NATIONAL ADVISORY COMMITTEE
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TECHNICAL NOTES

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No. 133

FLIGHT CHARACTERISTICS.

By Captain Student.

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FLIGHT CHARACTERISTICS.*

By Captain Student.

For some time the Air Service group at Adlershof has been conducting a series of test flights, with the object of accurately determining the comparative performances of new types of airplanes under the same conditions. Airplanes for similar tactical employment were used throughout the experiments, e.g. C1 airplanes with 160 HP engines, C airplanes with 200 HP Benz engines, etc. Types already in use at the front were also selected for comparison, and these tests give a very accurate idea of the progress shown in a new type, and formed the basis for deciding as to the desirability of its introduction into the service.

The dead weight of each airplane participating in the flights is first determined. Since some doubt still seems to exist with regard to the inclusion of certain items in the dead weight, it may be repeated here that, according to existing regulations, this weight includes the oil in the engine crankcase, the cooling water, all fitted instruments such as revolution-counters, switches, compass, wireless leads and plugs (in so far as wireless is specified), attachments for mounting the fixed machine gun, spare ammunition racks and boxes, the ring mounting of the movable machine gun, and all other necessary parts which are not expressly stated in the specification to form part of the useful load. The machine guns

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themselves, and instruments, such as airspeed indicators, altimeters, etc. not permanently installed, belong to the useful load.

Before the altitude flight, carried out by a pilot from the factory, and in which the airplane was required to reach its ceiling, the agreement between the actual gross weight with the sum of the dead weight, and the stipulated useful load, is determined by weighing and, if necessary, ballast is added to make up any deficiency in weight. The fuel consumption is ascertained by weighing the airplane after the completed flight. In order that variations in the engine performance may not affect the results of the tests, each engine is tested on the ground by a calibrated fan brake, a revolution-counter and stop-watch.

At least three previously calibrated sealed recording altimeters were carried on each flight. In order to be able to compare the climbing speeds during flights carried out under differing atmospheric conditions, the air temperature was recorded at intervals of 500 meters (1640 feet) and the true climbing speeds were calculated subsequently, the results being reduced to a uniform or standard average air density. It has proved impossible in practice to carry thermographs for this purpose, as the readings obtained are unreliable, and the instruments have too much lag. The airplanes under test were subsequently flown by officers, close together in horizontal flight at full power and at different heights, for the purpose of direct speed comparison. New types were also flown by the Experimental Section at Lake Muritz, over a fixed triangular

course, their positions being ascertained at frequent intervals by means of theodolites on the ground, so that their actual flying speeds were obtained with the greatest accuracy at present possible.

The most important tests were those intended to exhibit the flying qualities and were carried out by officers in individual practice flights, and in battle formation. The demands made in this respect on an airplane vary with its tactical use, since a heavy C airplane with a Maybach engine cannot be required to possess the same maneuverability as a C1 airplane, which must possess exceptional maneuverability and must be able to dive steeply, resembling a D airplane in this respect. Our present C1 airplanes still have many faults. A C1 type introduced at the front, where it is very popular, filling on our side the same role as the British Bristol single-seater combat plane, for example, does not respond quickly to the rudder owing to its short body, while turning uncomfortably fast with rudder hard over. On a turn with wide-open throttle, for the same reason, banking is also difficult. On a really sharp turn with wide-open throttle, the airplane side-slips easily and has a tendency to nose-dive. These defects, however, have been partly overcome by lengthening the body.

This example shows that the designer, with a praiseworthy effort to reduce weight, must nevertheless, with our comparatively heavy engines, retain a certain length of fuselage. Other C1 airplanes have the same or other lesser faults, among which may be mentioned the strong pressure on the ailerons in gliding flight.

The flight characteristics of airplanes fitted with Bz IV en-

gines are ordinarily satisfactory.

The requirements for heavy airplanes fitted with Maybach engines are naturally different. Besides high speed, good climbing power and high ceiling are needed, maneuverability being of secondary importance, though this quality should not be entirely neglected. An airplane must, at least, be able to bank smoothly and easily, and ought not, as is the case with one existing type, require a forcible throwing into a turn, out of which it can be brought only with the greatest difficulty.

