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ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

CALIBRATION MODELS FOR DYNAMIC STABILITY TESTS

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1. INTRODUCTION

The purpose of "calibration models" in the present context is to enable experimenters to compare their various techniques by making measurements on similar models. The specification of such models has become a traditional and useful function of AGARD. The series of models intended for static measurements is well known; in addition there are two existing models for dynamic stability tests:

Model D, an elementary unswept wing for low speed tests.

Model F, a thin delta with sharp leading and trailing edges, of aspect ratio 2.41.

These models were introduced about 1955.

The question of calibration models for dynamic tests was raised at the AGARD Stability and Control Meeting at Cambridge in 1966. In response to this, and in view of the limited applications of Models D and F, the present report has been prepared. Three new models are described which have been designated AGARD Models G, H and J. It will be apparent that the choice of models has been arbitrary; this is because the choice has been strongly influenced by the fact that, in each case, a certain amount of relevant work has already been done on the particular model.

The authors are grateful to the members of the AGARD Flight Mechanics Panel and other organisations and individuals who have taken an interest in, and commented on, their suggestions.

2. DESCRIPTION OF MODELS

2.1 Model G

A slender wing has been included in this series of calibration models because the aerodynamic characteristics are so different from those with more moderately swept wings (e.g. slender wings have relatively low values of the lift curve slope and high values of l_v at incidence). The model chosen is shown in Figure 1. It is suitable for tests over a wide speed range and is fitted with a fin so that a complete set of lateral derivatives is generated as well as the longitudinal set. It is also fitted with a sting fairing. Standard tests should be made with the sting fairing even if the rig does not require it. In the latter case, however, comparative tests with the fairing removed would yield useful information on the effects of such a fairing.

A certain amount of work has already been done on this model in free flight[2] and wind tunnel tests are to be made on a sting rig[3].

2.2 Model H

Model G (and to some extent Model F) have the disadvantages that the derivatives can only be calculated at zero incidence (when the flow is attached) and that they cannot reasonably be tested as half-models. For high speed tests (when Model D is unsuitable) the thin tapered wing, Model H shown in Figure 2, has been chosen. This model is very simple to make and reliable values of the pitching derivatives at supersonic speeds have been obtained at NPL[4,5]. Experiments have also been made in slotted and perforated tunnels at subsonic and transonic speeds[6,7] but these are subject to large wall interference. Figure 19 to 21 of Reference 6 and Figures 16 to 19 of Reference 7 give some guidance.

2.3 Model J

For tests at high supersonic speeds, many US organisations have adopted a 10° semi-angle cone as a calibration model[8]. This has therefore been designated Model J and is shown in Figure 3. The figure also shows sting dimensions which are not standardised, but should be recorded.

3. ADDITIONAL REMARKS

3.1 Reference Axis

Some measuring techniques give sufficient derivatives to enable the results to be referred to any required fore-and-aft axis position. When this is not the case, measurements should be made for standard axis positions to facilitate comparisons. These standard positions are as follows:

Model G	50% centre-line chord
Model H	50% centre-line chord
Model J	55% length (Fig.3).

3.2 Boundary Layer Transition

There is little or no information available on the effects of transition position on dynamic measurements. Standard tests should be made without attempting to fix transition. However, in any series of tests, comparative measurements with transition fixed would yield useful information on this aspect of technique.

3.3 Nomenclature

In the presentation of results it is important that a clear statement should be made of the axis system and of the way in which the derivatives have been made non-dimensional.

