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ROYAL AIRCRAFT ESTABLISHMENT,
SOUTH FARNBOROUGH, HANTS.

P/D.R.A.E./51.

SECRET

11th July 1942.

My dear Douglas,

F.W.190.

I expect to be in a position to hand over the F.W.190 to A.F.D.U. for tactical trials sometime during the weekend. The engine is running a bit rough, and we have two more performance test flights to make, but unless we are unlucky we should be through before Monday.

I am glad you agreed to the suggestion, made I believe by Campbell-Orde himself, that the A.F.D.U. should do the job here. Not only will this be easier on the aircraft, on account of our runways, but the opportunity of having them here and working with them is one that we all welcome. In addition, it will enable our maintenance team, who by now are expert in the aircraft's peculiarities, to look after it without leaving Farnborough. This will be an advantage, as they are some of my best men and are very busy.

I understand that you would like a preliminary note of our measurements of performance. I attach a list of the salient figures.× You will note that we have not been able to do a ceiling climb, but I do not think this will show us anything which we cannot deduce from the known rate of climb. We have left this till last, mainly because we have found it a little difficult to adjust the carburation to our fuel.

We have evidence that the engine is "de-rated". It is difficult to find out exactly what this means, but its present maximum speed is 2,450 r.p.m., whereas a very similar engine in the Do.217 goes up to 2,700. This, and other evidence suggest that there may be another 10% increase

p.t.o.

× I have added Sp. Vb. figures for comparison, obtained from A.A.E.E. Report.

in the power available fairly soon, probably dependent on whether the engine stands up to the temperature. It would mean about another 10 m.p.h. in top speed.

From the size of the engine it might very well go up considerably more later on.

I hope this information is what you want. A complete report will be available very soon.

I was glad to see Freebody here the other day. It is a long time since I was at your Headquarters. I should very much like to come over some time and see you, when you can spare a moment.

Yours sincerely,

Enc. figs.

G. L. Dawes.

Air Chief Marshal Sir Sholto Douglas, K.C.B., M.C., D.F.C.,
Air Officer Commanding-in-Chief,
Fighter Command,
Bentley Priory,
Stanmore, Mddx.

P.S. My congratulations on your promotion.

198.

Report on F.W.190 Bomber by W/Cdr. J. Rankin, D.S.O., D.F.C.,

61A

A short test flight was carried out on 20th April 1943 at Farnborough to find out if there were any outstanding differences between this aircraft and the one which was flown in September 1942. The following is the report:-

(i) The vents in the fuselage allowing exit for the engine cooling air, (there being no controllable gills on the cowling), are now adjustable by a handle in the cockpit. On the previous aircraft these were fixed.

(ii) The switch for controlling the tail plane incidence is now slightly different, but in the same position.

(iii) Engine limitations in revs. and boost are marked on appropriate dials. This was not done in the first aircraft.

(iv) Diving speed limitations at 3, 5, and 8 kilometres altitude are marked. This was not done in the first aircraft.

(v) Three racks are fitted, one beneath fuselage and one under each wing (covered by a large fairing), below the position occupied by the outboard cannons in first aircraft. These outboard cannons are not fitted in the former aircraft.

(vi) Flying characteristics were approximately the same except for the following:-

(a) This Bomber Aircraft requires much more tail trimming adjustment for dives and climbs.

(b) Perhaps owing to rigging, the lateral control, though still good, was not nearly so light at high speeds as in former aircraft.

(c) Slight buffeting was experienced on elevators at more than 350 m.p.h., probably due to interference in airflow by fuselage bomb rack.

(vii) Generally speaking, this is the same aircraft as that previously tested. Engine maximum limitation is the same as that used in former aircraft for comparative tests.

W/Cdr. P.V.LUCAS, OPS.1, A.D.G.B.

Air Ministry, A.I.2(g), The Manor, Brookshill, Harrow Weald, Middlesex.

Fw 190

The Fw 190, numbered PM.679, which was allotted to A.F.D.U. has become unserviceable, and in view of certain urgent commitments, it has been agreed that one of the cased Fw 190's from Italy will be allotted to A.F.D.U.

Owing to shortage of personnel in No. 1426 Flight, it has been agreed that A.F.D.U. will provide the personnel to erect this aircraft, and that the work will be done at Colley Weston.

It is requested that the number of the Fw 190 which is handed over to A.F.D.U., together with airframe and engine numbers, may be forwarded to this Headquarters in order that the necessary allotment action may be taken.

Will A.F.D.U. also forward to this Headquarters details of the engine and airframe numbers of Fw 190 PM.679, as this aircraft will be transferred to 1426 Flight.

29229?

15.IV.44.

SECRET

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DRAFT.

AIR FIGHTING DEVELOPMENT UNIT,
R.A.F. STATION, DUXFORD.