Visibility likewise is not important with these airplanes. A good field of view is especially important, however, in fighting - and in formation flying, neither of which need to be considered as within the duty of the long-distance reconnaissance airplane. An airplane with the upper wing above eye-level need not, therefore, be rejected on this account.

Manufacturers' pilots become somewhat biased through numerous flights with airplanes of the same type and are, in most cases, therefore, hardly in a position to determine accurately the real flying qualities of new types. It is better, therefore, with such new types as are considered by the manufacturers to promise successful development, to test by the "Flugzeugmeisterei" for their flying qualities, before submitting to the "type" test. On application to the "Flugzeugmeisterei" manufacturers' pilots can even be allowed to test airplanes of other origin.

Although increasing stress is being laid on efficient equipment by those in charge of operations at the front, there are still air-

planes in which hardly any of the fittings are conveniently and comfortably situated. It ought, for instance, to be unnecessary for the pilot to disappear head downwards inside the fuselage, in order to read the revolution-counter. The seat in long distance reconnaissance airplanes is often extremely uncomfortable. The chair arms should be high enough for the pilot to rest his elbows on them with his hands on the control stick while the back should reach to his shoulder blades.

Either designers and pilots do not yet work in close enough touch, or else manufacturers do not pay sufficient attention to the recommendations of their pilots.

The Army authorities aim at the careful and reliable conduct of the test flights, but should errors creep into the experiments, especially in the altitude tests, it is desired that their attention should be called to them, in order that they may be rectified. Only intelligent cooperation with the manufacturers can develop our aerial weapon to a high standard of efficiency.

Discussion.

Capt. d. R. Hoff. Before the discussion opens, it may be mentioned that it is intended to publish the papers in the "Technische Berichte der Flugzeugmeisterei." The accompanying very welcome discussions will, likewise, be published. The speakers are therefore requested to supply me with written copies of their communications.

"Dipl. ing." Gaule. Should airplanes which are brought to Adlershof for their preliminary flight tests (according to proposal of Capt. Student), be flown by officers, even when they have not passed the breaking test?

Capt. Schwarzenberger. We can safely assume nowadays that an airplane which comes up for type tests possesses a certain margin of safety, and will not break down even under a fifty per cent overload. I should have no hesitation in flying an airplane before the strength tests, and would allow the men in my division to do the same.

Lieut. d. R. Jaretzky. The flying qualities of airplanes are not always the most important. Climbing power is undoubtedly more necessary for long distance reconnaissance airplanes. Such an airplane cannot fight and must therefore rise above all enemy single-seaters. In this connection a ceiling of 8000 meters (26000 feet) will be required by the spring of 1919. A fight in the air 100 kilometers (62 miles) behind the lines will in most instances lead to a crash or forced landing. Of course, a long distance airplane must also have certain fighting qualities to enable it to participate successfully in combat.

Visibility is decidedly important and must be good on long distance observation planes. Overhead visibility

may perhaps be neglected to a certain extent, but it must be as wide as possible on all sides and downward, in order to spot enemy airplanes at long distances and thus be enabled to avoid them.

The results of a reconnaissance are always photographically recorded. A long distance airplane must, therefore, also be fitted for photography, and capable of housing the apparatus comfortably. The pilot must be able to see downward, in order to assist the observer by flying directly over the objective. The downward view for the pilot is lacking in all the existing airplanes, so that, with these types, the objective can be spotted only with great difficulty. In one instance at the front, we remedied this to a certain extent by means of slits in the floor, two slits rather far forward, right and left, for approaching, and one slit for vertical vision. Strength considerations forbid, however, in most cases, cutting slits in the fuselage.

Much attention must be paid, as mentioned by Capt. Student, to the comfort of the pilot. Flights of four and more hours, at an altitude in which one can exist only with oxygen respirators and with the crew dressed to suit the low temperatures encountered, demand the most attention.

Baron Von Thüna. To whom have the aircraft manufacturers to apply, when they desire to have new airplanes tested?

Capt. Schwarzenberger. To Division A, of the Aircraft Inspectorate, Charlottenburg.

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