

Side view of the Me 109F. Compared with the 109E it has a smaller diameter airscrew, a larger spinner, a slightly smaller rudder and a cantilever tailplane.

THROUGH BRITISH EYES

A Critical Examination of the Original Messerschmitt Me 109E, the Changes Incorporated in the 109F, and Some Handling and Performance Tests

REPORTS of new German fighters notwithstanding, the Messerschmitt Me 109 is still Germany's mainstay in the single-engined fighter class. The original Me 109E was fully described and illustrated in *Flight* of October 24th, 1940. Since then modified versions have appeared, to which we have referred, and pictures of which we have published from time to time. By the courtesy of Lt. Col. Moore-Brabazon, Minister of Aircraft Production, it has now become possible to publish an even more critical and detailed examination of the original machine, an outline of the main respects in which the newer model, the Me 109F, differs from the original, and to give some results of handling and performance tests.

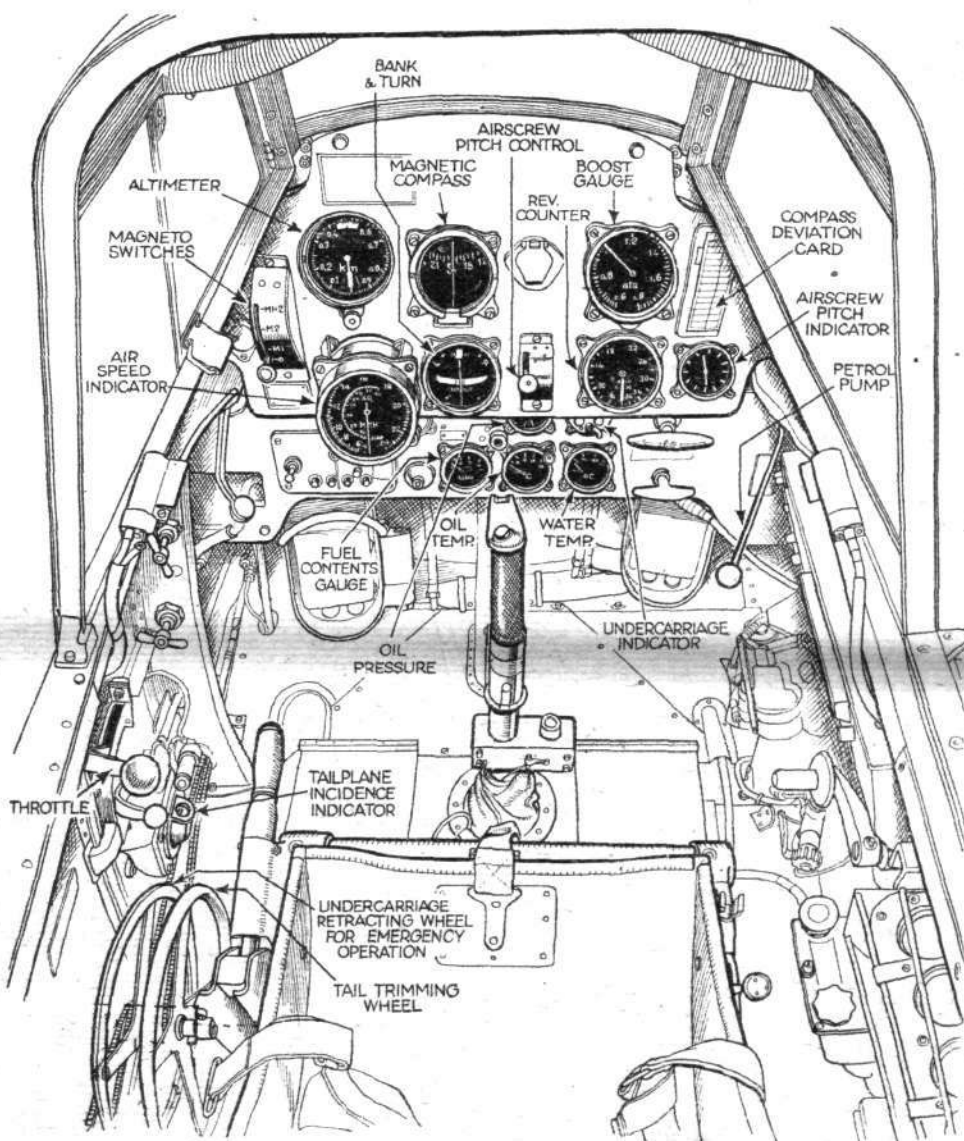
We feel sure that many of our readers, and more particularly those in the aircraft industry and in the Royal Air Force who have had no opportunity to see the Messerschmitt fighter, will welcome this authoritative evaluation of the merits and demerits of the design, its handling characteristics as ascertained by British pilots, and the features which have caused the later version to be such an improvement on the original in many respects.

Handling Characteristics

General.—The Me 109 is a modern stressed-skin low-wing monoplane, powered by a Daimler-Benz DB 601 1,150 h.p. inverted V-12 liquid-cooled engine. The following notes on handling characteristics apply only to the Me 109E, no flying experience having

yet been obtained on the more recent version of the Me 109F.

