10,000 and 24,000 ft., in auxiliary high supercharger gear, both with and without water injection.

4. Results of tests.

The results have been corrected to standard atmospheric conditions by the methods of A.S.A.E.E./Res/170.

Both level speed and position error correction results have been corrected to 11,500 lb. (95% of take-off weight). The compressibility correction has been determined by the method of Report No. A.S.A.E.E./Res/208.

4.1 Position error. The static position error correction varied from +1 mph at 120 mph ASI to +9.7 mph at 320 mph ASI. Full details are given in Fig. 2.

Correction curves for the altimeter when connected to the static side of the airspeed indicator system are given in Fig. 3.

4.2 Level speed. Results of the level speed tests are given in Table I and Fig. 4.

The maximum true airspeeds attained were:

- With water injection: 400 mph (34.7 knots) at 18,400 ft.
- Without water injection: 395 mph (34.3 knots) at 22,500 ft.

At all heights up to 18,400 ft., an increase of speed of 20 mph (17.4 knots) TAS was obtained by the use of the increased boost with water injection.

4.3 Propeller tip Mach number. The highest propeller tip Mach numbers obtained were:

<table>
<thead>
<tr>
<th>Height</th>
<th>Mach No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,400</td>
<td>1.04</td>
<td>FTH with water injection</td>
</tr>
<tr>
<td>22,500</td>
<td>1.06</td>
<td>FTH without water injection</td>
</tr>
<tr>
<td>24,000</td>
<td>1.06</td>
<td>Highest altitude reached</td>
</tr>
</tbody>
</table>

As the aircraft crashed, it was not possible to investigate the effect of decreasing rpm (and hence Mach number) on the level speed performance.

The differences in temperature from ICAN standard values were within the ranges given below:

- 10,000 ft. to 15,000 ft.: -2 to +1 °C
- 15,000 ft. to 20,000 ft.: -7 to +0.5 °C
- 20,000 ft. to 24,000 ft.: -6 to -3 °C

5. Comparison with previous results.

The following table gives a comparison of the performance of this aircraft with that of Corsair II Jt. 417, reported in the 12th Part of Report No. A.S.A.E.E./5146.

/ Table.
<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Max. speed without water injection (knots)</th>
<th>Height ft</th>
<th>95% take-off weight lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corsair II</td>
<td>393 (341)</td>
<td>23,400</td>
<td>11,290</td>
</tr>
<tr>
<td>JT.417</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corsair IV</td>
<td>395 (343)</td>
<td>22,500</td>
<td>11,500</td>
</tr>
<tr>
<td>KL.227</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*2700 rpm, 52.5 in. Hg. manifold pressure.

This comparison is intended merely to demonstrate the approximate agreement in level speed performance between the two variants.

**TABLE I.**

Level speed performances.
Corrected to 95% of the take-off weight - viz. to 11,500 lb.
Engine cowling gills, intercooler shutter, and oil cooler shutter closed.

<table>
<thead>
<tr>
<th>Standard height ft.</th>
<th>TAS in knots (mph)</th>
<th>ASI in knots (mph)</th>
<th>Corrections</th>
<th>Manifold pressure in or off. Hg.</th>
<th>RPM</th>
<th>S/c gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>349 (305)</td>
<td>300 (261)</td>
<td>9.0 -3.2</td>
<td>52.5</td>
<td>2700</td>
<td></td>
</tr>
<tr>
<td>12,000</td>
<td>356 (309)</td>
<td>296 (257)</td>
<td>9.0 -3.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14,000</td>
<td>363 (315)</td>
<td>293 (255)</td>
<td>8.9 -4.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16,000</td>
<td>371 (322)</td>
<td>289 (251)</td>
<td>8.8 -4.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18,000</td>
<td>378 (328)</td>
<td>285 (248)</td>
<td>8.7 -5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20,000</td>
<td>383 (334)</td>
<td>281 (244)</td>
<td>8.6 -5.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22,000</td>
<td>389 (341)</td>
<td>277 (241)</td>
<td>8.5 -6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24,000</td>
<td>395 (343)</td>
<td>273 (237)</td>
<td>8.4 -6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26,000</td>
<td>393 (341)</td>
<td>260 (233)</td>
<td>8.2 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28,000</td>
<td>398 (345)</td>
<td>256 (229)</td>
<td>8.0 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30,000</td>
<td>405 (350)</td>
<td>252 (225)</td>
<td>7.8 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32,000</td>
<td>410 (355)</td>
<td>248 (221)</td>
<td>7.6 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34,000</td>
<td>415 (360)</td>
<td>244 (217)</td>
<td>7.4 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36,000</td>
<td>420 (365)</td>
<td>240 (213)</td>
<td>7.2 -6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Pull throttle heights.*