REPORT No. 55

on

TACTICAL TRIALS - FW.190

INTRODUCTION

1. In accordance with instructions contained in Air Ministry, Dept. C.A., letter C.S.14560/D.D.A.T., dated 29th June 1942, the FW.190 recently captured at Pembrey Aerodrome was attached to this Unit on 13.7.42 for tactical trials. It is understood that this aircraft is a de-rated version which is normally given to inexperienced squadrons, and that the performance of the rated version is considerably better. The reason for this appears to be due to the apparent unreliability of the engine.

2. As it was important for these trials to be carried out as quickly as possible, it was decided to conduct them at the R.A.E., Farnborough, and their assistance and special facilities for dealing with enemy aircraft proved invaluable.

3. The trials eventually had to be abandoned owing to continuous engine trouble and this unfortunately prevented the completion of the trials against the Typhoon. Arrangements have been made with the R.A.E., however, to complete these as soon as the trouble with the engine has been cured.

BRIEF DESCRIPTION OF THE AIRCRAFT
(See photograph at Appendix 'A'.)

General

4. The FW.190 is a small, compact, single-seater, single-engined, low wing monoplane fighter. There are fittings under the fuselage to enable it to carry bombs or a jettisonable fuel tank. It has a fully retractable undercarriage and partially retractable tailwheel. The mainplane is fully cantilever and is fitted with split flaps of metal construction. The flaps have four positions:- retracted, 15° for take-off, 30° for use in the event of a baulk landing, and fully down for landing. Operation is by means of 3 electric push buttons.

5. The power unit is a BMW.801-D, 14-cylinder, 2-row radial engine, fitted

/detailed by name by O.C. A.F.D.U. ...

with a two-speed supercharger giving the best performance at 9,000 and 18,000 feet. The estimated power of the engine is 1700 h.p. at the maximum power altitude of 18,000 ft. The engine oil coolers and induction system are totally enclosed by an extremely neat cowling and cooling is assisted by an engine driven fan behind the propeller.

6. The constant speed V.D.M. 3-bladed metal propeller is electrically operated. It is automatically controlled by an hydraulic governor and if required manually, by an electric switch on the pilot's throttle lever.

7. The undercarriage is retracted by pushing a red button. The operation for lowering the undercarriage consists of pushing a green button and releasing the undercarriage locks by pulling a lever which is situated on the left-hand side of the cockpit. In the event of an electrical failure, the only emergency method of lowering the undercarriage is by means of this lever, gravity completing the operation. The tailwheel is partially retracted, and lowered, mechanically by a cable attached to the starboard undercarriage leg. It is fully castering and can be locked for take-off and landing by holding the control column right back.

8. All the control surfaces are fabric covered and are fitted with metal trimming tabs which can only be adjusted on the ground.

9. For trimming, the tailplane is adjustable in flight over a range of +5° to -3°. It is operated electrically by two push buttons governing the up and down movements. There is a visual indicator on the cockpit.

10. The armament consists of 4 x 20 mm. guns in the wing and 2 x 7.92 mm. machine guns in the engine cowling.

11. The all-up weight of the aircraft with full war load, including pilot, is approximately 8,600 lbs., and the wing loading is 41.8 lbs.

Pilot's Cockpit (See Appendix 'B')

12. The cockpit is fully enclosed and although rather narrow is otherwise extremely comfortable. The positioning of instruments is excellent and all controls fall easily to the pilot's hand, the absence of unnecessary levers and gadgets being particularly noticeable. The front panel is in two pieces, the top containing the primary flying and engine instruments and the lower panel the secondary instruments. Cut-out switches for the electric circuits are housed in hinged flaps on the starboard side.

13. The switches and indicators for the operation of the undercarriage, flaps and tail incidence, are situated on the port side. The control column is the standard German fighter type with a selector switch and firing button for guns, and a send/receive button for wireless.

14. The cockpit canopy, which is made of moulded plexiglas, is well shaped and extends far back along the fuselage. The bullet-proof windscreen has a pronounced slope which is unusual. The canopy can be slid back for entry and exit and for taxying, operation being by means of a crank handle similar to that in the Westland Whirlwind. The enclosure can be jettisoned in emergency by pressing a red lever on the starboard side; this unlocks the hood and detonates a cartridge which breaks the runners and blows the canopy off. Heating for the cockpit appears efficient, and cooling is effected by a small flap on the port side and seems quite sufficient for the pilot's comfort.

Armour Plate (see Appendix 'C')

15. The pilot's bucket seat is made of 8 mm. armour plate and in the unprotected gaps behind are fitted shaped strips varying in thickness between 5 and 6 mm. The pilot's head and shoulders are protected by shaped armour plate 13 mm. thick and the windscreen is of bullet-proof glass about 1¾" thick.