The general conclusion on this aircraft is that, although



This copyright *Flight* sketch shows the layout of the original Me 109E cockpit. The cramped position of the pilot is referred to in this article.

THROUGH BRITISH EYES

it handles well and has excellent response to the controls at low speeds, all the controls become far too heavy at speeds in excess of 300 m.p.h., the ailerons in particular being virtually solid at 400 m.p.h. This restricts manoeuvrability. Turning circle is also poor, being, for example, 885ft. at 1,200ft., due to the high wing-loading. Wing-loading on the Me 109 is 32 lb./sq. ft. These disadvantages greatly detract from the fighting qualities, but are to some extent offset by:—

Good performance at altitude, the machine having an absolute ceiling of 37,500ft.

Excellent rate of climb; this is developed at low air-speed, hence the angle of climbing is very good.

The direct-injection engine does not cut out or splutter under negative "g" as when diving suddenly to seek shelter in cloud.

The stall is very gentle even under "g," with no tendency to spinning, and ample warning of the approach of the stall is provided by the aileron vibration and buffeting which sets in as the stall is approached. Owing to high wing-loading, however, stall occurs at quite high airspeeds.

Outstanding points in relation to handling are detailed below:—

Take-off.—Flaps are lowered 20 deg. for take-off, the run being remarkably short, the initial rate of climb excellent.

Landing.—Landing is somewhat tricky until the correct technique is acquired, since the aircraft has to be rotated through a large angle on touch down, due to the abnormally high ground attitude. The wheels are positioned well forward of the C.G., and this allows fierce braking immediately on touch down without causing tail-lift, resulting in a short run. The aircraft can be taxied fast.

Flying Controls.—The flying controls have excellent response and "feel" at low speeds, but are far too heavy for manoeuvring at high speeds. The extreme heaviness of the ailerons makes rolling almost impossible at speeds above 400 m.p.h.

Trim.—The only trimming control adjustable during flight is that of the variable incidence tailplane. Ground adjustment is provided for trim of ailerons, rudder and elevator by bending specified parts of their trailing edges.



The handle of the control column has a safety catch over the gun trigger switch.

The absence of a rudder trimmer is severely felt, since there is a large change of directional trim with speed, and at high speeds the continuous application of rudder necessary to fly straight is very tiring.

Flaps.—Lowering the flaps produces a nose heaviness which can be readily counteracted by adjustment of tailplane incidence, an operation made easy by the juxtaposition of control hand-wheels of flaps and tailplane for simultaneous operation.

On the Me 109E the ailerons are interconnected with the flaps and come down 11 deg. with them; this does not detract from the effectiveness of the ailerons, but makes them feel heavier. This interconnection is not present on the Me 109F.

The very simple and effective flap-position indicator is worthy of note. Lines painted on the slotted flaps at 10 deg. intervals lie under the trailing edge of the wing and successively emerge into the pilot's view as the flaps are lowered. Take-off and landing positions are indicated by differently coloured lines.

[This arrangement, simple and useful in a day fighter, would be of little help on a night fighter.—ED.]

Cockpit Control Arrangements

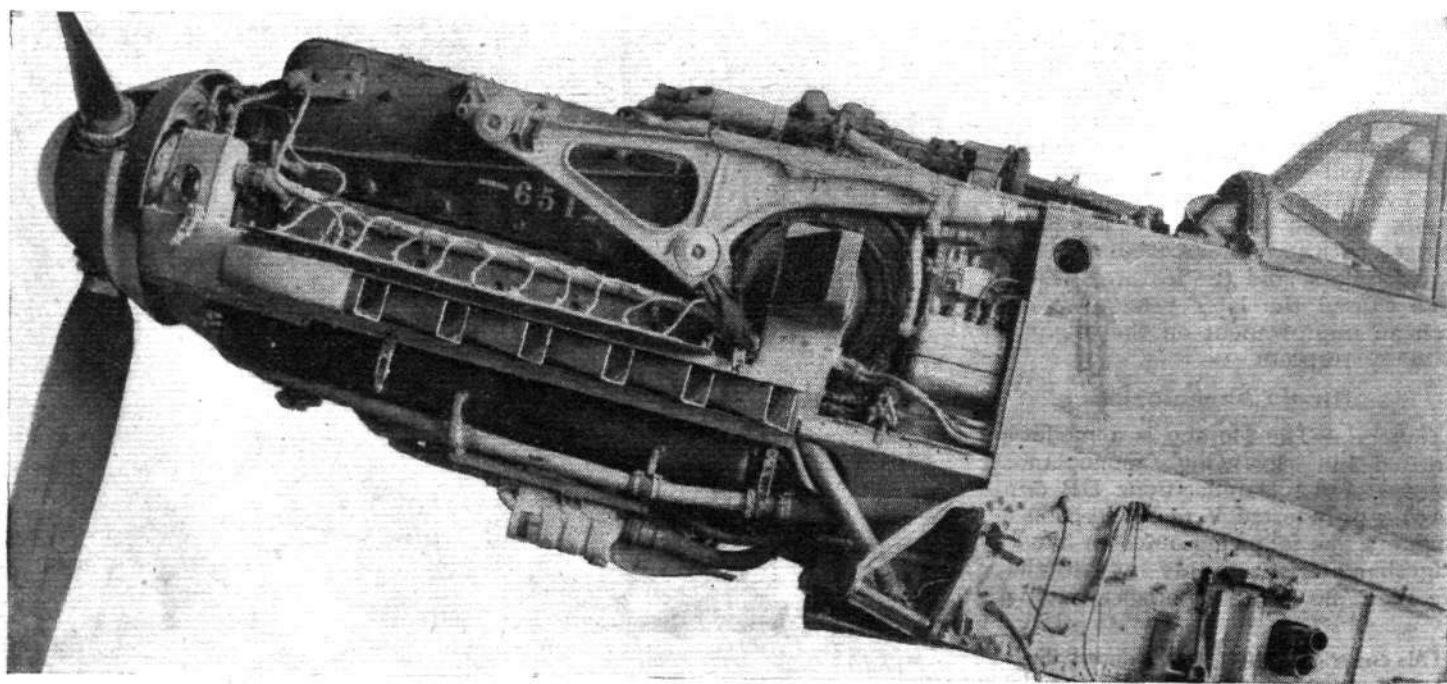
General.—The cockpit is too cramped for comfort. It is too narrow, has insufficient head-room and a tiring seating position. The cramped position seriously restricts the force which the pilot can exert on the control column, particularly in the lateral direction for aileron operation.

