Some remarks on glider design and related subjects

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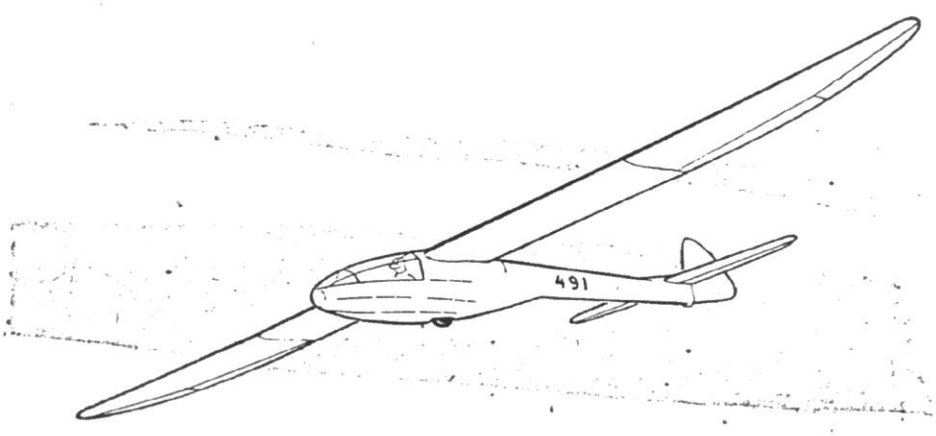
Introduction

In introducing my paper I wish to apologize for having chosen a subject falling far outside the scope of the subjects, which have been set out last year as the principal ones to be discussed in this session of the O.S.T.I.V. We in Holland have, much to our regret, not yet been able to take an active part in the research on either standing waves or high-altitude sailplanes.
We have, however, been doing some technical work, mostly on "everyday" problems, which may be of interest to discuss in this meeting, not because this work has produced any far-reaching results,but because we feel that much the same problems arise in other countries as well. I wish to emphasize, therefore, that I am not presenting a paper of any highly scientific nature, but that I am merely mentioning a few points we have tackled and the way we have approached these problems.
The main purpose in presenting this paper is, therefore, to put before you a few technical points on which, in my opinion, much valuable work can be done by the O.S.T.I.V. not only in providing a means of exchanging experiences, but in taking an active part in setting some international standards, e.g. with regards to airworthiness requirements. The discussion, which I hope will follow, is, therefore, the main issue and the paper itself serves only the secondary purpose of suggesting some of the subjects to be discussed.



Design of a glider for advanced training and general purposes

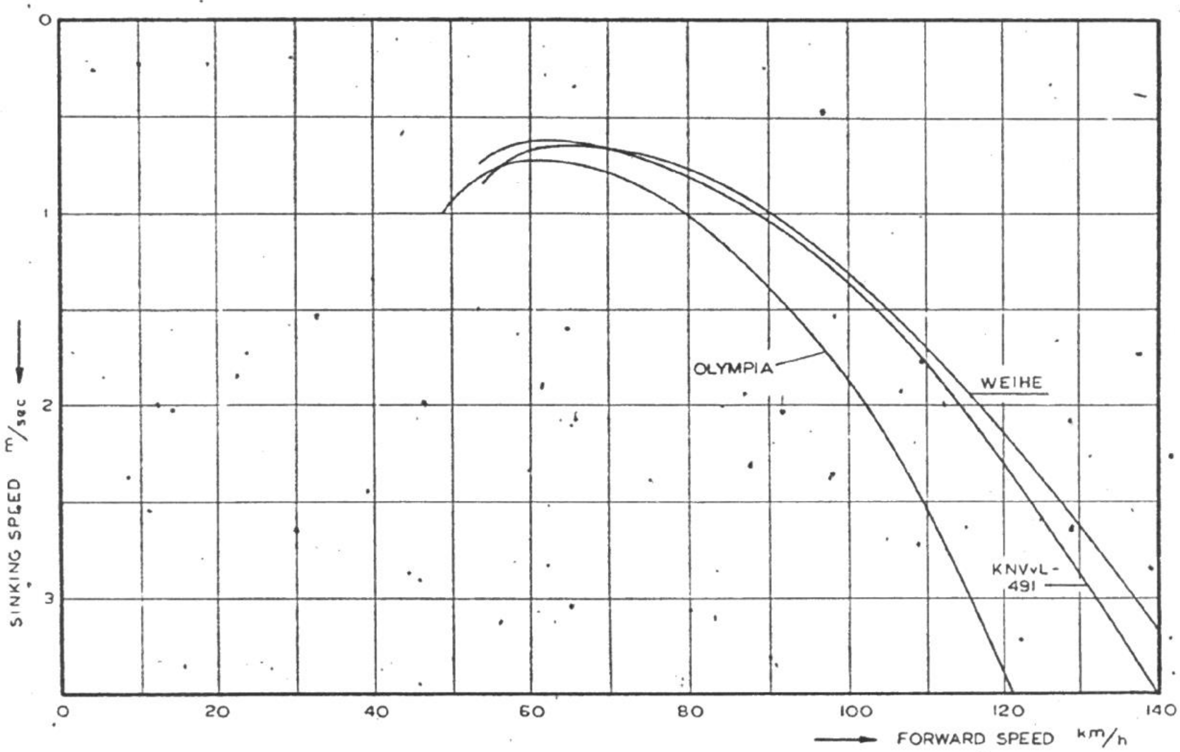
Gliding activity in Holland has expanded fairly rapidly after the war, helped by a government subsidy, aiming at stimulating the airmindedness in general and the provision of sufficient pilots for both the civil and military flying schools in particular. As a result of a few years intensive training the number of glider pilots holding "C" and "silver C" certificates has rapidly increased and the problem of providing sufficient sailplanes for these pilots to continue their training and to enable them to fly often enough to keep their interest lively, has become an acute one. A small number of "Olympia" sailplanes is available, but this fleet should be expanded rapidly.
In selecting the type of aircraft, best suited for this purpose, the following points have been considered:

1. Its performance and handling qualities should be equal to or better than those of the "Olympia"; the best speed for cross-country flights could be higher.
2. It should not be too large, the span should preferably be less than 16 m.
3. It should be reasonable cheap to produce.
4. It should be easy to maintain and to repair.

After considering various existing aircraft types the subcommittee of the Technical Committee on gliding, which studied the above mentioned points, rejected the idea of either importing a number of sailplanes or building them under license because some of the types under consideration did not fully meet the requirements, others were too costly. The subcommittee thereupon started on the design of a glider to meet the above mentioned requirements, trying to keep both the initial costs and the costs of maintenance and repair at a minimum. At present the design of this aircraft is nearly completed and the construction of a prototype, which is expected to fly in the autumn of this year, is progressing satisfactorily. *)
In order to achieve the highest possible performance the wing span has been kept at the maximum permissible value of 16 m. The wing section is a laminar-flow one designated as NACA 64 (215) - (7)(16,25),a = 0.7, a 16.25% thick section which should provide laminar flow to 40% chord over a range of lift-coefficients from 0.3 to 1.1 If the required smoothness of the wing can be achieved the performance of the aircraft will equal that of the "Weihe" over the speed range in which the laminar flow is effective, that is between 60 and 100 km.h. It has been decided not to use any wash-out as this increases the induced drag at higher speeds to such an extent, that the sinking speed at high forward speeds becomes excessive and at the same time produces adverse torsional loadings of the wing. Nevertheless the stalling characteristics are expected to be quite mild, because the wing plan form has been chosen so as to produce a favourable lift-distribution, achieved by using a centre section of constant chord and elliptic outer wings.
The flying characteristics should approach that of powered aircraft, both in stability and handling and in the harmonization of control forces.
The aircraft is of wooden construction with the exception of the front fuselage, which is constructed of welded steel tubes in order to increase the "crashworthiness". In order to achieve the utmost serviceability and ease of repair as well as to facilitate production the structure has been split up in several parts. The wing is divided into three parts, a centre section and two outer wings. This layout, which is similar to that of most powered aircraft, is thought to be preferable to the more usual wing constructed in two halves as far as maintenance and repair is concerned. At the same time the transport of the dismantled aircraft is facilitated. In minor crashes usually only the outer wing is damaged and if this can be replaced quickly the efficiency of the aircraft is improved. In the design under consideration the wing has been split at the inboard end of the ailerons. The centre section houses both the complete aileron control system and the dive

*) The designation of this type of saiplane is "K. N. V. v. L. - 491."

brakes, the ailerons being driven from the inboard end. In order not to reduce the aileron effectiveness they should be rigid in torsion, this being achieved by using a large diameter duralumin tube for the spar, the wooden ribs being attached by "Araldite" plastic glue.
The wooden rear fuselage, complete with tail unit, is connected to the welded steel tube front part by three bolts.
In the control system most joints are provided with ball bearings, it being considered that the slightly higher initial costs are repaid in reduced wear and servicing. In this connection it should be mentioned that,



although most of the servicing and minor repair work is done by club members and therefore need not to be paid for, it is just as important to save as much as possible on these points because of the increased number of flying hours per aircraft resulting from ease of maintenance and repair.
The aircraft is to be fully aerobatic and can be used for cloud flying. The ultimate load factor is 9.75, in accordance with the loading cases for the aerobatic category of the British Civil Airworthiness Requirements for gliders. In consultation with our Government Aeronautical Service the British Requirements have been chosen as a basis for this design, the existing Dutch requirements having become obsolescent and being under review. Upon closer study the British requirements do not fully cover the design, additional assumptions having been made for landing loads and stiffness criteria for flutter prevention which have not been included in the British set of requirements. On other points too our views are not in full accordance with these requirements.
This brings me to the next item to be discussed, the airworthiness requirements for gliders.