16. Both fuel tanks are self-sealing. The oil tank, which is situated in front of the engine cowling, is protected by a ring of armour plate varying in thickness, and the tank itself is surrounded by a toughened steel ring.

Radio

17. The wireless installation is the old type FuG.7 and the only unusual feature is that there is no wireless mast.

Oxygen

18. The aircraft is fitted with standard improved "Hohenatmer" oxygen equipment with "Blaser" attachment, giving pure oxygen at great height. Three bottles of unusual shape are the source of supply (see Appendix 'C'). It was not possible to test the efficiency of this equipment but it is understood that the R.A.E. are carrying out investigations and will render a report in due course.

Compass

19. Details not yet available.

ARMAMENT CHARACTERISTICS
(See Appendix 'C'.)

20. The armament consists of:-

(i) Two M.G.17 guns of 7.92 mm. calibre fitted above the engine, synchronised, firing through the propeller arc.

(ii) Two M.G.151/20 guns of 20 mm. calibre, synchronised, firing through the propeller arc are installed in the wing roots about 12" out from the engine cowling.

(iii) Two Oerlikon FF 20 mm. guns fitted in the wings outboard of the propeller arc.

See Appendix 'D'.

Gun Button and Switches

21. The guns are fired by means of a button on the front of the control column. A small selector switch at the side of the column enables the pilot to select the following alternatives:-

(i) M.G. 17 and M.G.151/20 guns.

(ii) Oerlikon FF 20 mm. guns.

(iii) All guns.

In addition to this, it is possible, by means of the cut-out switches, which are situated on the starboard side of the cockpit, to fire each pair of guns independently. There are round counters for each gun.

Heating

22. Hot air from the engine cowling is led by means of ducts to the ammunition chutes of the M.G.17 guns and thence upwards to the breech mechanism. The Oerlikon FF 20 mm. guns are also heated by hot air from the engine cowling. No special provision is made for heating the M.G.151/20 guns and it is thought that owing to their position near the engine, this is unnecessary.

Sight

23. A reflector sight, type Revi 12-D, is mounted 1½" starboard of the vertical centre line. The graticule is 5°48½' in diameter, which is the equivalent of approximately 95 mph. for the high muzzle velocity of the German armament. Vertical and horizontal lines are marked off in degree steps from the centre of the graticule. Seven such lines are visible each way.

/detailed by name by O.C. A.F.D.U....

Harmonisation

24. The harmonisation ranges for each pair of guns are:-

Two M.G.17 guns at 300 metres or 330 yards.

Two M.G.151/20 guns at 450 metres or 490 yards.

Two Oerlikon FF 20 mm. guns at 250 metres or 270 yards.

The guns lines of the M.G.17 guns are not symetrical about the vertical centre line. The port gun converges whereas the starboard gun diverges with the result that they cross over 1'2" on the starboard. This may be due to incorrect harmonisation.

25. The sight line crosses the vertical centre line at 30 yards and is therefore considerably offset to port, i.e. 2 feet at 500 yards range. The sight line is also depressed relative to the gun lines. Even after allowing for the gravity drop of the bullets, the sight line is still about 6 feet below the centre of the bullet pattern at 500 yards range. It is a possibility that the depression of the sight is intentional in order to counteract the usual tendency of aiming too low. On the other hand, it may be due to incorrect harmonisation.

Bullet Patterns

26. The bullet patterns, obtained with the guns harmonised above, are shown in Appendix 'B'.

Sighting View

27. The sighting view, when sitting comfortably in the normal position, is about a half ring better than that from a Spitfire. The view downwards from the centre of the sight graticule to the edge of the reflector plate holder, is about 5 degrees. This view is not obtained by elevating the guns (and consequently the sight) relative to the line of flight, but is entirely due to the attitude of the aircraft in flight, which is nose down. In terms of deflection allowance the view downwards is 160 mph. and this enables the pilot to sight and fire at angles of attack as follows:-

Target Speed	Angle of Attack
200 mph.	60°
300 mph.	40°
400 mph.	25°

TACTICAL TRIALS

General

28. The FW.190 is considered an excellent low and medium altitude fighter. It is fast, well armed, and very manoeuvrable. The fighting qualities have been compared with a Spitfire VB, Spitfire IX, Mustang IA, Lockheed P.38F, Typhoon I, and prototype Griffin Spitfire. All aircraft were carrying full war load.

Flying Characteristics

29. The aircraft is pleasant to fly, all controls being extremely light and positive. The aircraft is difficult to taxy, due to the excessive weight on the self-centreing tailwheel when on the ground. For take-off, 15° of flap is required, and it is necessary to keep the control column back to avoid swinging during the initial stage of the take-off run. The run is approximately the same as that of the Spitfire IX.