Flying Controls.—The control column, with its offset grip, is well positioned, but the absence of fore-and-aft adjustment for the rudder pedals is a bad feature.

Trimming and Flap Controls.—The variable incidence tailplane and the flaps are controlled by two coaxial hand-wheels arranged close together to be operated simultaneously by one hand, whereby change of trim due to flap operation is readily corrected.

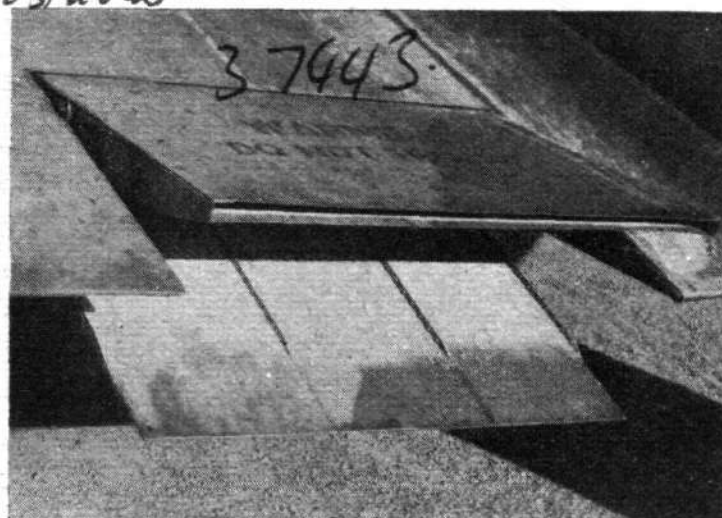
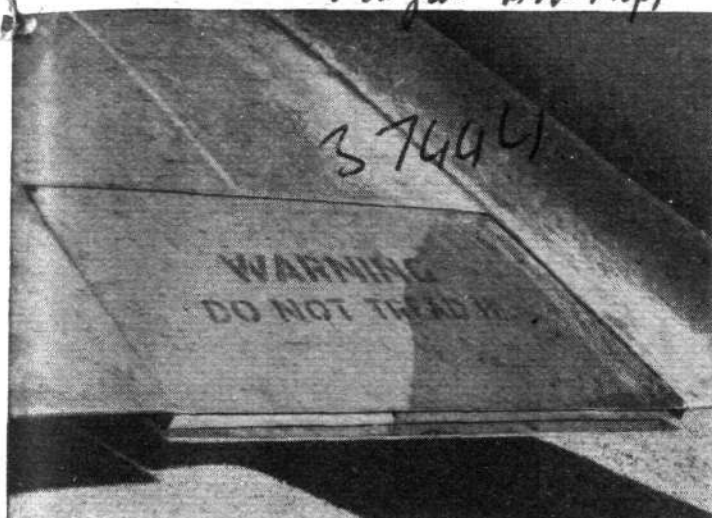
Flap operation is entirely mechanical, by screw-and-nut gear, thus avoiding the vulnerability inherent in hydraulic systems.

Engine Controls.—A feature of the engine controls is the extreme simplicity afforded by the degree of automaticity achieved. Thus the throttle arrangements comprise only



Mounting of the Daimler-Benz DB 601A in the original Messerschmitt Me 109E. Features are ready accessibility and ease of engine changing.

Royal Aircraft Establishment



The radiator exit flaps of the Me 109F closed and open.

The operation is automatic with a manual over-ride.

a single lever with no gate or over-ride. The following list indicates the more important engine functions which are performed automatically:—

Mixture.