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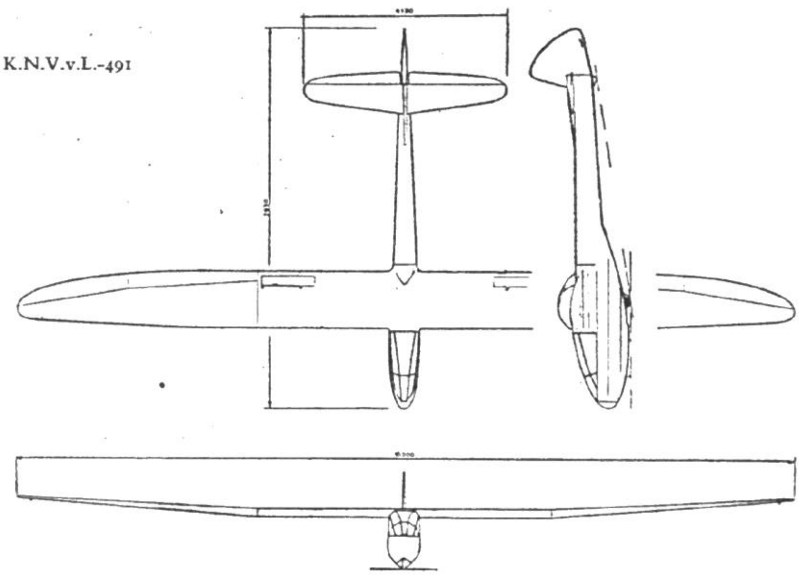

Airworthiness Requirements for Gliders

Upon comparing the Airworthiness Requirements for Gliders issued by the governments of various countries–we have, so far, studied the British, U.S., Swiss, German and Dutch requirements–several differences become apparent, some on points of minor importance, but also in basic conception. These differences can become very awkward when importing or building under licence foreign-designed gliders. Furthermore they can be a handicap to pilots participating in international contents such as the present one if the requirements according to which their gliders have been constructed are more severe than those of other countries.

The first step towards setting up requirements on an international basis has been made in 1939, when the "Commission du Vol sans Moteur" of the F.A.I. put forward requirements for the design of the glider, to be used at the Olympic Games which should have been held in 1940. The wellknown "Olympia" glider has been selected from the types, built after these requirements.

In my opinion it is highly desirable that the O.S.T.I.V. continues work along these lines and that it starts on the preparation of airworthiness requirements for gliders, which might be internationally accepted. It will not be an easy task, but perhaps a small committee could be charged with preparing a draft to be considered at next year's meeting. If I am well informed the I.C.A.O. does not propose to lay down international requirements for gliders, as they are not normally used in international flights. It will, however, be advisable to keep in touch with I.C.A.O. on this matter.

Of the other points we have studied, I should like to mention calculations on rudder flutter of the "Olympia" and loads on gliders in winch-launchings. But before dealing with these points it is, perhaps, desirable to give a brief outline of the organization of our Technical Committee on gliding.

In order to cope with several technical problems for which the bureau of the gliding section of the Royal Aero Club has been placed in connection with gliders and associated materiel, such as winches, an appeal has been made two years ago to the gliding enthusiasts among the technical people in Dutch aviation to make available some of their spare time and help solve these problems. In this way a group of some 30 people has been gathered, which has been split into several sub committees, each dealing with a particular problem. This organization works reasonably well, taking into account that the work is done on a voluntary basis, which makes it difficult to exert much pressure on the time in which the problems are tackled. The largest subcommittee is the design group for the above-mentioned glider, comprising some 15 people, among whom are some members of the staffs of the Fokker factory and of the Technical University in Delft. In order to coordinate the work of this group and to keep it in touch with the construction of the prototype, one salaried person has been engaged, who also assists in the preparation of workshop drawings. Other subcommittees deal with winches, aeroplane-tow, radio, instruments and such specialised cases as flutter calculations for the "Olympia" rudder.

Flutter calculations for the "Olympia" rudder

Among the 72 gliders, which the Royal Aero Club had ordered to be built by the Fokker factory shortly after the war, were 6 "Olympia's". The flutter expert of the Fokker works had after a preliminairy investigation put forward that in his opinion the critical speed for rudder flutter might be appreciably lower than the maximum diving speed with fully deflected airbrakes. Hereupon the Government Aeronautical Service has limited the maximum permissible speed of these aircraft to 160 km/h and has not allowed them to be used for cloud flying.