30. Once airborne, the pilot immediately feels at home in the aircraft. The retraction of the flaps and undercarriage is barely noticeable although the aircraft will sink if the retraction of the flaps is made before a reasonably high airspeed has been obtained.

31. The stalling speed of the aircraft is high, being approximately 110 mph. with undercarriage and flaps retracted, and 105 mph. with undercarriage and flaps fully down. All controls are effective up to the stall.

32. One excellent feature of this aircraft is that it is seldom necessary to re-trim under all conditions of flight.

33. The best approach speed for landing with flaps and undercarriage down is between 130-140 mph. Indicated, reducing to about 125 mph. when crossing the edge of the aerodrome. Owing to the steep angle of glide, the view during the approach is good, and the actual landing is considered straightforward and the touchdown occurs at approximately 110 mph. The landing run is about the same as the Spitfire IX. The view on landing is poor, due to the tail down attitude of the aircraft. The locking of the tailwheel again assists in preventing swing during the landing run.

34. The aircraft is very pleasant for aerobatics, which can be carried out even at high speed.

Performance

35. The all-round performance of the FW.190 is good. Only brief performance tests have been carried out and the figures obtained give a maximum speed of approximately 390 mph. True, 1.42 ats. boost, 2700 r.p.m. at the maximum power altitude of about 18,000 ft. All flights at maximum power were carried out for a duration of 2 minutes only.

36. There are indications that the engine of this aircraft is de-rated and this is supported by the pilots instruction card found in the cockpit, and by information obtained from P/Ws. Further performance tests and engine investigation are to be carried out by the R.A.E., and more definite information will then be available.

37. Throughout the trials the engine has been running very roughly and as a result pilots flying the aircraft have had little confidence in its reliability. The cause of the roughness has not yet been ascertained, but it is thought that it may be due to a bad period of vibration at certain engine speeds which may also affect the injection system. It is understood from P/Ws. who have flown the aircraft that the roughness of the engine is usual and that they also have little faith in its reliability, in fact they dislike flying the FW.190 over the sea.

Endurance

38. The total of 115 gallons of fuel is carried in two self-sealing tanks and each tank is fitted with an immersed fuel pump for use at altitude. A total of 9 gallons of oil is carried in a protected oil tank. (For position of tanks, see Appendix 'C'). The approximate endurance under operational conditions, including dog-fights and a climb to 25,000 feet, is approximately 1 hour 20 minutes. There is a red warning light fitted in a prominent position which illuminates when there is only sufficient fuel left for 20 mins. flying.

Climb

39. The rate of climb up to 18,000 feet under maximum continuous climbing conditions at 1.35 ats. boost, 2450 r.p.m., 165 mph. is between 3,000 and 3,250 ft/min. The initial rate of climb when pulling up from level flight at fast cruising speed is high and the angle steep, and from a dive is phenomenal. The operational ceiling of this version of the FW.190 is considered to be about 22,000 to 23,000 feet, at which height the power is gradually falling off.

Dive

40. The FW.190 has a high rate of dive, the initial acceleration being excellent. The maximum speed so far obtained in a dive is 580 mph. True, and at this speed the controls, although slightly heavier, are still remarkably light. One good feature is that no alteration of trim from level flight is required either during the entry or during the pull-out. Due to the injection system it is possible to enter the dive by pushing the control column forward without the engine cutting.

Search View

41. The view for search from the FW.190 is the best that has yet been seen by this Unit. The cockpit hood is of moulded plexiglas and offers an unrestricted view all round. No rear view mirror is fitted and it is considered unnecessary as the backward view is so good. The hood must not be opened in flight as it is understood that tail buffeting may occur and that there is a chance of the hood being blown off. This, however, is not a disadvantage for search as the quality of the plexiglas is excellent. During conditions of bad visibility and rain, or in the event of oil being thrown on the windscreen, the fact that the hood must not be opened is obviously a disadvantage.

Instrument Flying

42. The aircraft, although extremely light on all controls, is reasonably easy to fly on instruments. There are no artificial horizon or climb and dive indicators which are naturally missed by English pilots. It appears that instrument flying is carried out by use of the gyro compass, turn and bank indicator, altimeter, and air speed indicator.

Low Flying

43. The good all-round view from the aircraft, particularly over the nose, makes the FW.190 very suitable for low flying and ground strafing. Another good point is that the sight is depressed, which would probably help in preventing pilots from flying into the ground. In conditions of bad visibility, however, low flying is likely to be unpleasant, as the hood must not be opened in flight.

Formation Flying

44. The aircraft is easy to fly in formation and due to the good view, all types of formation can be flown without difficulty. The aircraft has a wide

speed range which greatly assists in regaining formation, but care must be taken to avoid over-shooting, as its clean lines make deceleration slow.