Supercharger speed (variable-slip Föttinger hydraulic coupling).

Coolant temperature. (On the Me 109F only, the radiator exit flaps are controlled by a thermostat in the coolant circuit operating the flaps hydraulically. A manual over-ride is provided.)

Oil temperature. (On the Me 109F only, the oil cooler exit flap is controlled by a thermostat operating through pressure in the engine lubrication system.)

Airscrew. (Constant-speed governor-controlled airscrew pitch-changing devices are found on some, but not all, engines. A hand pitch control lever is mounted on the dashboard.)

Brakes.—The brakes are foot operated, each rudder pedal being arranged to rock and operate on a master cylinder which applies the brakes hydraulically. The brakes are good, but a hand-operated system is thought to be more sensitive.

Instrument Panel.—The instruments are well grouped, with flying instruments on the left and engine ones on the right. A bad feature on the Me 109E is the absence of a gyro horizon.

View.—During flight the view is similar to our own fighter aircraft, but, due to the cramped seating position, the tailplane can only be seen with an effort.

The cockpit hood hinges along the starboard side and so cannot be opened in flight. The arrangements for jettisoning this hood are outstanding, the hood being spring-loaded so as to be flung clear, together with the wireless mast, when the jettison lever is operated. This is an excellent feature.

During taxiing the view ahead is very bad, due in part to the high ground attitude and to the fact that the hood cannot be opened to obtain a view round the side.

A good feature is the direct-vision opening provided by the front corner panel on the port side of the windscreen. This panel is vertically divided into two parts, the forward one of which hinges inwards about its leading edge, forming a 2in.-wide direct-vision opening which is completely draught free and greatly facilitates the maintenance of high flying speeds in rain or snow.

The windscreen is not fitted with bullet-proof glass. The plastic transparencies of the hood are of very good quality and do not oil up in flight.

Maintenance Provisions

General.—Great care has obviously been exercised in the design stage of all German aircraft to ensure ease of maintenance, requiring a minimum amount of skill. The following brief notes cover some of the outstanding points.

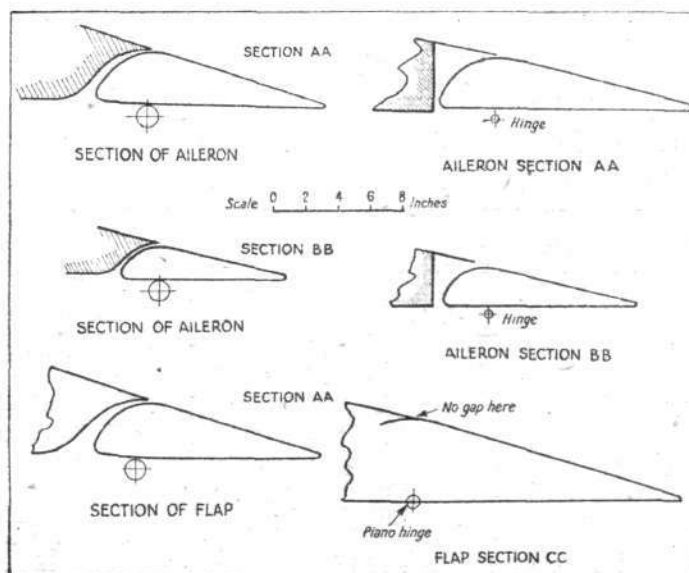
Inspection Doors.—Inspection doors are very liberally provided and are usually locked by a single fastener. On the Me 109 the doors are mostly hinged and are locked and released very simply, without tools, by a single neat flush-fitting fastener of the spring-loaded push-button type. The doors are always a good flush fit when closed and they spring open when released. Wing guns, in particular, are very accessible through a large door hinged along its leading edge.