**Circulation List.**

- C.R.D.
- D.T.D.
- D.R.T.
- D.R.T.
- A.D.R.T.
- A.D.R.T.
- C.E. (T.R.)
- D.R.E.
- R.T.E.
- R.T.E.
- A.D.R.E.1
- A.D.R.E.5
- R.T.E./T.R.
- A.D.R.E.N.A.

- A.D.R.D.N. 3 copies (1 for action)
- C.N.R.
- D.C.N.R.
- R.D.N.3.
- R.D.N.
- R.D.E.7(4)
- A.F.E.E.
- T.F.2
- Chief Overseer
- C.I. Accidents
- R.T.E. Accidents
- D.P.A.
- D.P.C.A. 3 copies
- A.I.C.2(7)
- A.I.S.
- O.C. Handling Squ.1
- R.T.P. (T.E.B) 6 copies + 1
- R.T.P.2a, 50 copies
- R.T.C. Blackburns 2 copies.
FIG. 1

PRESSURE HEAD POSITION
(L.E. WING)

DETAIL OF APERTURE

<table>
<thead>
<tr>
<th>Type of Pressure Head</th>
<th>Kollsman AN-58612 24V MFR5 Part No. 3690-012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio of Aperture of Tube to External Dia. of Static Tube</td>
<td>See Sketch</td>
</tr>
<tr>
<td>Incidence of Main Plane (Adjacent to Pressure Head)</td>
<td>+2°.05</td>
</tr>
<tr>
<td>Angle of Head to Chord of Main Plane</td>
<td>-5°.45</td>
</tr>
<tr>
<td>Nose of Head to Main Plane (Minimum Distance)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Supporting Strut</td>
</tr>
<tr>
<td>Z</td>
<td>Chord Line</td>
</tr>
<tr>
<td>X</td>
<td>M.P. Leading Edge (Parallel to Chord)</td>
</tr>
<tr>
<td>C</td>
<td>Length of Chord at Section</td>
</tr>
<tr>
<td>E</td>
<td>Strut to Vents (Mean)</td>
</tr>
<tr>
<td>M</td>
<td>Major Axis of Strut</td>
</tr>
<tr>
<td>N</td>
<td>Minor</td>
</tr>
<tr>
<td>Y</td>
<td>Distance from Plane of Symmetry</td>
</tr>
</tbody>
</table>

Position | Leading Edge Port Main Plane |
Semi Span | 20'-2" |
Ratio of Thickness to Chord of Aerfoil Section, Adjacent to Pressure Head | 55% |
POSITION ERROR CORRECTION
(CORRECTED TO 11,000 LBS. VIZ 95% TAKE-OFF WEIGHT)

MPH

KNOTS

ASL

240

220

200

180

160

140

120

100

MPH

KNOTS

-4

0

4

PEC

8

12

FIG 2
ALTIMETER CORRECTION.

CORRECTED TO 11,500LB. VIZ. 95% OF TAKE-OFF WEIGHT.
LEVEL SPEED PERFORMANCE.
IN AUXILIARY HIGH SUPERCHARGER GEAR
(WITH AND WITHOUT WATER INJECTION)

ENGINE, COWLING GILLS ~ INTERCOOLER SHUTTER & OIL COOLER SHUTTER CLOSED.

CORRECTED TO 95% TAKE-OFF WEIGHT VIZ ~ 11500 LB.

FIG. 4.