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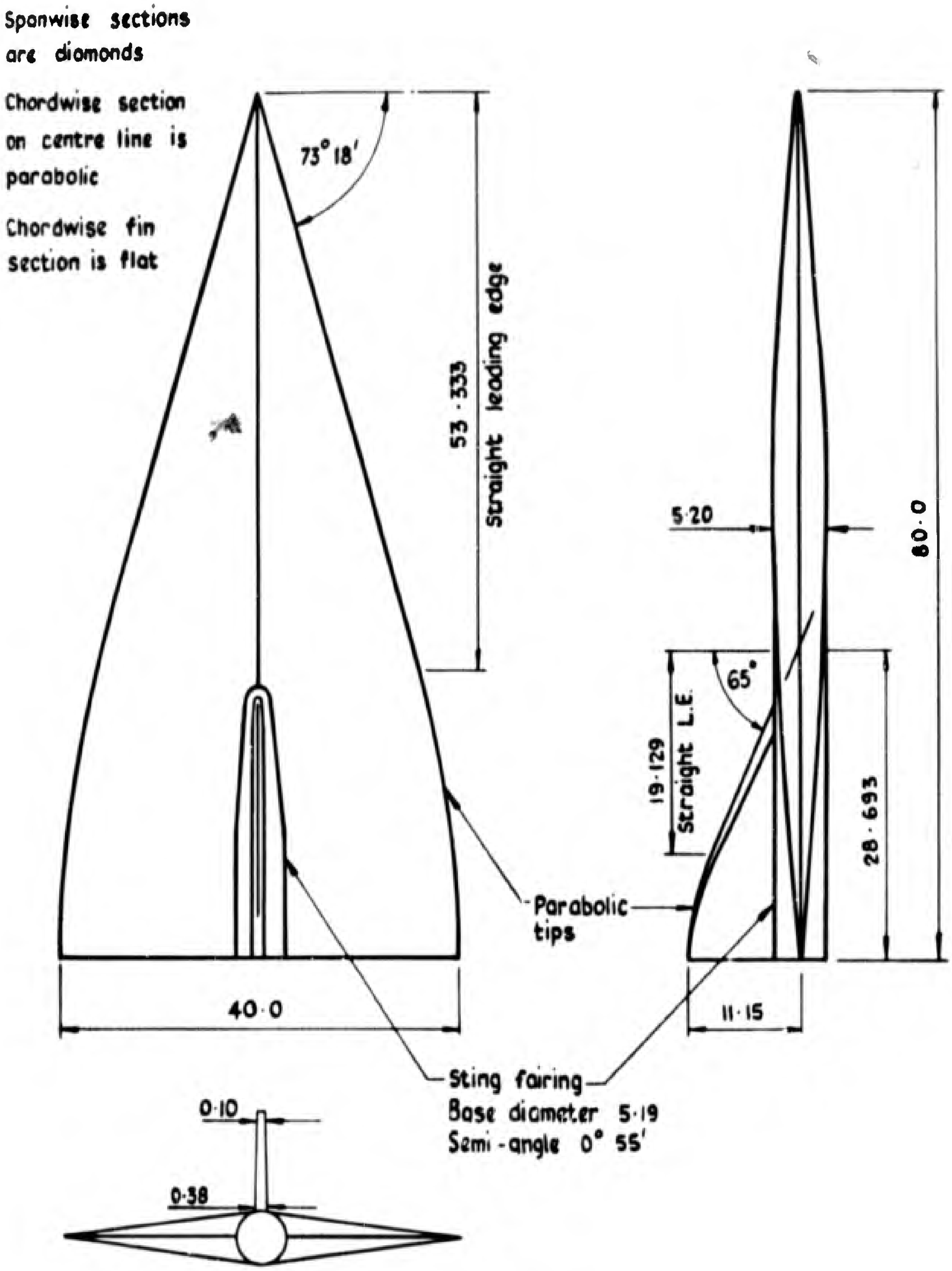