Night Flying

45. The aircraft was not flown at night but was inspected with the engine running on a dark night, with no moon. The cockpit lighting appeared very efficient and did not reflect on the canopy. The exhaust flames viewed from about 100 yards ahead were seen as a dull red halo, and viewed from the beam could be seen from about 500 yards away. The flame can be seen from astern about 200 yards away. It is considered that the glare will badly affect the pilot, particularly during take-off and landing. Although the aircraft carries full night flying equipment, there is no indication that flame dampers are normally fitted. It is possible that the cause of the red flame may be due to faulty mixture.

Engine starting and quick take-offs.

46. It is possible to start the engine up by means of the internal battery, or an external battery, and in the event of emergency, by hand. The method of starting is similar to the Me.109, being an inertia system. If the engine is cold it will require running up for a considerable time before the oil temperature reaches the safety margin for take-off and even with a warm engine some minutes are necessary as the cooling is so effective on the ground. This is obviously a disadvantage and coupled with the fact that the aircraft is not easy to taxy, makes the FW.190 inferior to our aircraft for quick take-offs.

Fighting Qualities

47. The fighting qualities of the FW.190 have been compared with various aircraft, and each comparison is dealt with separately. The trials against the Griffin Spitfire were only brief and against the Typhoon had to be abandoned before completion owing to the unsatisfactory state of the engine in the FW.190.

FW.190 v. Spitfire VB

48. The FW.190 was compared with a Spitfire VB from an operation squadron for speed and all-round manoeuvrability at heights up to 25,000 ft. The FW.190 is superior in speed at all heights, and the approximate differences are as follows:

At	1,000 ft.	the	FW.190	is	25 - 30 mph.	faster	than	the	Spitfire	VB
At	3,000 ft.	"	"	"	30 - 35 mph.	"	"	"	"	"
At	5,000 ft.	"	"	"	25 mph.	"	"	"	"	"
At	9,000 ft.	"	"	"	25 - 30 mph.	"	"	"	"	"(second blower in operation)

At 15,000 ft.	the FW.190 is	20 mph.	faster than the Spitfire VB.
At 18,000 ft.	" " "	20 mph.	" " " " "
At 21,000 ft.	" " "	25 mph.	" " " " "
At 25,000 ft.	" " "	20 - 25 mph.	" " " " "

49. Climb - The climb of the FW.190 is superior to that of the Spitfire VB at all heights. The best speeds for climbing are approximately the same, but the angle of the FW.190 is considerably steeper. Under maximum continuous climbing conditions the climb of the FW.190 is about 450 ft/min. better up to 25,000 feet.

50. With both aircraft flying at high cruising speed and then pulling up into a climb, the superior climb of the FW.190 is even more marked. When both aircraft are pulled up into a climb from a dive, the FW.190 draws away very rapidly and the pilot of the Spitfire has no hope of catching it.

51. Dive - Comparative dives between the two aircraft have shown that the FW.190 can leave the Spitfire with ease, particularly during the initial stages.

52. Manoeuvrability - The manoeuvrability of the FW.190 is better than that of the Spitfire VB except in turning circles, when the Spitfire can quite easily out-turn it. The FW.190 has better acceleration under all conditions of flight and this must obviously be most useful during combat.

53. When the FW.190 was in a turn and was attacked by the Spitfire, the superior rate of roll enabled it to flick into a diving turn in the opposite direction. The pilot of the Spitfire found great difficulty in following this manoeuvre and even when prepared for it was seldom able to allow the correct deflection. A dive from this manoeuvre enabled the FW.190 to draw away from the Spitfire which was then forced to break off the attack.

54. Several flights were carried out to ascertain the best evasive manoeuvres to adopt if 'bounced'. It was found that if the Spitfire was cruising at slow speed and was 'bounced' by the FW.190, it was easily caught up even if the FW.190 was sighted when well out of range, and the Spitfire was then forced to take avoiding action by using its superiority in turning circles. If on the other hand, the Spitfire was flying at maximum continuous cruising and was 'bounced' under the same conditions, it had a reasonable chance of avoiding being caught, provided the FW.190 was seen in time, by opening the throttle and going into a shallow dive. This forced the FW.190 into a stern chase and although it eventually caught the

the Spitfire, it took some time and as a result was drawn a considerable distance away from its base. This is a particularly useful method of evasion for the Spitfire if it is 'bounced' when returning from a sweep. This manoeuvre has been carried out during recent operations and has been successful on several occasions.

55. If the Spitfire V is 'bounced' it is thought unwise to evade by diving steeply, as the FW.190 will have little difficulty in catching up owing to its superiority in the dive.

56. The above trials have shown that the Spitfire V must cruise at high speed when in an area where enemy fighters can be expected. It will then, in addition to lessening the chances of being successfully 'bounced', have a better chance of catching the FW.190, particularly if it has the advantage of surprise.