As these aircraft had especially been meant to be used for advanced training and cloud flying, it was of the utmost importance to have this matter further investigated. Thanks to the help of the section Aeronautics of the Technical University vibration tests have been carried out on an "Olympia" in which three cases have been considered.

1. rudder free
2. taking into account the mass damping provided by the weight of the pilots feet and lower legs
3. taking into account additional pedal forces of up to 40 lbs.

Upon the basis of the natural frequencies and vibration modes, measured during these tests, flutter calculations have been prepared. So far only the results for the first case have been obtained as we have not yet been succesful in attracting volunteers to carry out the remainder of the very laborious calculations. The results obtained so far indicate that in the "rudder free" case the critical flutter speed may be as low as 100 km/h. In judging this rather alarming result it should be borne in mind that the data upon which the aerodynamic coefficients for the fin and rudder have been based, are not yet very complete and that arbitrary values have been chosen. It may be, therefore, that the discrepancy between the calculated and the actual value is larger than for a wing, for which the aerodynamic coefficients for instationary flow have been more firmly established. Furthermore, it is hoped that subsequent calculations will prove the mass damping of the pilots feet and legs and of additional pedal forces to have the effect of substantially increasing the critical speed.

Meanwhile, as you may have seen, our Olympia's, taking part in this year's contest, have been fitted with a massbalanced rudder in order to make sure that no rudder flutter will occur. We hope, however, that the final results of the investigation will be such that the balance weight can be removed.

Loads on gliders in winch-launchings

Before the war, the tow-hook used for winch-launching was usually fitted at the forward end of the fuselage. Calculations we made during the war indicated that by placing the hook further backwards the height gained in winch-launchings can be substantially increased. This conclusion had, meantime, also been reached in other countries. The main reason for this increase is that if the tow force gives a large nose-down moment, its magnitude is limited by the maximum balancing moment which can be provided

by the horizontal tail surface. So by making the tow force pass nearer to the c.g. of the aircraft the tow force and therewith the lift can be increased and better climb performance obtained. The maximum lift coefficient to be reached during winch-launching is, therefore, a function of the position of the tow-hook. In order to guard against overloading the aircraft the maximum allowable flying speed during winch-launches is limited to a value at which the maximum lift coefficient to be achieved cannot produce a load in excess of the design load for the max. positive acceleration. This maximum allowable speed in launches thus depends on the position of the tow-hook.
As the pilot cannot always prevent the aircraft from attaining a speed beyond the allowable value, it has become practice to include a "weak link" in the tow cable, which should break at a slightly lower load than the design load of the glider. The use of such a "weak link" is compulsory in Holland. Furthermore, some winches have been fitted with dynamometers, measuring the tow force, in order to assist the operator in keeping this force at the desired value. We are still somewhat in doubt as to the value of this instrument, as the operator of the winch has to divide his attention between the dynamometer and the glider. Some people have the opinion that the operator had better concentrate his attention fully on the glider. This is a point whereon I should like to have the opinion of the delegates.
A problem which is still being studied is the determination of gust loadings on a glider during a winch-launching.
In concluding this short review I should like to thank the chairman for having given me the opportunity to put these points before you and to call upon you to put forward your views on them.

Quelques informations sur le développement de planeurs et les problèmes y relatifs

PAR L. L. TH. HULS

Dans ce discours quelques points techniques ont été nommés dont, suivant l'opinion de l'orateur, un échange d'idées au sein de l'OSTIV est désirable. C'est pour cela que le discours doit être considéré comme une introduction à la discussion, qui en résultera.
Une des Sub-commissions de la Commission Technique de l'Aéro-Club Royal des Pays-Bas, travaillant au loisir à la solution de différents problèmes techniques se présentant dans le cadre du vol à voile, a étudié la question quel planeur sera préféré en Hollande comme planeur de performance.
Ayant apparu que les types actuels par leur prix élevé et leurs qualités techniques n'étaient pas satisfaisants, on a fait le projet pour le développement d'un nouveau type de planeur, dont les performances devraient au moins égaler celles du planeur Olympia et dont le prix d'achat, mais surtout les frais d'entretien et de réparation, seraient relativement avantageux. Le prototype est en construction. Une description globale du principe est donnée.
Ensuite on propose que l'OSTIV doit essayer de parvenir à des prescriptions internationales concernant la navigabilité des planeurs.
Finalement quelques résultats de recherches concernant des vibrations instabiles du gouvernail de direction du planeur Olympia et concernant les charges sur les planeurs pendant le décollage au treuil sont discutés.