Fig.1 AGARD model G

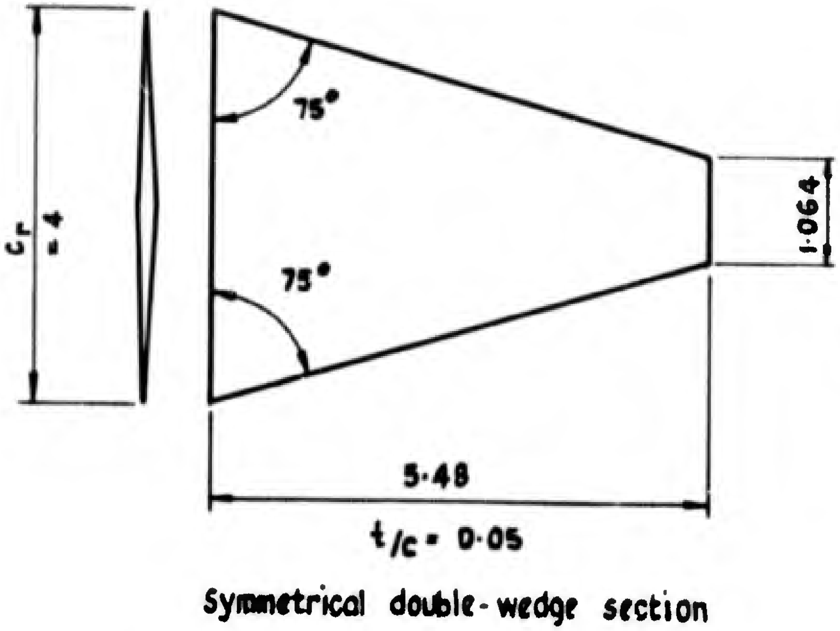

Fig. 2 AGARD model H

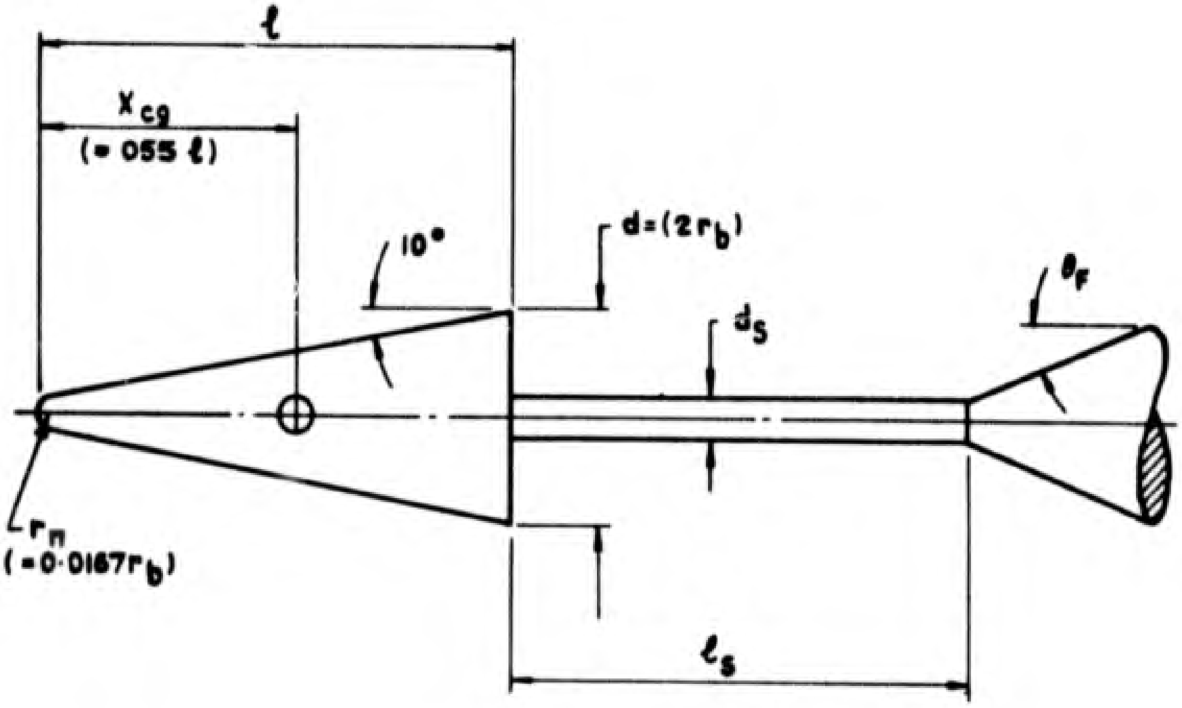

Fig. 3 AGARD model J

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