57. Owing to the trials being abandoned, it was not possible to compare the Spitfire V using 16 lbs.boost. It is thought, however, that the extra performance gained by the increased boost would reduce the all-round superiority of the FW.190.

FW.190 v. Spitfire IX

58. The FW.190 was compared with a fully operational Spitfire IX for speed and manoeuvrability at heights up to 25,000 feet. The Spitfire IX at most heights is slightly superior in speed to the FW.190 and the approximate differences in speeds at various heights are as follows:-

At 2,000 ft.	the FW.190	is 7-8 mph. faster than the Spitfire IX.
At 5,000 ft.	" FW.190 and Spitfire IX are approximately the same.	
At 8,000 ft.	" Spitfire IX is 8 mph. faster than the FW.190.	
At 15,000 ft.	" Spitfire IX is 5 mph. faster than the FW.190.	
At 18,000 ft.	" FW.190 is 3 mph. faster than the Spitfire IX.	
At 21,000 ft.	" FW.190 and Spitfire IX are approximately the same.	
At 25,000 ft.	" Spitfire IX is 5-7 mph. faster than the FW.190.	

59. Climb - During comparative climbs at various heights up to 23,000 feet, with both aircraft flying under maximum continuous climbing conditions, little difference was found between the two aircraft although on the whole the Spitfire IX was slightly better. Above 22,000 feet the climb of the FW.190 is falling off rapidly, whereas the climb of the Spitfire IX is increasing. When both aircraft were flying at high cruising speed and were pulled up into a climb from level flight, the FW.190 had a slight advantage in the initial stages of the climb due to its better acceleration. This superiority was slightly increased when both aircraft were pulled up into the climb from a dive.

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60. It must be appreciated that the differences between the two aircraft are only slight and that in actual combat the advantage in climb will be with the aircraft that has the initiative.

61. Dive - The FW.190 is faster than the Spitfire IX in a dive, particularly during the initial stage. This superiority is not as marked as with a Spitfire VB.

62. Manoeuvrability - The FW.190 is more manoeuvrable than the Spitfire IX except in turning circles, when it is out-turned without difficulty.

63. The superior rate of roll of the FW.190 enabled it to avoid the Spitfire IX if attacked when in a turn by flicking over into a diving turn in the opposite direction and as with the Spitfire VB, the Spitfire IX had great difficulty in following this manoeuvre. It would have been easier for the Spitfire IX to follow the FW.190 in the diving turn if its engine had been fitted with a negative 'G' carburettor, as this type of engine with the ordinary carburettor was found to cut very easily.

64. The Spitfire IX's worst heights for fighting the FW.190 were found to be between 18,000 and 22,000 feet and below 3,000 feet. At these heights the FW.190 is a little faster.

65. Both aircraft 'bounced' one another in order to ascertain the best evasive tactics to adopt. The Spitfire IX could not be caught when 'bounced', if it was cruising at high speed and saw the FW.190 when well out of range. When the Spitfire IX was cruising at low speed its inferiority in acceleration gave the FW.190 a reasonable chance of catching it up and the same applied if the position was reversed and the FW.190 was 'bounced' by the Spitfire IX, except that it took a little longer.

66. The initial acceleration of the FW.190 is better than the Spitfire IX under all conditions of flight, except in level flight at such altitudes where the Spitfire has a speed advantage and then, provided the Spitfire is cruising at high speed, there is little to choose between the acceleration of the two aircraft.

67. The general impression gained by the pilots taking part in the trials is that the Spitfire IX compares favourably with the FW.190 and that provided the Spitfire has the initiative, it has undoubtedly a good chance of shooting it down.

FW.190 v. Mustang IA

68. The FW.190 was compared with a fully operational Mustang IA for speed and all-round manoeuvrability at heights up to 23,000 feet. There was little to choose between the aircraft in speed at all heights except between 10,000 and 15,000 feet, where the Mustang was appreciably faster. Approximate differences are as follows:-

At 2,000 ft.	the FW.190	is 2 mph.	faster than	the Mustang IA.
At 5,000 ft.	the Mustang	is 5 mph.	" "	FW. 190.
At 10,000 ft.	the Mustang	is 15 mph.	" "	"
At 15,000 ft.	the Mustang	is 10 mph.	" "	"
At 20,000 ft.	the FW.190	is 5 mph.	" "	Mustang IA.
At 23,000 ft.	the FW.190	is 5 mph.	" "	"

69. Climb - The climb of the FW.190 is superior to that of the Mustang IA at all heights. The best climbing speed for the Mustang is approximately 10 mph. slower than that for the FW.190; the angle is not nearly so steep and the rate of climb is considerably inferior. When both aircraft are pulled up into a climb after a fast dive, the inferiority in the initial stage of the climb is not so marked, but if the climb is continued the FW.190 draws away rapidly.