New Cowling Fastener

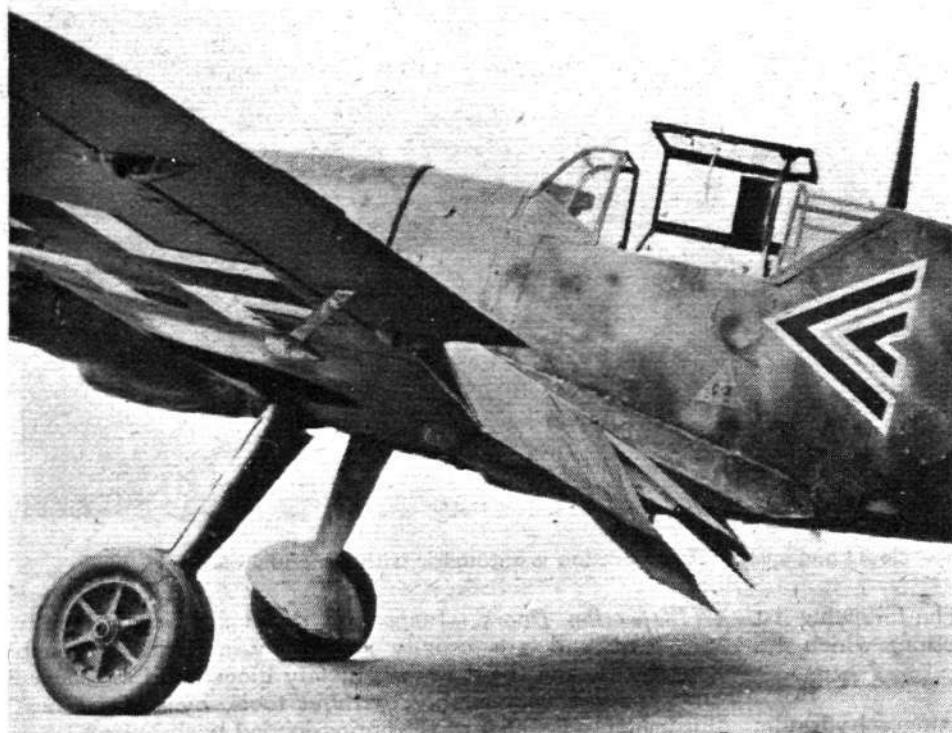
Engine Cowling.—Engine cowling is in three large sections. The top two, which cover well down the sides, are permanently joined at their top meeting edges and are held down by two pairs of push-button fasteners and a single bolt at the front. A new type of cowling fastener comprises a quick-pitch round-threaded pointed screw, trapped in the cowling and engaging nuts formed by cup-shaped pressings having two thicknesses of metal displaced relatively to form a coarse thread.

Sparking Plugs.—The sparking plugs are very accessible, being all situated on the outside of the cylinder banks.

Fairing.—An interesting new type of attachment has appeared on the wing root fairings of the Me 109F. A stranded cable passes round pulleys on the fuselage and through loops inside the fairing so that by pulling the cable up tight by means of a single turn-screw, the fairing is drawn into position. Leather packing ensures a snug fit at the edges of the fairing, but this method, by eliminat-



Compliment to Bristol designer. On the left, sections of the original aileron of the Me 109E. On the right the Frise type introduced in the Me 109F.



Trailing its coat. The radiator flap, plain flap, and aileron of the Me 109F together form a completely movable trailing edge. Another feature of Messerschmitt's latest version is the placing of the wheels far forward. This prevents nosing over, but requires a special landing technique.

ing all the usual screws or clips, presupposes a fairly accurate shaping of the fairing.

Greasing.—Grease nipples are of the Tecalemit (grooved type) and are all painted red. Airscrew hubs are also lubricated by grease-gun, necessitating removal of the spinner. This is a simple matter requiring only a single tool inserted through a slot marked red at the rear edge of the spinner, the tool being then turned to free a spring-loaded toggle lock which allows the spinner to be turned to release a number of grooved locking pegs around its inner periphery. The spinner can then be withdrawn forwardly.

Hydraulic System.—There is little of interest from the maintenance point of view. The reservoirs for the master cylinders of hydraulic brakes in the 109F are now formed integrally with the simple strut piston-and-cylinder assembly which is linked between the rudder pedals and fixed points. They are filled through a ball non-return valve, thus necessitating use of a syringe.

Air Inflation.—A standard air inflation valve for all services has not yet been observed. Tyres have the usual Schrader valve; oleos an enlarged version of the Schrader with a screwed coupler; and air bottles a large common external connection adapted to receive a bayonet type quick coupler.

Oxygen Inflation.—Oxygen bottles are charged at an

Comparative Data for Me 109E and Me 109F2

Data.	Me 109E.	Me 109F2.
Wing.		
Span (ft.)	32.4	32.7
Gross area (sq. ft.)	174	173.0
Mean chord (ft.)	5.36	5.29
Ailerons.		
Type	Slotted	Frise
Span (ft.)	11.4	9.84
Area (sq. ft.)	11.0	10.84
Mean chord (ft.)	0.964	1.10
Volume coefficient	0.050	0.045
% set back hinge balance	21.6	23.0
Flaps.		
Type	Slotted	Plain
Area (sq. ft.)	24.8	20.0*

* This area includes that of both inner and outer portions.

THROUGH BRITISH EYES

external filling point on the skin of the aircraft. This filling point is screwed to receive a dust cap or the hose coupler.

Refuelling.—The Me 109 is fitted with a refuelling point on the skin of the side of the fuselage leading into the side of the tank. The coupler on the fuelling hose is of the quickly attachable type.

Aerodynamic Features of the Me 109F2 and Comparison with Me 109E

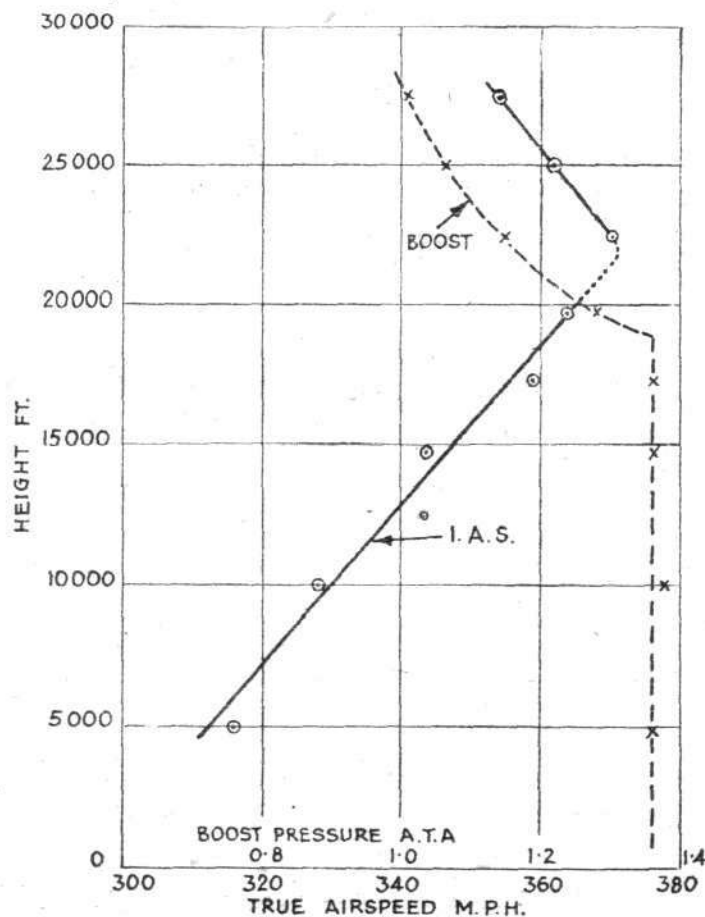
The data given in this note result from an examination of a Me 109F2. This fighter is basically a Me 109E (the ordinary Me 109) with a number of modifications, the most obvious of which is the rounding of the wing tips. It was for the purpose of noting the aerodynamic modifications that this note was written.

The plan form has been altered. No accurate measurement of the wing section was made, but the root thickness was the same as for the Me 109E. It will be seen that the wing taper has been left unchanged, but the tip made

more rounded: the spar is slightly increased and the area is slightly reduced.

There are two glycol radiators, one in each wing root as in the 109E. In the 109F2, however, the ducted by-pass system has been used.

As in the Me 109E, an oil cooler is fitted underneath the body



Me 109F1/2 performance. Full-throttle level speeds and boost pressures. Engine revs. = 2,600 r.p.m.; aircraft weight = 6,090 lb.

THROUGH BRITISH EYES

Each flap is divided into an inboard and outboard part; the former consists of two portions, which are capable of simultaneous downward movement (thus acting simply as a wing flap) or of opposite movements (acting as radiator flaps). The former motion takes place when the outer flaps are lowered. The latter motion is under the control of a thermostat placed between the glycol header tank and the radiator.

It will be noticed that both the flap span and area are less for the 109F2 than for the 109E.

The ailerons have been reduced in span and increased in chord from those of the 109E, the area, however, remaining almost unaltered: the type has been changed from slotted to Frise. Two diagrams give sectional views of the two types of ailerons.

The ailerons are fitted with small tabs for ground adjustment only, as in the 109E. External mass balance weights are fitted as in the 109E, but the ailerons do not come down with the flaps.

The leading edge slats are of rather less span than for the 109E, but otherwise of similar design.

A cantilever tailplane placed slightly below and forward of the original position replaces the braced tailplane of the 109E; it remains adjustable in flight. The elevators of the Me 109F2 are now over mass-balanced; at zero elevator angle the residual weight moment for both elevators about the hinge is of the order of 10 lb.-ft. tending to pull the elevators up. The elevators of the Me 109F1/2, however, are identical with those of the 109E, both being approximately mass-balanced. The obvious difference between the two elevators is that on the 109F2 the (lead) mass-balancing weight is screwed to the nose of the horn and can be easily detached, whereas on the 109F1/2 and 109E the weight is enclosed in the metal skin of the horn.

The rudder area has been reduced from 8.1 to 7.5 sq. ft. The fin section has also been cambered (on the 109E the section was symmetrical), presumably to reduce the amount of rudder needed on the climb.

The original armament of the 109E is replaced by a 15 mm. cannon firing down the airscrew shaft and two machine guns mounted in the usual position over the engine; the only alteration from the 109E is, therefore, the omission of the wing guns. The fuselage seems to be the same as that of the 109E, except that external strengthening plates are screwed on to the sides of the fuselage near the rear as though to strengthen it in bending about the vertical axis.

Brief Performance Tests on a Me 109F1/2 (DB 601N.)

Brief performance tests on a Me 109F covered the following points:—

Determination of the full throttle level speeds at a series of heights from 5,000ft. to 27,500ft.

Full throttle partial climbs at 5,000ft. and 20,000ft.

The result so far obtained indicate that the maximum level speed is 371 m.p.h. T.A.S.; it is obtained at about 22,000ft., although boost pressure starts falling off at 19,000ft. The maximum rate of climb at 5,000ft. is 3,320 ft./min., and at 20,000ft. is 2,370 ft./min. Full throttle and 2,600 engine r.p.m. were used throughout.