70. Dive - Comparative dives have shown that there is little to choose between the two aircraft and if anything the Mustang is slightly faster in a prolonged dive.

71. Manoeuvrability - The manoeuvrability of the FW.190 is better than that of the Mustang except in turning circles, where the Mustang is superior. In the rolling plane at high speed the Mustang compares more favourably with the FW.190 than does the Spitfire.

72. The acceleration of the FW.190 under all conditions of flight is slightly better than that of the Mustang and this becomes more marked when both aircraft are cruising at slow speed.

73. When the FW.190 was attacked by the Mustang in a turn, the usual manoeuvre of flicking into a diving turn in the opposite direction did not appear so effective against the Mustang as against the Spitfire, particularly if the aircraft were flying at high speed. The fact that the engine of the Mustang does not cut during the application of negative 'G' proved a great asset and gave the Mustang a reasonable chance of following the FW.190 and shooting it down. It must be appreciated, however, that much depends on which aircraft has the initiative and that obviously the FW.190 can escape if the Mustang is seen when well out of range. The FW.190 in this case will almost certainly utilise its superior climb.

/detailed by name by O.C. A.F.D.U....

74. Trials were carried out to ascertain the best manoeuvre to adopt when 'bounced'. If the Mustang was cruising at a high speed and saw the FW.190 about 2,000 yards away, it usually managed to avoid by opening up to full throttle and diving away, and once speed had been built up it was almost impossible for the FW.190 to catch it. When the Mustang was 'bounced' by the FW.190 when flying slowly, it was unable to get away by diving and was forced to evade by means of a quick turn as the FW.190 came into firing range.

75. When the FW.190 was 'bounced' by the Mustang, it could evade by using its superiority in the rolling plane and then pull up violently from the resultant dive into a steep climb which left the Mustang behind. If the Mustang is not seen until fairly close, it will get the chance of a short burst before it is out-climbed.

76. Against the FW.190 the worst heights for the Mustang IA were above 20,000 feet and below 3,000 feet where the FW.190 was slightly superior in speed. The best height for the Mustang was found to be between 5,000 and 15,000 feet.

FW.190 v. Lockheed P.38F

77. The FW.190 was compared with an operationally equipped Lockheed P.38F flown by an experienced U.S. Army Air Corps pilot. The two aircraft were compared for speed and all-round manoeuvrability at heights up to 23,000 feet. The FW.190 was superior in speed at all heights up to 22,000 feet where the two aircraft were approximately the same. The difference in speed decreases as the P.38F gains altitude, until at 23,000 feet it is slightly faster. The approximate differences in speeds are as follows:-

At 2,000 feet	the	FW.190	is	15 mph.	faster	than	the P.38F.
At 8,000	"	"	"	15 mph.	"	"	"
At 15,000	"	"	"	5-8 mph.	"	"	"
At 23,000	"	P.38F	"	6-8 mph.	"	"	FW.190

78. Climb - The climb of the P.38F is not as good as that of the FW.190 up to about 15,000 feet. Above this height the climb of the P.38F improves rapidly until at 20,000 feet it becomes superior. The best climbing speed for the P.38F is about 20 mph. less than that of the FW.190 and the angle approximately the same. The initial rate of climb of the FW.190 either from level flight or a dive is superior to that of the P.38F at all heights below 20,000 feet, and above this height the climb of the P.38F becomes increasingly better.

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79. Dive - Comparative dives between the two aircraft proved the FW.190 to be better, particularly in the initial stage. During prolonged dives the P.38F on occasion was catching up slightly with the FW.190, but during actual combat it is unlikely that the P.38F would have time to catch up before having to break off the attack.

80. Manoeuvrability - The manoeuvrability of the FW.190 is superior to that of the P.38F, particularly in the rolling plane. Although at high speed the FW.190 is superior in turning circles, it can be out-turned if the P.38F reduces its speed to about 140 mph, at which speed it can carry out a very tight turn which the FW.190 cannot follow.

81. The acceleration of the two aircraft was compared and the FW.190 was found to be better in all respects.

82. When the FW.190 'bounced' the P.38F and was seen when over 1,000 yards, the pilot's best manoeuvre was to go into a diving turn and if it found the FW.190 was catching it up, to pull up into a spiral climb, flying at its slowest possible speed. Although time did not permit trials to be carried out with the FW.190 being 'bounced' by the P.38F, it is thought that the P.38F would stand a reasonable chance of shooting down the FW.190 provided it had a slight height advantage and the element of surprise. If the pilot of the FW.190 sees the P.38F when it is just out of range, a quick turn in one direction followed by a diving turn in the opposite direction will give the P.38F a most difficult target, and as the acceleration and speed of the FW.190 in a dive builds up very rapidly, it is likely to be able to dive away out of range.