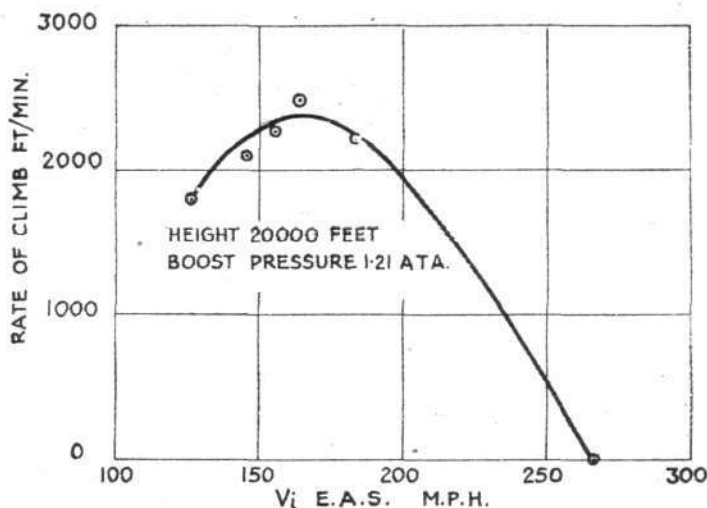
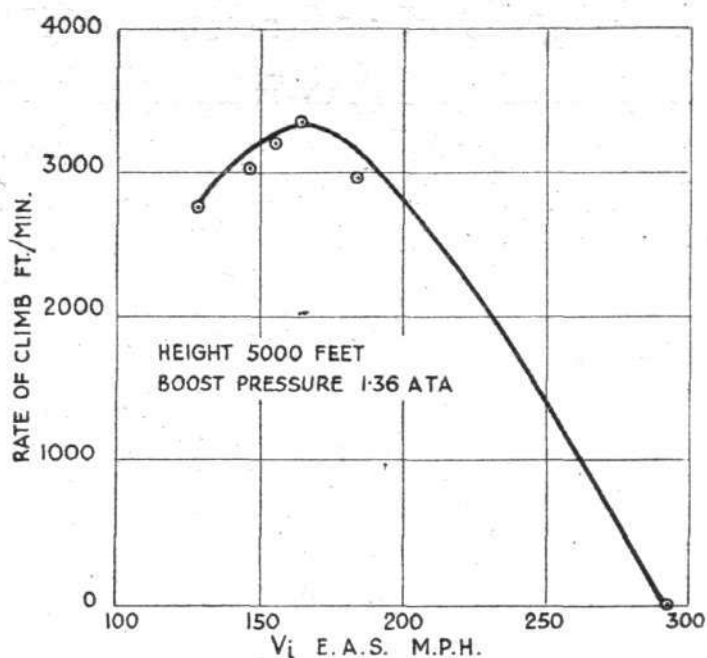
All the above figures are applicable to the aircraft flying with its full service load, all-up weight 6,090 lb., wing loading 35.2 lb./sq. ft.

Description of the Aircraft

The Me 109F1/2 is a development of the Me 109E. The following are the more important differences between the two types which may affect performance:—

The wing plan form has been modified; the wing tips are now rounded, with only slight changes in span and area.

The radiators, which are in the same position as on the Me 109E, incorporate a boundary layer by-pass; this



Full-throttle partial climbs of Me 109F at 5,000ft. and 20,000ft. Engine r.p.m.=2,600 and aircraft weight 6,090 lb.

collects the boundary layer on the lower wing surface immediately ahead of the radiator, leads it round the top of the radiator and discharges it at the trailing edge. This has allowed the radiators to be sunk farther into the wing and they now project only about 2.5in. The oil and coolant radiator flaps are thermostatically controlled, but a pilot-controlled over-ride is provided to open the coolant radiator flaps.

The tail wheel now retracts.

The braced tailplane has been replaced by a cantilever tailplane.

The DB 601A engine installed in the Me 109E has been replaced by a DB 601N. The chief differences between the two engines is that piston tops are now flat instead of concave; the compression ratio has thereby been increased from 6.9 to 7.9. Bench tests show that the sea-level B.H.P. of the DB 601N is 1,085, compared with 985 for the DB 601A.

The air intake to the supercharge has been redesigned. The entry is farther out from the side of the fuselage than on the Me 109E, probably in order to obtain a greater ram effect.

The airscrew diameter has been reduced from 10.2ft. to 9.7ft., and the diameter of the spinner has been increased.

The petrol capacity of about 80 gallons is slightly less than that of the 109E. Provision is made to carry a jettisonable tank slung under the fuselage.

The airscrew has now been fitted with a constant-speed unit of novel design. The r.p.m. at which the airscrew

THROUGH BRITISH EYES

is controlled depend on the position of the throttle lever. With the throttle lever fully forward the unit is set to control at 2,600 r.p.m.; when the throttle lever is moved back the r.p.m. automatically fall an appropriate amount.

The constant-speed unit can be cut out by the pilot and the airscrew pitch controlled in the same way as on the Me 109E.

The normal service load of the aeroplane with two M.G.17 machine-guns firing through the airscrew and one M.G.151 firing 20-mm. ammunition is 6,090 lb. The aeroplane was flown at this loading, which is about 500 lb. heavier than that of the Me 109E. The wing area of the Me 109F is 173 sq. ft., giving a wing-loading of 35.2 lb./sq. ft., compared with 32.1 lb./sq. ft. for the Me 109E.

Photographs of the aeroplane and of the radiator, with the flaps in their closed and open positions, are attached.

Programme of Tests

The programme of tests covered the following points:—
Determination of the position error curve.

Measurement of full-throttle level speeds at 2,600 engine r.p.m. at heights from 5,000ft. to 27,500ft.

Partial climbs at 5,000ft. and 20,000ft. at full throttle 2,600 engine r.p.m.

The following table gives the limitations of the DB 601N engine:—

	Boost Ata.	r.p.m.
5 minutes ..	1.34-1.4	2,600
30 minutes ..	1.3	2,400
Continuous ..	1.2	2,300

At full throttle the boost on the engine used was controlled at 1.36 ata. The tests were done at full throttle at 2,600 engine r.p.m.

All the results were corrected to the take-off weight, 6,090 lb.

Results

Position error curve.—The aircraft was timed at various speeds over a $7\frac{1}{2}$ miles speed course in order to establish the position error.

Level Speeds.—The full-throttle level speeds and the corresponding boost pressures at 2,600 engine r.p.m. are shown plotted against height in the chart. The engine was allowed to cool between each level so that the thermostatically controlled radiator flaps would be closed.

Speeds were corrected on the density basis and boost on the half-and-half basis above the supercharged height. Below this height both were corrected on the pressure basis.

The maximum level speed with radiator flaps fully closed is 371 m.p.h. at about 22,000ft.

An interesting feature is that whereas the full-throttle height as indicated by boost pressure is 19,000ft., the maximum level speed is obtained at about 22,000ft. This phenomenon was also observed on the Me 110. Discussion of this apparent anomaly is deferred until the DB 601 engine has been tested on the altitude test-bed.

Partial Climbs

Partial climbs were done at 5,000ft. and 20,000ft. The rates of climb are shown plotted against E.A.S. in a graph. The climbs were done at full throttle at 2,600 engine r.p.m. and have been corrected to the normal load of 6,090 lb.

At 5,000ft. the maximum rate of climb is 3,320 ft./min. at 165 m.p.h. E.A.S., the boost pressure being 1.36 ata. At 20,000ft. the maximum rate of climb is 2,370 ft./min. at 165 m.p.h. E.A.S., the boost pressure being 1.21 ata.

The rate of climb of the Me 109F at 20,000ft. seems rather low in view of its reputed ceiling of about 40,000ft. It should be borne in mind, however, that the engine gave trouble and that the results contained in this note merely represent the best obtained under test. They do, however, give a useful guide to the minimum performance of the aircraft.

LORD TRENCHARD ON AIR POWER

"Air Must Dominate Strategy."

VISCOUNT TRENCHARD made a very important speech in the House of Lords on Thursday, January 29th. He began by welcoming Lord Moyne's statement that in Russia, Britain and the Middle East we well knew that the key to success lay in the balance of air power. He regretted that in this war air power has often been used wrongly or not used at all. One reason for our setback in the Pacific was that 15 or 16 years ago the Government would not agree to make Singapore an air base in peace time. The Army and Navy only wanted aircraft to spot for the big guns; the Air Service wanted to make it an air base as the best defence, and as it had possibilities of a great air offence from that base.

Lord Trenchard went on to state certain facts which governed, and would always govern, the use of air power in war. They were of paramount importance but were still imperfectly understood by many critics. He thought that most of the public felt that our setbacks in Norway, Greece and Crete were due to the air, and that the Germans used their air more efficiently than we did. The same was felt by many as regards Malaya.

To sum up, the setbacks and victories on both sides in this war had been due chiefly to air power. The Army, and the Navy in narrow waters, could not fight successfully without air cover, without air support, and without air superiority. Short-range fighters were always—and always would be—superior to long-range aircraft. The geographical position affected the air force more than it

affected the other services. We must choose, as far as possible, our battleground.

If those vitally important considerations were overlooked or ignored it was no earthly use blaming the R.A.F. for lack of co-operation, bad organisation, or anything else. Of course, the Royal Air Force authorities must draw attention in Council to those factors when knowledge of them appeared to be lacking. But if, after making clear the facts—and they were facts which were universally recognised as fundamental by the Royal Air Force—their advice or warnings were not followed, then the true responsibility must rest elsewhere.

If their lordships believed what he had said, and he believed that nobody who was well informed could deny it, and if it was recognised by all, then it meant that air must dominate strategy. He did not mean that air could win the war without the Army and the Navy. It could not, but it must dominate strategy. He asked their lordships to influence all with whom they came in contact to understand these very simple facts, because on them bore the successful conclusion of this war.

ADVERTISED GOODS

THE fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.