FW.190 v. 4-cannon Typhoon

83. Owing to the unsatisfactory condition of the engine of the FW.190 which caused the trials to be abandoned, only brief tests could be carried out against the Typhoon. Arrangements have been made with the R.A.E., Farnborough, to complete the trials as soon as the engine of the FW.190 has been overhauled and passed fit for further flights. Trials were carried out against two operationally equipped Typhoons, one from a squadron and the other from the Hawker Aircraft Co., Both aircraft were flown by experienced pilots.

84. The FW.190 was compared with the Typhoon for speed and all-round manoeuvrability at 2,000 feet and in addition a partial climb was carried out between 12,000 and 17,000 feet. At 2,000 feet there was little to choose between the two aircraft in speed, the Typhoon being slightly faster. The runs were made from cruising speed to full throttle for a period of two minutes and this did not give the Typhoon time to build up to its maximum speed. From the knowledge of both aircraft it can be safely assumed that the Typhoon will be faster than the FW.190 at all heights, having the best advantage in speed at the following approximate heights:- 8,000 ft., 10,000 ft., 16,500 ft., and 20,500 feet.

85. Climb - During the partial climb from 12,000 to 17,000 feet, the Typhoon was out-climbed by the FW.190 quite easily. The best climbing speed of the Typhoon is considerably higher than that of the FW.190 and the angle not nearly so steep, the rate of climb at all heights being inferior. The difference in a comparative climb after a dive is unlikely to be so great.

86. Dive - It is thought that the Typhoon will out-dive the FW.190, but the FW.190 is likely to be slightly better in the initial stage. The controls of the Typhoon, although good in a dive, are not so light and responsive as those of the FW.190.

87. Manoeuvrability - The manoeuvrability of the FW.190 and the Typhoon was compared during one flight at 2,000 feet, the Typhoon being flown by a very experienced test pilot from Hawkers, and it appeared that there was little to choose between the two aircraft in turning circles. The opinion of both pilots was that it was doubtful whether either aircraft would be able to hold its sights on sufficiently long for accurate sighting. The Typhoon was unable to follow the FW.190 from a turn in one direction into a diving turn in the opposite direction due to the FW.190's superiority in the rolling plane. The initial acceleration of the Typhoon, particularly from slow speed is much slower, although the difference in acceleration when flying at high speed is not so great. It is considered that the FW.190 would have the greatest difficulty in 'bouncing' the Typhoon provided the Typhoon was flying at a high speed. The Typhoon, however, should have a good chance of 'bouncing' the FW.190 provided it has a slight height advantage.

FW.190 v. Griffin Spitfire

88. Two brief flights at between 1,000 and 2,000 feet were carried out between the FW.190 and a prototype Griffin Spitfire flown by an experienced test pilot from Messrs. Vickers. Two speed runs were made from high cruising speed over a distance of about 10 miles. The acceleration of the Spitfire proved superior to that of the FW.190 and its speed appreciably faster. Owing to adverse weather conditions it was not possible to compare the two aircraft for dive and climb.

89. Manoeuvrability - Brief manoeuvrability tests were carried out and the Spitfire had no difficulty in out-turning the FW.190. It should be borne in mind, however, that the pilot of the FW.190 was reluctant at the time to risk stalling the aircraft in the turn at such a low height and it is therefore possible that the turn could have been tighter and the difference between them less marked.

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Addendum to A.F.C.131

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Tactical Trials of the F.W. 190
(Air Fighting Development Unit Report No. 55)

This additional information is being circulated to all holders of A.F.C. Paper No. 131 and this sheet should be attached to page 7 of that paper.

For the comparative performance trials between the F.W.190 and various British and American fighter aircraft shown in this report (paras. 47 to 87), all level speed runs were for two minutes at maximum emergency (3 minute) ratings, and all sustained climbs were carried out at maximum continuous climbing conditions (30 minute rating). In the case of the F.W.190 the 30 minute rating was taken to be 2450 r.p.m. @ 1.35 ata.

Speed Runs (Maximum 3 minute ratings used)

F.W.190	... ...	2700 r.p.m. @ 1.42 ata.
Spitfire VB...	...	3000 r.p.m. @ + 12 lbs/sq. inch (The Spitfire VB has since been cleared for 3000 r.p.m. @ + 16 lbs/sq.inch)
Spitfire IX...	...	3000 r.p.m. @ + 15 lbs/sq.inch.
Mustang IA ...	...	3000 r.p.m. @ 45½" mercury.
Lockheed P38F (Lightning)	...	2800 r.p.m. @ 42" mercury.
Typhoon I	...	3700 r.p.m. @ + 7 lbs/sq. inch.

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